

A Disease-based Comparison of Health Systems

WHAT IS BEST AND AT WHAT COST?

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A Disease-based Comparison of Health Systems

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Foreword

This publication comprises a collection of papers that examine health expenditures, ageing, technology and outcomes, issues at the heart of health system performance. Health system performance is a function of how effective the health system's approach to treating diseases is in improving health outcomes and reducing resource costs. In an era when health systems account for increasing sums of money aiming to provide their citizens with the best healthcare possible, surprisingly little is known about how effective much of this spending is.

Health policy makers have extensive information available to them on how much is spent on healthcare at an aggregate level. But their knowledge of what, in terms of health outcomes, they receive in return for this spending remains very limited. A better comprehension of the interrelationship between health expenditure and health outcomes begins by understanding the underlying characteristics of health systems: the incentives, policies and regulations that influence treatment patterns. It ends by applying this knowledge in an examination of the costs and outcomes of those treatments.

The OECD Ageing-Related Diseases project, started in 1999, was initiated as part of the OECD work on ageing. The study employs a disease-based approach to comparing health systems. *The objective of the project is to examine the treatments, costs and outcomes of diseases that particularly afflict the elderly. The goal is to understand how we can maximise the social value of health care, while making it as efficient as possible. To this end, the OECD has drawn upon a wide variety of information sources to examine how variations in treatments are influenced by incentives, policies and regulations. The knowledge gained from this examination is used to draw insights on the implications for health expenditures and outcomes. With the active participation of 150 experts from 21 countries, the Ageing-Related Diseases project has been an extensive co-operative effort. The project was funded by grants from the US National Institute on Aging and from the Japanese Ministry of Health, Labour and Welfare.*

The culmination of the project was a workshop held on June 20-21, 2002 which attracted 120 participants from 26 member countries. The OECD was able to bring several internationally respected experts to the workshop to make presentations on the issues at the core of the* Ageing-Related Diseases study. *Those presentations are the basis for the papers included in this volume. The workshop also included a panel of high-ranking government officials who discussed the implications of a disease-based approach for studying health systems. The workshop ended with a panel discussion, summarised at the end of this volume.*

The Ageing-Related Diseases project is an important first step in improving our understanding of the performance of health systems. Together with this volume, the results of the project will serve as a valuable tool for better comprehension of expenditure, ageing, technology, outcomes and policy within an international health perspective.

John P. Martin, Director
Directorate for Employment, Labour and Social Affairs, OECD

* More information can be found on the OECD Health Policy Unit's web page at *www.oecd.org/els/health/policy*

Acknowledgements. The OECD would like to thank all those who contributed to the June 2002 workshop and this volume. It would like to express particular gratitude to the Government of France for allowing the OECD to host the conference at the International Conference Centre in Paris. Thanks go to Peter Scherer, Stéphane Jacobzone, Pierre Moïse and Lynelle Moon for organising and planning the workshop. Special thanks also to Victoria Braithwaite, Kristel Le Cerf, Diane Lucas and Marianne Scarborough for their help in preparing the publication and their tireless efforts in making the workshop a success.

The workshop and publication are the culmination of almost four years work. There are many people whom the Ageing-Related Diseases (ARD) team would like to thank. We would first like to thank Véronique de Fontenay for the excellent statistical support she has provided for all three disease studies and this publication. We would be remiss if we did not mention the exceptional work of the leader of the breast cancer study, Melissa Hughes, an original member of the ARD team now with the Dana Farber Cancer Institute, Harvard University. Finally, we reserve our greatest thanks to the experts from participating countries, who are too numerous to name here. Their names are listed at the end of this publication.

Table of Contents

PART I

Introduction to the Results of the Ageing-Related Diseases Study

Chapter 1. **Introduction to the Ageing-Related Diseases Project** 11
1. An introduction to the Ageing-Related Diseases project 12
2. The contribution of a multidisciplinary disease-based approach 15
3. Methods 20
4. Conclusions 22

References 24

Chapter 2. **The Heart of the Health Care System: Summary of the Ischaemic Heart Disease Part of the OECD Ageing-Related Diseases Study** 27

Introduction 28
1. Policies and regulations: influence on the demand and supply of health care for IHD ... 28
2. Epidemiology of IHD 30
3. Dealing with IHD: preventing, diagnosing and treating 32
4. Outcomes: the consequences of dealing with IHD 36
5. Economic aspects 39
6. Discussion 40
7. Conclusion 48

References 50

Chapter 3. **Stroke Treatment and Care: A Comparison of Approaches in OECD Countries** 53

Introduction 54
1. Summary of results 55
2. Discussion 67
3. Summary and conclusion 74

References 75

Chapter 4. **Summary of Results from Breast Cancer Disease Study** 77

Introduction 78
1. Cross-national patterns of breast cancer care 79
2. Performance: description of costs and outcomes 83
3. Discussion 85
4. Conclusion 89

References 92

Chapter 5. **Comparing Health Care Systems from the Disease-specific Perspective** 95

Introduction 96
1. Productivity and measurement of efficiency 97
2. The McKinsey health care productivity study 99

3. Prospects for disease-specific international comparative studies 103
References 103

PART II
Why do Different Countries Spend Different Amounts on Health Care?

Chapter 6. **Why do Different Countries Spend Different Amounts on Health Care?** ... 107
Introduction 108
1. Health care expenditure – international comparisons 108
2. What can we learn from these comparisons? 112
3. Impact of population age structure – Sweden as an example 113
4. The output of health care 115
5. Concluding remarks 116
References 117

Chapter 7. **A Framework for Evaluating Medical Care Systems** 121
Introduction 122
1. Preliminaries 122
2. Characterizing medical systems 123
3. Explaining the facts 126
4. Implications 128
References 129

Chapter 8. **Integrating Cost-of-disease Studies into Purchasing Power Parities (PPP)** 131
1. Health care expenditures and health 132
2. The human repair model 134
3. Assessing the ARD cost-by-procedure data 137
4. Conclusions 139
References 141

PART III
Measuring Ageing and Health Expenditure Today and Tomorrow

Chapter 9. **Projecting Future Needs: Long-term Projections of Public Expenditure on Health and Long-term Care for EU Member States** 145
1. Summary and background 146
2. The demographic outlook for the EU – the common projection 147
3. Ageing and health and long-term care expenditure 150
4. Description of the projection exercise 154
5. The results of the projections 156
References 160

Chapter 10. **Population Ageing, Health Expenditure and Treatment: An ARD Perspective** 163
Introduction 164
1. The ageing-health expenditure relationship 164
2. The age dimension of disease 170
3. Outcomes 175
4. Discussion 176
5. Conclusion 177
References 178

Chapter 11. **Data Needed for Research and Policy in Ageing Societies** 181
1. Issues about ageing 182
2. Data needed 183
3. The SHARE project 184
4. Conclusions 190

References 190

PART IV
Health Technology Diffusion, Assessment and Expenditure

Chapter 12. **The Technology-Health Expenditure Link** 195
Introduction 196
1. How does technological change affect health expenditures 196
2. ARD results and technology 200
3. Discussion 213
4. Conclusion 215

References 216

Chapter 13. **The Relationship Between Health Policies, Medical Technology Trends and Outcomes: A Perspective from the TECH Global Research Network** 219
Introduction 220
1. Unresolved issues in international comparisons of health and health care systems 221
2. Innovative aspects of the TECH global research network 225
3. Methodology used 226
4. Data used 230
5. Evidence on international differences in the causes, nature, and consequences of technological change 231
6. What policy-makers can learn out of these findings 237
7. Conclusions 238

References 240

Chapter 14. **How Health Technology Assessment, Regulation and Planning Affect the Diffusion of Technology in Health Care Systems** 243
Introduction 244
1. What impact does health technology assessment (HTA) have on decision making? 244
2. The use of economic data 246
3. Barriers to the use of economic evidence 250
4. Conclusions 254

References 255

PART V
Health Outcomes Over the Continuum of Care

Chapter 15. **Comparable Measures of Population Health with a Focus on OECD Countries** 261
Introduction 262
1. Cross-population comparability of health 263
2. Methods 265
3. Results 270
4. Concluding points 271

References 273

Chapter 16. **Progressing the Collection of Information on Health Outcomes: A Perspective from the ARD Study** 275
Introduction 276
1. Background 276
2. Health outcome measures in the ARD study 279
3. General patterns in the ARD results 281
4. What is driving the variations? 282
5. Next steps 284
References 286

PART VI
Policy Implications

Chapter 17. **Understanding the Performance of Health Systems: The ARD Perspective** ... 289
Introduction 290
1. Understanding the drivers of resource utilisation 292
2. Do we get value for money? 306
3. Discussion 311
References 314

Chapter 18. **Information Needs and the Implications for Monitoring Health Systems: The Australian Experience** 317
Introduction 318
1. Developing indicators 318
2. Information framework 320
3. Sources of data 321
4. Using data for performance monitoring 333
5. Future directions 335
References 336

Chapter 19. **Ageing and Health Policy: The Value of International Comparisons and the Potential of Surveys to Add a Missing Perspective** 339
Introduction 340
1. Tracking access and system responsiveness: the potential of surveys to compare and present the patients' perspective 341
2. Caring for the frail elderly: formal and informal care giving and support of caregivers . 347
3. Summary 348
References 350

PART VII
Roundtable Panel Discussion

Chapter 20. **Summary of Roundtable Panel Discussion** 355
Introduction 356
1. How can a disease-based approach contribute to dealing with the issues of ageing and health policy? 356
2. What data collection and measurement activities are needed to implement the disease-based approach to comparing health systems? Are these data already available? If not, are they in the process of being developed? 357
3. What contributions can cross-national analyses make? Are cross-national benchmarks useful or valid? 358

Participating Countries and Organisations 361

PART I

Introduction to the Results of the Ageing-Related Diseases Study

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PART I

Chapter 1

Introduction to the Ageing-Related Diseases Project*

by
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Abstract. *This introduction presents the questions addressed in the Ageing-Related Diseases study. The need to move beyond the existing aggregate studies justifies a disease-based approach, with a particular focus on technology and ageing. The paper discusses the existing disease-specific clinical studies, the studies on utilisation rates, and the epidemiological studies. The framework of the current study is to adopt a global "production" line approach for analysing health care systems. The three-year project was conducted with collaborative expert networks, and has made innovative and extensive use of large administrative individual patient records, to obtain large representative samples for cross country analysis.*

* This work has benefited from the collaborative work of a network of experts. The Ageing-Related Diseases study was supported by grants from the US National Institute of Aging (Y1-AG-9363-9364) and the Japanese Ministry of Health, Labour and Welfare.

1. An introduction to the Ageing-Related Diseases project

The goal of the Ageing-Related Diseases (ARD) project was to examine how different health care systems affect the allocation of resources in the health sector and how this impacts on health care system performance in terms of value-for-money. Existing available macro-data at an international level does not allow for satisfactory answers to such questions. For this project, a microeconomic disease-based approach has been followed, looking at cohorts of patients and focusing on international comparisons of treatments for a spectrum of prevalent conditions in older populations with high aggregate medical spending, well-identified episodes of care, high prevalence and high policy relevance. Health expenditure for the population aged 65 and over represents an estimated 35 to 50% of health expenditure as a whole. However, meeting the needs of an ageing population also involves treating more chronic conditions and adapting use of high technologies. Therefore, the project had a specific emphasis on ageing-related issues, analysed the impact and utilisation of modern technologies in detail, and took a broad perspective in analysing the various phases of each disease.

More specifically, the study addressed the following key questions:

1. How much does the treatment of particular conditions differ across countries?
2. Why does the use of these treatments differ, in terms of incentives, health policy, planning and regulation?
3. Might these differences affect survival rates and functional capacity in an objectively measurable way?
4. What is the impact in terms of expenditure for health care systems ?
5. What are the implications for improving the performance of health care systems?

The Ageing-Related Diseases study was developed to address those challenges in an innovative way, focusing on conditions such as myocardial infarction and heart disease, cerebrovascular disease, osteoporosis and hip fractures, breast cancer, cataracts and diabetes.

To date, three diseases have been studied: ischaemic heart disease, breast cancer and stroke. The issue of dementia was partly considered in a first stage, but needed a slightly different framework, and therefore has been left to a second phase of the study and is now under way.

First, the introduction discusses the need to move forward in international comparisons of health systems which have to cope with ageing and are strongly reliant on new technologies. Second, the introduction presents the contribution of a multidisciplinary disease-based approach, which builds on existing approaches while developing an original framework. The methods used are discussed in a third section, in particular the collaborative work with national experts with the utilisation of a micro-approach based on patient records. Finally, a few preliminary observations are made.

1.1. The need to move forward in international health systems comparisons

Health care systems face increasing expectations from the population in OECD countries. Increasingly, patients are better informed and more aware of existing alternative treatments. The rise in the number of older citizens will lead to greater demand for health care, putting pressure on public finances (Dang *et al.*, 2001). There is also an increased awareness that these systems make a key contribution to the improvement of living standards enjoyed in OECD countries (Nordhaus, 2002; Cutler and Richardson, 1997), and may not be unrelated to the recent reductions in disability observed in the elderly population in OECD countries (Jacobzone *et al.*, 2000). Health systems are significant for public finances, as public expenditure on health represents on average 12.1% of public spending in OECD countries (OECD, 2001). In terms of delivery, health systems represent one of the largest service industries in most OECD countries, accounting for, on average, 8-10% of OECD national income. These systems are therefore key to improving the well-being of citizens in OECD countries. Their economic impact and their importance for public finances calls for a thorough assessment and continuous improvement of their performance, if they are to live up to citizens' expectations.

Significant benefits can arise from comparative work to investigate the solutions to health policy problems. With the exception of pharmaceuticals, international trade is relatively restricted in health services and products. Therefore, national health systems represent a series of relatively isolated experiments in financing and delivery arrangements. This is true even if the medical knowledge underlying those systems is increasingly shared across countries through academic networks. This also helps to explain the variability among health system institutions and the wide range of levels and patterns of health care we observe internationally. From an economist's perspective, this variability is a sort of "natural experiment", which can be used to test the impact and implications of various forms of organising and delivering health care. This is an area where an organisation such as such as the OECD can help in collecting data and benchmarking good practice.

The collection of macroeconomic data has been one of the primary efforts of economists and statisticians in this field since the end of the 1970s (OECD, 1977), with very significant efforts in the 1980s (OECD, 1987; Schieber *et al.*, 1991; OECD, 1993). These efforts have resulted in a regular data collection exercise which provides macroeconomic estimates on health expenditure used as a reference by many analysts in national and international debates. Numerous macroeconomic studies have documented variations in expenditure across countries. These macroeconomic investigations have revealed striking differences in levels of health expenditure, with no direct link to existing indicators of life expectancy or the demographic structure of the population.

Besides quantitative data, significant efforts have also been devoted to the understanding of the instutions which underpin the functioning of health care systems. A systematic compilation of the structures of health systems was undertaken at the OECD at the end of the 1980s and in the early 1990s (OECD, 1992). Since then a very large number of national and international reports has been produced which describes the general functioning of systems.

However, the general indicators which have been used to judge the global performance of health care systems remained unsatisfactory. Often the information collected in terms of activity rates and overall expenditure for the purpose of international comparisons remains

distanced from clinicians' and patients' experience. The modern production of health care is a specialised activity, often involving very specific interventions by highly-skilled professionals. The general aggregate indicators which have been used for international comparisons to date cannot capture these interventions and they have remained up to now extremely scanty in terms of "outcomes". Therefore awareness of the level and causes of variations in treatments and outcomes remains limited. In particular, international comparisons are in their infancy due to the lack of data (Anderson, 1997; Anderson *et al.,* 2000). The scope for a full analysis of performance, in a value for money approach remained restrained by these data limitations.There is therefore a great need for a better understanding of what is happening within health care systems across countries.

Besides general system descriptions, many studies have focused on the utilisation of health care services. Most studies have found that large variations exist in the frequency and the mix of medical services provided, as well as the type of technology applied within and across countries. The research on geographical variation has progressed within countries and has shown, for example, that up to 20% of the variation of health expenditure across areas was unlikely to provide any additional benefit in terms of survival or quality of life (Skinner *et al.,* 2001; Cutler and Sheiner, 1999). However, these studies have often remained confined within national boundaries.

There was therefore a gap between the expectation of knowledge, the need for policy making and the applied evidence that could be produce for informed decision-making. Policy makers and researchers in many countries compare their spending, with no clear consensus emerging from aggregate data about the effectiveness of patient treatment within health systems. In each of these debates, the issue arises of what medical care is buying:

- When countries spend more or less, how does that affect resource allocation in the medical sector?
- What happens to patients in terms of health outcomes and how does this impact on performance?

The current project was designed to provide concrete answers to these pressing questions. The disease-based approach has allowed for a level of detail and analysis that has not been matched by any other previous systematic international effort. However, in order to keep its relevance for a wide audience, the project has addressed three different, but core, conditions of modern health care systems. The goal was not to develop research into these conditions in a clinical way, but to see how these various diseases could provide general illustrations and findings that could then be translated and applied to other policy and research settings.

1.2. Coping with ageing while making the best of new technology

Policy makers are faced with ageing populations, emerging technologies and increasing costs (Reinhardt *et al.,* 2002), while the resources which can be provided, either publicly or privately, for health care remain limited.

Ageing is also a multidimensional challenge facing OECD countries, and can be seen as the reward for economic prosperity and better standards of living. Therefore, international organisations have had to address ageing in terms of the research and policy agenda, both to provide adequate analysis and to foster the need for collecting more comparable international data. As a result, the OECD has been developing an "active ageing" strategy as a follow up to the Denver G8 summit held in 1997.

Technology is another major facet of modern health care in industrialised societies. Constant improvements to medical knowledge have brought a very large field of potential treatments, which offer new opportunities to improve patients' outcomes, but which also entail additional costs to payers. The contribution of modern technologies to the improved performance of health care systems in OECD countries over the past 20 to 30 years is evident. Yet, not all nations can afford to use this technology with the same intensity. Therefore, finding the solutions to more efficient technology utilisation is a pressing challenge in many countries to ensure that services can be improved at an affordable cost.

These two core dimensions of modern health care have both been examined in detail with the tools of the current study. The focus on older populations with growing needs, with a specific emphasis on a number of key technologies, was a recognition of this double challenge. The technologies analysed in the current volume do not span the entire spectrum of modern health-related technologies, but can be considered as "markers" used to track and analyse the impact of technological progress.

2. The contribution of a multidisciplinary disease-based approach

A disease-based approach has been used in this project to address the objective of better understanding the parameters of health systems performance at the international level. The focus on ageing and technology also helped to concentrate on some of the pressing issues faced in providing high quality health care in modern industrialised countries.

A wealth of studies was of course available when this study was started. The existing and often very sophisticated, disease-specific literature has been developed for a variety of reasons – clinical, epidemiological, etc. However, many of them do contain some insights which contribute to an economic approach of the factors driving the performance of health care systems. This value-for-money approach includes treatment, outcomes and costs. Before introducing the full framework which underpinned the study, the advantages and drawbacks of these existing studies are reviewed.

2.1. Existing studies

Disease-specific clinical studies

Clinical studies exist in huge numbers, reflecting rapid advances in medical progress. However, these studies often do not give direct answers for the specific purpose of assessing how health care systems work on *average* in practice. They have been mainly concerned with research on the effectiveness of new treatments derived from medical research. Some of these studies rely upon very small samples of specific patients and may not be representative from a population perspective. Studies with very large samples *do* exist, such as the multicentric international clinical trials. However, their approach remains fundamentally different: their main aim is to investigate medical practices at the margin from a research perspective. They assess what happens for *selected samples of "pure" defined patients* to test the effectiveness of new medical treatments. However, they are not necessarily informative of the current treatment practices, for the *average patient*. As a result, they are representative of the frontiers of the possibilities of medical knowledge, but do not necessarily reflect the treatment a "typical" patient might expect to receive.

Clinical studies can help us to find appropriate guidelines and are generally key to implementing evidence-based medicine. However, gaps between actual practice and

publications in medical journals often remain. Some of these studies do review "average" trends in patients' treatments, in order to analyse compliance with established medical findings. For example, in the United States several studies have documented the rate of uptake of mastectomy and breast-conserving surgery in line with the most recent guidelines of the National Cancer Institute. Similar studies existed in other countries and have been referenced as part of the breast cancer study. However, to our knowledge, none of these studies were systematically developed with a view to performing cross-national comparisons in order to relate differences in practice to institutional differences between health care systems.

Studies on utilisation rates across countries

Another branch of the literature has sought to extend the earlier results of the analysis on geographical variations between micro areas (Wennberg *et al.,* 1989; Keller *et al.*, 1990) to the international level. These results are often available within countries (Domenighetti and Quaglia, 2001), but fewer of them exist at the international level. Such studies provide fascinating, but partial, answers to the questions being asked here. Often, the studies are of a cross-sectional nature and many of these studies have remained purely descriptive. They analyse the differences in treatment, but do not necessarily make the link with the incentives embodied in the health care systems or with expenditure patterns. Therefore, their ability to offer a complete story about the effect of incentives, epidemiology and health interventions in shaping health outcomes and costs remains limited. Nevertheless, they certainly represent an interesting first step. For example, Van den Brand (1993) provides an extensive analysis over time of utilisation of coronary angioplasty and the cost of angioplasty services in 14 European countries over the period 1985-91.

Epidemiological studies

Epidemiological studies have been developed long ago to offer an understanding, from a public health perspective, of disease incidence, prevalence, mortality and outcomes. These studies have generally made an invaluable contribution to the current study, as illustrated through the work of EUROCARE, or the WHO's MONICA. These studies were most useful when they were able simultaneously to address trends in treatment and outcomes, which has often occurred in the mature stage of those studies. The MONICA study offers an excellent example, with a collection data process which spans over 20 years. The most recent analytical results provide an estimation of the contribution of changes in classic risk factors to trends in coronary-event rates, and an estimation of contribution of changes in coronary care to improving survival, event rates, and coronary heart disease mortality (Tunstall-Pedoe *et al.*, 1999 and 2000; Kuulasma *et al.*, 2000). The EUROCARE study has also collected indicators on survival for various types of cancer in Europe, based on the European cancer registries over the 1990s, with two waves of study (Berrino *et al.*, 1995 and 1999). In the most recent analytical results, the authors suggest that the persisting regional differences can be related to corresponding differences in the availability of diagnostic and therapeutic facilities, and the effectiveness of health care systems.

Disease-oriented studies

Specific studies comparing average treatment rates and their impact exist across countries, but often on a limited basis, for example between the United States and Canada.

Several studies focused on cardiovascular disease (Rouleau *et al.*, 1993; Mark *et al.*, 1994; Tu *et al.*, 1997a). Additional studies on breast cancer exams and mammography include Katz and Hofer (1994). Roos *et al.* (1996) investigate poorer Manitoba outcomes in the case of hip fracture. Further, Ho *et al.* (1998) show that waiting times for surgery are longer in two Canadian provinces than in US states. In Europe, Lievens *et al.* (2000) also found that reimbursement practices varied across European countries. In countries, or in hospitals whose reimbursement is through global budgets, or through payment per case, the total number of fractions of radiation was lower, and the total dose was lower.

Two other studies are worth a special mention. The first is the McKinsey Study (Baily and Garber, 1997; McKinsey Global Institute *et al.*, 1996) which represents an interesting attempt to address the type of questions being addressed in the Ageing-Related Diseases study (see Garber, Part I in this volume). The main objectives of this study were to assess differences in productivity at a disease level for three countries (the United States, the United Kingdom and Germany), and to examine the major causes of these differences by focusing on variations in diagnosis and treatment, and by relating such variations to incentives and supply constraints. This study focused on four diseases (diabetes, gallstones, breast cancer and lung cancer). The main drawback is a lack of access to representative micro data sets to analyse countries, and the fact that the results refer to the mid- and late 1980s. Outcome measures were derived from literature reviews and secondary data. In addition, the study made extensive use of coefficients for measuring quality of life, which can be debated at length. The interesting insights are, for example, that in terms of outcomes, the differences in diabetes[1] treatment between the United Kingdom and the United States remained limited, in spite of different levels of resources. The UK performance appeared to be high in relation to its cost, although it could have been improved further at reasonable cost. The study is also interesting as it made the link between patterns of treatment and differences in provider incentives, constraints and regulations.

The second is the recent TECH study on heart attacks and coronary care which was considered as a pilot study for this OECD project (see Atella, Part IV in this volume). It demonstrated early on the feasibility of conducting such a project, at least for heart attacks, in a range of developed countries, mainly OECD members. This study adopted a framework for linking patterns of treatments with the overall characteristics of the health care system and relating these treatments to outcomes (McClellan and Kessler, 1999; TECH, 2001).

2.2. The Ageing-Related Diseases study approach

The approach followed in this study draws on existing approaches for analysing health systems, while producing a specific framework for analysis tailored to the needs of the research.

Paying for care, producing health: a "production-line" approach for analysing of health care systems

Historically, the international analysis of health care systems has concentrated on understanding the key financial relationships between the main players. This is reflected in the diagrams produced as part of early OECD efforts (OECD, 1992), and now available in *OECD Health Data* for all OECD countries. These diagrams capture the financial relationships between the stakeholders in health systems which are often the core of health policy discussions. However, these financial relationships do not provide

information on the actual quantities of care being delivered, and on the resulting impact in terms of the performance of health care systems. While the stakeholders are mostly focused on these financial relationships, the ultimate social goal can be seen as producing "health", which is the key factor contributing to improved well being.

Producing health when consuming health care involves complex interrelationships (Evans and Stoddart, 1990; Evans *et al*., 1994), and necessitates the adoption of a broad framework. This broad framework insists on the role of the social, physical environment, as well as on the role of genetic determinants. All these factors influence the pathogenesis of the disease and its evolution. They often interact with each other in a very complex way. This broad understanding of the production of health calls for a multidisciplinary understanding which draws on the contribution of various social sciences: epidemiology, sociology and, more recently, economics. This approach, developed notably by the Canadian Institute for Advanced Research (Evans *et al*., 1994) has played a seminal role on our understanding of how "health" is being produced.

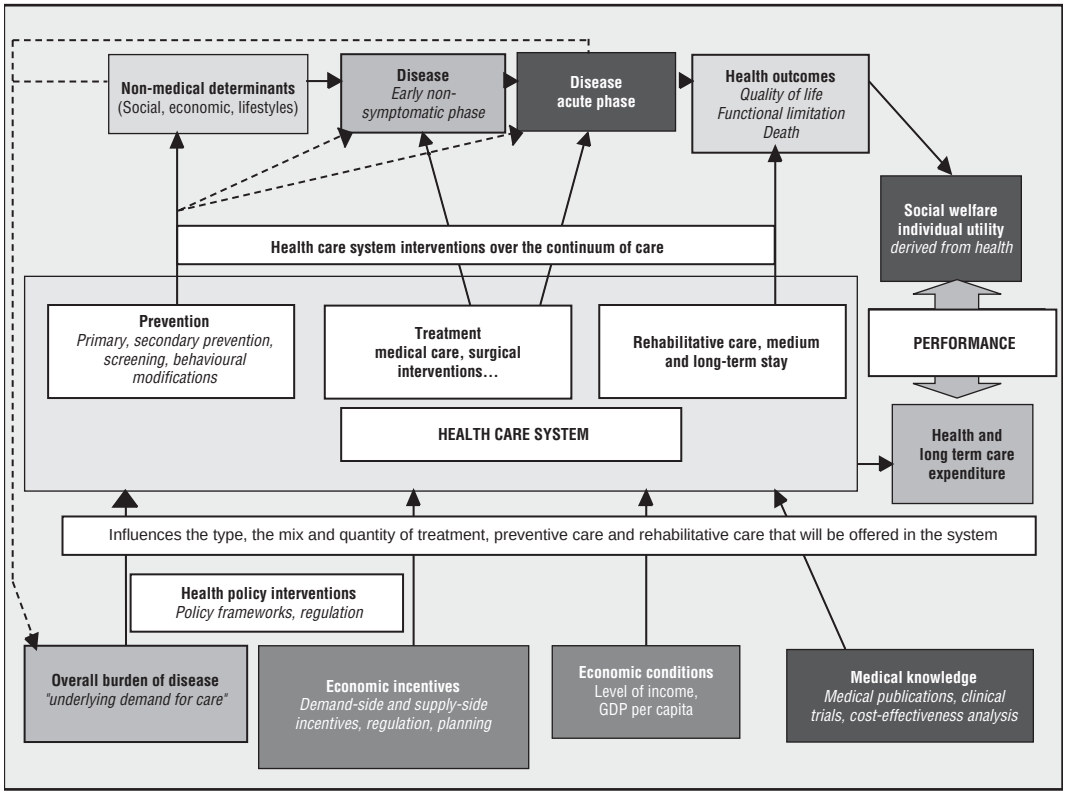
The difficulty with the very broad framework is that many of its dimensions are not amenable to health policy interventions, such as the level or distribution of income or the physical environment. Therefore, this approach can be applied in a "reduced" form, to focus on what happens within the health care systems, while keeping track of the non-medical determinants. We obtain a relationship between risk factors (non-medical determinants and health status), health care interventions (utilisation of services), economic incentives influencing those interventions. The result is a modification, possibly an improvement of health status which produces an increase in social welfare and individual utility. However, this focused framework needs to be focused one more step to understand what really happens within the health care system.

Modern health care systems are complex industries, often specialised in many branches, which correspond to broad disease categories. The recent collection of data on health expenditure by broad disease categories in several countries illustrates this need of a decomposition by disease to understand, from a functional perspective, the key areas where health care resources are being consumed (*e.g.* Hodgson and Cohen, 1995; Polder *et al*., 1994; AIHW, 1993). From an industrial organisation perspective, these areas can be seen as a set of multiple and related production lines, each of them related to a specific disease category. Some parts of the system are not disease-specific, such as general practitioners. However, their role, as being the point of entry of patients to the health care system, is to offer them the proper orientation so that their disease can be appropriately managed according to the guidelines, the resources and the status of knowledge existing in a given country.

A disease-based approach as a holistic tool addressing the complexity of the health care system

The current study uses a framework which encompasses the approaches briefly sketched out above. This aimed at taking into account all the relevant key interrelationships in a broad model, presented in Figure 1.1. The progression of the disease can be influenced by various non-medical determinants. In the study, the main risk-factors for each of the diseases are discussed and, if possible, documented in a cross-national perspective. The disease itself can evolve in several "phases", from the non-acute or "low" phase of the disease to the acute phase, with full clinical symptoms. The disease will be addressed through various types of treatments and interventions, which will lead to

Figure 1.1. **Disease-based model of health care system**



Source: Author.

different outcomes, in terms of quality of life, functional limitation or even death. These "health outcomes" in turn play a role in the overall social welfare, or utility function (Cutler and Richardson, 1997; Nordhaus, 2002).

However, the various health interventions also result in different types of expenditures incurred in different care settings, which are part of the health care system. The health care system itself can be seen as a number of social arrangements, from the preventive care aspects, to the continuum of care providers. The functioning of this system, in terms of the type, mix and quantity of treatments, will be influenced by several key factors. The first factor will be the "underlying demand", which corresponds to the burden of disease. The second factor corresponds to the economic incentives, in terms of demand and supply which will influence the purchasing decisions by patients or other stakeholders and also the supply decisions by care providers.

In a given country, the health care system as a whole is also subject to two other broad factors. The first is the relative economic development of the country, which will influence its ability to pay for treatments, and particularly the new and expensive technologies. The second is medical knowledge which will have an impact on how various preventive and curative strategies will be developed. On the whole, the health care system will perform a number of health care interventions, which will result in certain health and long-term care expenditures, but also in improved outcomes. Assessing the performance of a health care system involves confronting these dimensions to judge what is the best value for money. Performance will be affected by a variety of often complex and interrelated factors, which are displayed in Figure 1.1.

The current study collected information on the three boxes inside the "health care system" (prevention, treatment, rehabilitative care), and on the four boxes at the very bottom of Figure 1.1 (overall burden of disease, economic incentives, economic conditions, medical knowledge). It also collected information on outcomes and costs. Some information on non-medical determinants was also collected, when relevant and available. As such, it provides a holistic innovative framework to understand the performance of health care systems.

3. Methods

Two key components of the study were the strong reliance on national expertise and the first full-scale attempt in using national micro-data sets based on patient records to compute comparable cross-national data.

3.1. Collaborative work with networks of national participating experts

The collaborative work with national experts involved several steps. A launch meeting was organised in May 1999. A strategy for the study was proposed at that meeting, with the following three components:

1. A review of national information on epidemiological trends and qualitative assessment of changes in medical treatments over time.
2. A review of national information related to incentives, health policy and regulation for the treatment of chosen diseases.
3. An analysis of micro data obtained from either administrative records, national individual registers or specific data sets or surveys. The analysis was intended to: compare treatment patterns by age and gender; explore outcomes with regard to survival rates, and possible comorbidities and rehospitalisations; compare treatment costs and prices.

Component 1 gathered information on available national data describing prevalence and incidence of disease, and current practice guidelines. Component 2 collected information on the key levers in health care systems, those which influence both the supply and demand for medical care. This provided a global description of treatment patterns for the OECD countries in the field of the chosen diseases and the institutional background to those patterns.

The project sought detailed comparisons of treatment patterns across countries following Component 3. This offers an understanding on whether differences may be caused by different types of medical care systems on the treatment of selected diseases, and also on what are the *consequences* of these differences in terms of outcomes and costs. A key variable of interest which was explored in depth was technology, its contribution to variations in medical spending, the microeconomic determinants of its diffusion in health care systems. A second key dimension was ageing, which could be explored through the availability of data for detailed age groups up to a fairly advanced age.

Questionnaires related for each of the component were developed and discussed with national experts, first during the launch meeting, and second in the course of the field work for each of the disease included in the study.

Subsequent to the launch meeting, OECD countries were invited to nominate teams of experts to participate in the project. These teams of experts often brought diversified expertise, including medical/clinical expertise, public health, health economics and a

policy-oriented approach reflecting the multidisciplinary approach chosen for the study. These networks collected the information during a period of 6 to 9 months. Meetings of experts were organised in the year 2000 and offered an opportunity for fruitful discussions, investigating the particularities of each of the national systems. Subsequent to these meetings, synthesis technical reports were prepared by the OECD Secretariat project team. These synthesis technical reports were circulated and discussed with the networks of experts and were revised in light of the comments received. On the whole, it has proved to be a difficult but not impossible endeavour, involving more than a hundred experts in 20 different countries over more than three years.

3.2. A microeconomic approach based on individual patient records

The study clearly showed that treatments and interventions needed to be analysed at individual patient level. A first step was to investigate the feasibility of the study, in order to see what relevant information was already available. This appeared possible due to the wealth of information currently collected by national administrations [largely in response to the increasing use of diagnosis-related groups (DRGs) and activity-based payments for hospital systems]. This information represents a relatively cheap source of information, as it requires only secondary analysis and as the very large scale of the datasets can partly compensate for some of the drawbacks in terms of the clinical detail available.[2] An alternative strategy would have involved specific clinical-based surveys, which would have been very costly to administer.

The datasets used in this study also had some limitations. Data was lacking in the following areas:

- the ambulatory care and rehabilitation fields;
- information on socio-economic determinants;
- linkage and the possibility of tracking the patient over the continuum of care.

In general, except for a few countries like Australia, or in some cases the United States, information on care received in ambulatory care settings remained scarce and limited. As a result, only hospital administrative databases could really be used to monitor performance aspects of the acute-care part of the health care system. In most cases, it was not possible to track, at patient level, the type and mix of interventions received in the ambulatory care field. Information on what happens to patients in terms of treatment after acute care also remained limited. Occasionally, discharge information including details of the facilities where patients were transferred was available, but not as a general rule. Information from hospital administrative databases was supplemented with data taken from surveys, disease registers (especially for breast cancer and stroke) and *ad hoc* studies. In addition, aggregate data on drug consumption were collected, as were data on transfers to rehabilitative care settings.

Another difficulty with the data was the limited amount of socio-economic information on patients, beyond age and gender. Often, this type of information is not registered in administrative databases. For certain countries, the administrative information could have been merged with other types of information and other surveys. However, such a merging would have been difficult and costly and was not the key goal of the study. As a result, certain factors affecting performance, such as the "social distance" from provider to patient and the role of socio-economic factors,[3] are not addressed as such in the study. Some of the gap in this information was filled through a desk review from

published evidence on the potential role of socio-economic factors in terms of access to preventive and curative care.

Finally, the possibility of linking the data was key to assessing outcomes. Hospital administrative databases are designed to record only in-hospital activities, which presents a problem for measuring health outcomes of discharged patients. The results of medical interventions need to be monitored, both during the hospital stay and *after* patients are discharged from hospital, that is, health outcomes should be measured during an "episode of care", defined as: the period in which a patient is admitted to hospital for treatment until the resolution of the health problem. Defining the "episode of care" is problematic, as for some chronic conditions, the disease may in fact remain until the end of the life. As a result and in order to keep this tractable, typical lengths of time were used, such as one year after a heart attack, and five years after cancer, to provide a reasonable overview of a given "episode of care".

The capability to link to other databases increases the ability to monitor health care system performance by allowing for better measuring health outcomes. This is particularly important for older patients. Older patients are more likely to suffer chronic conditions and to receive multiple interventions. However, in many countries, the potential for a full assessment of the episode of care, including the full continuum of care, with long-term care and rehabilitative care, remained extremely limited, due to the fragmentation of the information and payment systems along the continuum of care.

4. Conclusions

The current study brought an exceptional wealth of materials that had remained hitherto confined to national boundaries. These materials are presented in the current volume with a summary for each of the diseases studied, and also in a thematic perspective, involving ageing, technologies and outcomes. The disease summaries can only present a short account of the full information which was collected and which is available in very large reports (Moïse and Jacobzone, 2003; Moon *et al*., 2003; Hughes and Jacobzone, 2003). Finally, the overall implications of the results are being discussed in terms of health and ageing policy and for the further monitoring and improvement of health care system performance across OECD countries.

Part I of this volume introduces a summary of the results for the three diseases together with a discussion by Alan Garber of a disease-based approach for comparing health systems.

Part II discusses the health expenditure, with a first contribution by Bengt Jönsson and Ingemar Eckerlund analysing why different countries spend different amounts on health care. A second contribution by David Cutler discusses the value of health care in relation to the expenditure that it generates while another article by Jack Triplett discusses key methodological aspects for comparing health expenditure, and in particular the role of Purchasing Power Parities (PPPs).

Part III invites contributions on ageing-related issues, with a perspective from the ARD study. This part includes a contribution by Mandeep Bains, on recent projections of public expenditure on health and long-term care in European countries, and a contribution by Brigitte Santos-Eggiman and Pierre-Yves Geoffard on the data needs for ageing societies, and in particular for longitudinal surveys on ageing currently under development in Europe.

Part IV discusses the technology dimension with a perspective from the ARD study. This part includes a presentation by Vincenzo Atella of the results of the TECH network and a discussion by Clive Pritchard of how health technology assessment, regulation and planning affects the diffusion of technology in health care systems.

Part V includes a perspective on outcomes from the ARD study together with an article from Ritu Sadana and other WHO analysts on comparable measures of population health.

Part VI on policy implications includes a contribution by Chris Stevenson, Richard Madden, Diane Gibson and John Goss on the information needs and the implications for monitoring health systems. Cathy Schoen discusses the value of international comparisons in health and ageing based on recent work by the Commonwealth Fund. An overview of the lessons learned from the ARD study contributes to the understanding of health system performance and draws policy implications.

Finally, the publication summarises in **Part VII** the discussions held during a roundtable of experts and policymakers which took place at the end of the conference. This panel discussed how research could best serve evidence-based policies while providing a strategic framework to address the implications of ageing for the health and well-being of population in a cross national perspective.

Before inviting the reader to the more specific papers, a few general points can be made:

- The study was generally successful in investigating the various health system parameters. This often helps to understand the implication of system design for the treatment of diseases.
- The results tend to show that general features of health systems have multiple and pervasive effects throughout the continuum of care and do impact on the amount and type of care delivered to patients. For example, systems based on insurance tend to provide a high level of technology, with more access to modern technologies, but at the same time, seemed to put less emphasis on some proactive preventive strategies. Other public integrated systems seem to be able to exert a strong level of control on costs, while limiting the use of certain technologies, particularly in the very old age groups.
- The study also highlighted the key role of the providers' payment systems, and also the need for further analysis of such systems.
- Significant differences in treatment patterns were found, which cannot be explained in terms of the current state of medical knowledge.
- The differences also certainly exist in terms of outcomes across countries. While the study is not intended to provide any benchmark or rating scale, differences exist which need to be discussed, even if they appear more limited than those observed in utilisation patterns
- The results provide significant insights on how performance is being achieved, and could possibly be improved. The study offeres a new perspective which should have a long-lasting influence in the field.

Notes

1. This refers to type 1 diabetes.
2. Some of these databases are listed in Moïse (2001).

3. For example, whether female patients were likely to receive different treatments depending on physicians' gender (as revealed through some studies in breast cancer), or patients' socio-economic status.

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PART I

Chapter 2

The Heart of the Health Care System:
Summary of the Ischaemic Heart Disease Part of the OECD Ageing-Related Diseases Study

by
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Abstract. *Ischaemic heart disease (IHD) is the world's leading cause of mortality. It is a complex disease that can be treated effectively through low-cost means, such as the reduction of risk factors, or through more expensive treatments such as invasive surgery. This paper focuses on the latter, summarising the work undertaken for the IHD component of the OECD Ageing-Related Diseases study. The characteristics of health care systems are explored and their influence on the inter-relationship between treatments, costs and outcomes for IHD is analysed. The paper demonstrates that a strong link exists between health care system supply-side incentives and the level and diffusion of invasive revascularisation procedures.*

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Introduction

Ischaemic heart disease (IHD) is the world's leading cause of mortality, responsible for an estimated 7.1 million deaths in 1999 (WHO, 2000). IHD is also one of the greatest contributors to health expenditures, having been estimated to be as much as 10% of total health expenditures (Moore *et al.* 1997; Hodgson and Cohen, 1999; Mathers and Penm, 1999).

Ischaemic heart disease is a complex condition. Several risk factors for IHD can be tackled using a population health approach, while drugs can be used in primary and secondary prevention of the disease. It is the nature of treatment for the acute phase of IHD, often involving high-cost, high-technology procedures that makes it an ideal disease to observe patterns of technology diffusion, a major component of this study.

This paper summarises the work of the IHD part of the Ageing-Related Diseases (ARD) study. In Section 1 the characteristics of health care systems that exert an influence on treatment patterns are examined. Section 2 explores some of the epidemiological indicators collected for the study, providing a proxy measure of the underlying demand for IHD health care services. In Section 3 treatment variations across countries are presented in the light of demand patterns established in the previous section. Section 4 extends beyond the examination of treatment patterns to explore the relationship with health outcomes. This is done in the fourth section. Since health care decisions invariably require us to ask how much all of this costs, an examination of the economic aspects of IHD is provided in Section 5. The last section of this paper provides a discussion of some of the results uncovered in this study, drawing some tentative conclusions.

1. Policies and regulations: influence on the demand and supply of health care for IHD[1]

1.1. Demand

There is virtual universal coverage for health care in all OECD countries. The lack of health insurance does not appear to be a significant hindrance on the demand for acute care for IHD in the 17 countries studied, with the possible exception of the United States where several studies have demonstrated that individuals without health insurance face constraints to obtaining high-technology, high-cost procedures for treating IHD (Wenneker *et al.*, 1990; Hadley *et al.*, 1991; Sada *et al.,* 1998; Canto *et al.*, 1999).[2]

While most health care services related to treating IHD are usually covered through health insurance, this is not necessarily the case for drugs delivered in ambulatory care. These tend to be drugs used for treating chronic cases of IHD, since drugs delivered during a hospital stay are provided as part of the overall care during the stay. Where ambulatory care drug coverage is not universal, supplemental private insurance is available to cover expenditures that the public system does not cover.

The greatest potential negative impact on the demand for drugs is patient cost sharing, under public and private health coverage, for drugs to treat chronic cases of IHD.

However, much of this negative impact is mitigated by policies with some form of exemption for, or reduction in, co-payments for drugs, mostly based on socio-economic status and age. There also exist policies specifically related to chronic diseases, including IHD. These policies focus on exemptions from payment, reductions in the co-payment and annual ceilings on the accumulated cost borne by the patient.

1.2. Supply

As the point of entry and provider for the majority of health care services, physicians are an important component of the supply of IHD health care services. Hospitals are also important since acute care is a significant aspect in the treatment of IHD. Methods of remunerating physicians and hospitals can influence the mix of health care services as well as the volume (OECD, 1994; McClellan, 1997; Gilman, 1999; Or, 2000). The information collected on these two aspects of the supply-side of health is summarised in this section (see Moïse and Jacobzone, 2003 for a classification of the 17 countries by payment methods for physicians and hospitals).

Physicians in Belgium, Korea and Switzerland are mainly paid fee-for-service, which tends to lead to higher volumes of services per physician than other payment methods, especially high-cost procedures, such as coronary artery bypass graft (CABG) and percutaneous transluminal coronary angioplasty (PTCA),[3] which are commonly used in treating IHD, where fees are high.[4] Therefore, we would expect higher rates of utilisation of revascularisation (CABG and PTCA) procedures in these countries. At the other end of the scale, physicians in the United Kingdom and the Nordic countries are mainly salaried so we would expect lower utilisation rates for revascularisation procedures in these countries *ceteris paribus*.

Hospitals in Belgium, Japan, Korea and Switzerland are mainly paid on a fee-for-service basis. The volume of hospital services in these countries would be expected to be higher than non fee-for-service countries for reasons similar to the incentives for fee-for-service physicians to provide greater volumes of services. On the other hand, a lower use of acute-care services would be expected in global budget countries, such as Canada, the United Kingdom and the Nordic countries.

The volume of health care services will also depend on the availability of resources. In the IHD part of the study, the information collected concentrated on the supply of cardiac care specialists and facilities used for revascularisation procedures (cardiac surgery facilities and cardiac catheterisation laboratories).

Very few countries applied explicit limitations on the supply of cardiac specialists, yet there was significant variation in the number of specialists per 100 000 inhabitants across countries. The reasons for this variation are not clear, but it does not appear to be related to the level of ischaemic heart disease.

The regulation of facilities and service volume is another important aspect affecting the supply of IHD health care services. Information collected on regulation show the Beveredgian countries[5] were most likely to restrict the number of revascularisation facilities, which coincided with the fact they tended to have the lowest number of these facilities, measured per 100 000 persons. Two Beveredgian countries, Sweden and Australia, were exceptions since the number of facilities in these countries were closer to the high-end countries (Germany, Japan, United States). This may be due to the fact constraints on the development of new facilities in these two countries were not as strong as in the other Beveredgian countries. Regulation of facilities are weakest in Belgium, Germany and Switzerland, all of which are social insurance countries, plus the

United States, which has a strong private health insurance industry. These countries had the highest number of facilities per 100 000, although the number of cardiac surgery facilities for Germany was surprisingly low. The important point to remember will be to see how these regulations translate into the volume of CABG and PTCA that are performed.

2. Epidemiology of IHD

Epidemiological information on IHD was collected to provide a picture of the level of the disease across countries, but also as an approximate indicator of the underlying demand for IHD health care services.

There are several well-known risk factors of IHD, but national level data are difficult to obtain since they must be collected through costly surveys. We collected information on body mass index, tobacco use, cholesterol levels and hypertension for both sexes. Among the group of countries with the highest burden of IHD are included some of the countries with the highest relative levels of risk factors: Australia and the United States (body mass index), Denmark (number of daily smokers, especially in 1980), Germany (cholesterol level) and Finland (hypertension).

The prevalence level of IHD, the number of persons with the disease at a given point in time, an appropriate measure of the demand for IHD health care services, was not available for any of the countries studied. Another appropriate indicator of demand is the number of new cases of IHD during a specified period of time (incidence), but these data too were generally not available. However, the incidence of IHD can be approximated using the number of new cases of heart attacks (acute myocardial infarction – AMI), which generally account for more than half of all new cases of IHD (AHA, 2000). Unfortunately, there exist remarkably few sources of incidence data for AMI, so the study had to rely on a small number of data sources.

Information on the incidence of AMI at the country level was available for only three countries, Australia, Denmark and Sweden. Regional data were available for three other countries, Germany, Japan and the United Kingdom. The patterns exhibited by these data show that higher incidence rates are positively associated with age and male gender, as expected. There appears to be a slight decline over time in incidence rates in Australia, Sweden and the United Kingdom (Oxford), by age and gender. The trends in these data are supported by the World Health Organisation (WHO) MONICA Project which reported declining coronary-event rates in many of the countries in our study and over a period of 10 years from the mid-1980s to the mid-1990s (Tunstall-Pedoe *et al.*, 1999).

IHD mortality is the only consistently reliable epidemiological measure available for international comparisons. IHD mortality rates for all of the countries in the study are shown in Table 2.1, separated by gender and presented for three separate periods, 1970, 1980 and 1995, with corresponding rates of change calculated for 1970-80 and 1980-95.[6]

Since 1970 there has been a general decline in IHD mortality rates, however, there were exceptions. From 1970 to 1980, IHD mortality rates in Germany, Hungary, Spain and Greece increased. Since the 1980s the general decline in IHD mortality rates has been more widespread, with the only exception being Germany, which experienced a brief increase following reunification (191 per 100 000 men aged 40 and over in 1989, prior to reunion, and 245 per 100 000 men aged 40 and over in 1990) but with rates that have been on the decline since the early 1990s, and Hungary following the collapse of the former communist regime (757 per 100 000 women aged 40 and over in 1989 and 807 per 100 000 men aged 40 and over in 1993).

Table 2.1. **Trends in IHD mortality rates for males and females, 1970-80 and 1980-95**

	Men (40 years and older)[1]					Women (40 years and older)[1]				
	Mortality			Average annual change (%)		Mortality			Average annual change (%)	
	1970	1980[2]	1995[3]	(70-80)[4]	(80-95)[5]	1970	1980[2]	1995[3]	(70-80)[4]	(80-95)[5]
Australia	1 138	825	447	–3.1	–4.4	555	392	241	–3.3	–3.5
Belgium	551	443	285	–1.7	–3.8	247	185	135	–1.9	–3.2
Canada	983	774	421	–2.4	–4.3	506	381	217	–2.9	–3.9
Denmark	895	890	513	1.0	–3.6	463	422	266	–0.2	–3.0
Finland	1 092	970	690	–1.0	–2.5	439	386	325	–1.2	–1.2
Germany	433	442	505	1.2	–0.6/–0.7	189	189	252	2.2	0.2/0.2
Greece	223	272	299	2.3	0.7	105	103	136	0.5	1.9
Hungary	715	693	785	0.5	0.5	451	359	427	–0.9	0.9
Italy	418	413	288	0.6	–2.7	247	207	138	–0.8	–3.0
Japan	175	155	143	–1.3	–1.9	104	92	78	–1.1	–2.6
Korea		22	77		13.3		10	38		13.7
Norway	791	738	502	–0.8	–2.8	353	296	217	–2.1	–1.9
Spain	172	267	236	5.4	–1.0	85	122	107	5.8	–1.1
Sweden	880	947	528	0.3	–4.1	483	438	239	–1.5	–4.0
Switzerland	374	411	332	1.6	–1.4	162	162	159	0.3	–0.2
United Kingdom	908	873	585	–0.5	–2.8	405	380	287	–0.7	–1.8
United States	1 133	804	463	–2.6	–3.9	589	402	262	–3.0	–3.0

IHD: Ischaemic heart disease.

Note: The data have been age-standardised to the European population aged 40 and over. Average annual change is calculated as the slope of the linear regression line through the continuous series of mortality rate data: 1970-80 and 1980-95.

1. Data for Australia and Greece are for persons aged 40 to 90 years.
2. 1985 for Korea.
3. 1994 for Belgium and Switzerland.
4. To avoid a disruption in the time series, the slopes have been calculated for the period of 1970-78 for Belgium, Germany, Hungary, Spain, Switzerland and the United States and 1970-76 for Denmark.
5. To avoid calculating mortality rates based on two different populations due to reunification, the slopes for Germany have been calculated over two different time periods: 1980-90 and 1990-95.

Source: WHO cause of death statistics.

The decline in IHD mortality rates has been the greatest for the countries with the highest mortality rates. While this is likely due in part to a simple arithmetic relationship, higher numbers will tend to have higher rate changes, these trends are supported by the MONICA study where there was a tendency for coronary-event rates to fall in high-rate countries and increase in low-rate countries. Confirming our observation for Germany and Hungary, the former communist countries of Eastern Europe also had increases in coronary-event rates (Tunstall-Pedoe *et al.*, 1999).

Not surprisingly, mortality rates for men are much greater than for women. During the 1970s mortality rates for IHD fell at the same rate for men as they did for women. However, since 1980 mortality rates have been falling faster for men than women, a fact supported by the MONICA study. Faster declining mortality rates for men have narrowed the gap with women over the past 20 years, but have not eliminated it.

Since the more appropriate indicators of demand for IHD health care services, prevalence and incidence of IHD, are generally not available, another indicator of demand is needed to place the utilisation of IHD treatments, to be examined in the following section, in context. This approximation must be widely available and highly correlated with IHD prevalence and/or incidence rates. The mortality rate for IHD meets the former

requirement of availability, but is it highly correlated with prevalence and/or incidence? The previous paragraphs show that, at a general level, IHD mortality rates are similar to AMI incidence rates; both increase with age, men have higher levels than women and rates have been declining over the past 20 years. Furthermore, the relative levels of AMI incidence across countries are consistent with the relative levels of IHD mortality rates, *i.e.* the countries with the highest IHD mortality rates also tend to have the highest AMI incidence rates. These general trends, buttressed with the results from other international studies, especially the MONICA study, make a compelling case for using IHD mortality rates as an approximation for the demand for IHD health care services. Therefore, a generalisation regarding relative demand across the countries in our study can be made by assuming that countries with high IHD mortality rates will also tend to be countries with high incidence and prevalence rates of IHD.

Using the epidemiological data we have collected we classify the countries in our study into two basic groups:

- Countries with the highest mortality rates, meaning those countries who would be considered as countries with a high demand for IHD health care services: Hungary, Finland, the United Kingdom, Denmark, Australia, Sweden, United States, Germany, Norway and Canada.
- Countries with the lowest mortality rates, meaning likely low demand for IHD health care services: Switzerland, Italy, Greece, Belgium, Spain, Japan and Korea.

3. Dealing with IHD: preventing, diagnosing and treating

3.1. Ambulatory care and prevention

The only information collected concerning ambulatory care and the prevention of IHD was on drug consumption. Drug consumption data were collected on drugs used in treating chronic cases of IHD as well as primary prevention of the disease, such as cholesterol and triglyceride reducers, diuretics, ACE inhibitors, beta-blocking agents, calcium channel blockers and antihypertensives.

In general, consumption of all these drugs, with the exception of diuretics, has been increasing across OECD countries. The category of diuretics include some of the oldest drugs used in the treatment of hypertension, a known risk factor of IHD. It is possible that some substitution away from diuretics toward newer, and subsequently more expensive, drugs is taking place. How much substitution is related to IHD treatment is difficult to ascertain since we do not have information on the indications for which these drugs were prescribed and diuretics are used to treat other conditions in addition to IHD (Table 2.2).

3.2. Acute care

Discharge rates for IHD reflect the demand for acute care hospital services and are a function of the supply of facilities that provide these services, but capacity constraints and provider incentives can alter the provision of these services. Data on IHD discharge rates are shown in Table 2.3.[7]

Discharge rates for IHD in OECD countries did not decrease during the 1990s (Table 2.3). The largest increases were observed for Sweden, 6.3% average annual change between 1990 and 1998, and Greece, 5.4% average annual change during the same period. This trend does not reflect the general decline in underlying demand, as approximated by IHD mortality rates, during this same period. To what extent the increase can be attributed to various

Table 2.2. **Consumption of drugs related to the treatment of IHD**

DDDs per 100 000 inhabitants

	1990	1998	%	1990	1998	%	1990	1998	%
		C02			C03			C07	
Australia	14.9	6.7	–9.6	89.3	56.1	–5.6	29.0	21.3	–3.8
Denmark	2.3	1.3	–6.9	105.6	101.5	–0.5	13.2	17.5	3.6
Finland		1.3		63.9	59.9	–0.8	32.4	51.1	5.9
Germany		12.8		55.8	55.5		20.6	30.6	5.8
Greece	9.3	5.5	–6.4	30.4	33.5	1.2	12.0	19.0	5.9
Hungary*		11.0			32.7			35.2	
Italy		7.0		25.0			12.1		
Norway	7.8	8.6	1.2	43.1	40.4	–0.8	24.5	29.6	2.4
Sweden	2.5	0.7	–14.2	81.7	66.8	–2.5	38.3	38.1	–0.1
		C08			C09			C10	
Australia	24.3	46.5	8.4	22.4	60.4	13.2	5.3	41.6	29.4
Denmark	12.7	33.8	13.0	7.4	26.8	17.4	0.7	7.8	34.7
Finland		32.3			53.7			15.8	
Germany		44.1					14.9	13.9	
Greece	23.0	41.2	7.6	14.3	46.4	15.9	3.5	12.9	17.6
Hungary*		51.1			87.0			8.5	
Italy	25.5	52.9						12.1	
Norway	16.7	37.8	10.8	16.7	39.8	11.5	1.7	37.7	47.3
Sweden		29.4			30.0		2.4	18.8	29.3

IHD: Ischaemic heart disease.

Note: ATC C02: cholesterol and triglyceride reducers; ATC C03: diuretics; ATC C07: beta-blocking agents; ATC C08: calcium-channel blockers; ATC C09: ACE inhibitors; ATC C10A: cholesterol and triglyceride reducers; DDD: defined daily dosage; ATC: anatomical therapeutic chemical classification (see ATC Index, 2000).

Source: These data were collected by the experts in the countries participating in the IHD part of the ARD study. OECD Health Database 2002 (Germany).

* The data for Hungary were collected as part of the stroke study.

factors such as lowering the threshold for admitting IHD patients to hospital or differences in coding practice during the period is unkown and would require further investigation.

There are basically three alternative treatments for IHD in acute care settings: thrombolytic drugs, percutaneous coronary interventions (PCI) or coronary artery bypass graft (CABG).[8] Due to difficulties in identifying thrombolytic drug use from hospital inpatient databases the analysis was limited to the study of PTCA[9] and CABG utilisation. These two procedures are often grouped together into one treatment modality, revascularisation, as a measure of the intensity of care for IHD.

Using aggregate level utilisation rates for PTCA and CABG (Table 2.3), the countries can be divided into three groups:

- Countries with the highest utilisation rates: Australia, Belgium, Germany, Switzerland and the United States.
- Countries in the middle in terms of utilisation rates: Canada, Denmark, Finland, Greece, Japan, Korea, Norway, Spain and Sweden.
- Countries with the lowest utilisation rates: Hungary, Italy and the United Kingdom.

It is the interplay among health system characteristics, provider incentives and the underlying demand for IHD health care services that determines utilisation patterns. The high levels of utilisation observed for the United States, Germany and Australia are not unusual given the high levels of IHD observed in these countries. However, high demand cannot explain

Table 2.3. **Selected aggregate indicators of acute care treatments for IHD**

	No. of IHD admissions per 100 000 population			No. of PTCA			No. of CABG		
				Per 100 000 population aged 40 and over					
	1990	1998	% annual change	1990	1998	% annual change	1990	1998	% annual change
Australia	–	839	–	76	231	14.9	177	223	2.9
Belgium	–	737	–	–	279	–	–	207	–
Canada	580	606	0.5	98	141	5.4	117	147	3.3
Denmark	–	794	–	9	155	43.6	32	131	19.3
Finland	1 155	1 161	0.1	30	102	16.7	104	175	6.7
Germany	–	1 143	–	88	386	20.4	70	185	12.9
Greece	386	588	5.4	14	126	31.2	42	129	15.1
Hungary	–	–	–	–	–	–	–	–	–
Italy	–	593	–	–	99	–	–	91	–
Japan	233	–	–	–	–	–	–	–	–
Norway	819	911	1.3	–	195	–	–	161	–
Spain	202	329	6.3	22	112	22.6	–	39	–
Sweden	868	994	1.7	27	150	27.9	106	188	8.5
United Kingdom	–	–	–	33	80	11.8	62	76	2.6
United States	776	800	0.4	284	396	4.8	409	541	4.1

CABG: Coronary artery bypass graft.
IHD: Ischaemic heart disease.
PTCA: Percutaneous transluminal coronary angioplasty.
Note: The population aged 40 and over was used as the denominator for PTCA and CABG, but not for AMI discharges. Greece – after 1996 only includes 17 out of a possible 24 hospitals. PTCA – ICD-9CM code 36.01, 36.02 and 36.05; the figures for Canada and the United Kingdom correspond to all sub-codes for ICD-9CM 36.0, which include all percutaneous coronary interventions. Data for Australia include ICD-9CM 36.06 and 36.07, insertion of stents. CABG – ICD-9CM 36.1.
Source: Discharges – OECD Health Database 2002. PTCA – OECD Health Database 2002 (Canada, and the United Kingdom); Mannebach, 1998 (Germany); for the remaining countries these data were collected by the experts in the countries participating in the IHD part of the ARD study. CABG – OECD Health Database 2000 (United Kingdom and the United States); for the remaining countries these data were collected by the experts in the countries participating in the IHD part of the ARD study.

the high utilisation rates observed for Belgium and Switzerland, where levels of IHD are not as great, and are actually lower than IHD levels in some countries with lower utilisation rates of PTCA and CABG. For Belgium and Switzerland, lower supply-side constraints are probably greater contributing factors to the high utilisation levels than in other countries.

In order to examine treatment patterns in greater detail, data from hospital inpatient databases from several countries were analysed. However, to facilitate comparisons across countries, data on AMI admissions rather than IHD were collected.[10] Indicators of treatment utilisation were created from these data and are measured as the proportion of AMI patients who received a PTCA and the proportion who received a CABG.[11] Patient-based data, which help track patients' movements in and out of hospitals, are preferable since these present a more accurate picture of treatment episodes. For example, most AMI patients who receive a CABG do not undergo this procedure during the initial admission. The patient is usually stabilised and then referred for a follow-up admission for CABG. Without the ability to identify the patient when he is readmitted to undergo CABG, the data would show this to be either two separate cases of AMI or one case of AMI and one case of IHD, when in fact it is the same case spread out over two separate admissions. Patient-based data, unlike event-based data, would show this as a single case of AMI, also known as an episode of care. For the ARD study, data on the utilisation of CABG and PTCA up to 90 days following the initial admission for AMI, the 90-day episode of care, were analysed.

Unfortunately, patient-based data were not available for all countries. In this paper only trends using patient-based data are described. However, the trends from the event-based data analysed for the study are similar (see Moïse and Jacobzone, 2002) to obtain further information regarding the study, including a more complete description of the differences between patient-based and event-based data).

These data show that the proportion of AMI patients undergoing PTCA has steadily increased during the 1990s in all countries (Table 2.4). Furthermore, the increase does not appear to be confined to younger age groups. This is most apparent in the US where the use of PTCA for treating the oldest AMI patients in our study (85-90 years) has increased 2.7 times for males and 3.9 times for females between 1990 and 1996.

Table 2.4. **Proportion of AMI patients undergoing PTCA and CABG, 1997**

	Men						Women					
	PTCA		CABG		Revascularisation		PTCA		CABG		Revascularisation	
	40-64	80-84	40-64	80-84	40-64	80-84	40-64	80-84	40-64	80-84	40-64	80-84
Australia	26.9	4.9	12.1	3.3	39.0	8.2	34.1	1.6	9.9	0.0	44.0	1.6
Canada	12.2	1.2	8.9	2.3	21.2	3.5	14.7	2.4	7.2	1.2	21.9	3.7
Finland	8.5	0.8	8.9	1.3	17.3	2.2	11.9	0.5	7.3	0.5	19.2	1.0
Spain	12.7	–	3.0	–	15.7	–	8.1	–	3.1	–	11.2	–
Sweden	18.2	1.7	6.4	1.2	24.6	2.9	16.8	1.1	4.8	0.7	21.5	1.8
United Kingdom	5.2	–	2.9	–	8.1	–	7.7	–	3.0	–	10.7	–
United States	38.7	16.0	19.5	12.4	58.2	28.4	32.7	13.4	14.9	8.5	47.5	22.0

PTCA: percutaneous transluminal coronary angioplasty.
CABG: coronary artery bypass graft.
Note: Denominator: persons admitted to hospital with a main diagnosis of AMI. Numerator: number of persons admitted to hospital with a main diagnosis of AMI who received PTCA or CABG. Revascularisation are PTCA + CABG. Data for Australia (Perth) are for 1995. Data for Spain (Catalunya and Pais Vasco) are for 1997-98. The data for the United States are for 1996 and the data for the 40-64 year age group are based on hospitalisations in California only.
Source: The data for Australia (Perth), Canada (Ontario), Finland, Sweden and the US were provided by the TECH Global Research Network (see TECH, 2001 and Atella, Part IV in this volume for more details on the TECH Global Research Network). For Spain (Catalunya and Pais Vasco) and the United Kingdom (Oxford), these data were collected by the experts in the participating countries.

In general, there do not appear to be any significant differences between males and females in the use of PTCA, except in Perth (Australia) where the proportion of women under 80 years receiving PTCA is greater than the proportion for men. The use of PTCA decreases with age, as expected. AMI patients in the US are far more likely to undergo PTCA than patients in other countries, mirroring the same pattern seen with the aggregate data, although the proportion of women in Perth aged 40-64 undergoing PTCA was slightly greater than the corresponding proportion of women in the US. This latter result may not reflect national trends since they are based on regional data; California for the US data (only for the 40-64 year age group) and Western Australia.

Similar to the trends with PTCA, the proportion of AMI patients undergoing CABG has increased in all countries during the 1990s, for all age groups, except for males and females aged 40-64 in the US. The proportion of US male and female AMI patients in this age group receiving CABG decreased from 23.4% (20.4%) in 1993 to 19.2% (14.4%) in 1990. In 1996 the level was roughly the same as three years earlier. It is not only the fact that this is an exception to the rule that makes this an interesting case. The data collected for this age group come from hospital administrative data for the state of California only, unlike the data for people aged 65 and over which come from Medicare files and are therefore

national in scope. Through Medicare, persons aged 65 and over have universal health insurance coverage, while a significant number of persons aged less than 65 years do not have health insurance coverage. However, this is only circumstantial evidence, no information on insurance status was collected, so it cannot be stated with certainty that this is the cause of the drop in use of CABG for the younger age group in the US. Another explanation is that these data may have captured a shift to PTCA for the younger age group. As mentioned previously, CABG is rarely used to treat AMI except in an emergency or as a follow-up elective procedure. It is possible the decline in the number of CABG performed within 90 days for younger persons in the US was due to a shift to more aggressive treatment of AMI, primary PTCA, where PTCA was used during the initial admission for AMI. This shift to more aggressive treatment may have occurred later for the elderly.[12]

There also appears to be no significant differences between the proportion of males undergoing CABG and the corresponding proportions for females, with the exception of the United States, where the proportion of males undergoing CABG is higher than females for all age groups. As expected, the proportion of AMI patients undergoing CABG decreases with age. The gap in utilisation between the US and the other countries is even greater for CABG than PTCA, even for people aged 40-64.

The increase in revascularisations among the elderly is indicative of a pattern of expanded indications of use. As providers gain experience performing revascularisations they will operate on progressively more complicated cases over time (see Moïse, Part IV in this volume) for a discussion on the diffusion of health technology using ARD data for more details). Data on the number of comorbidities were not collected, but older persons will generally have more complicated cases due to a greater number of comorbidities.

For the use of PTCA there may have been a further impetus to increasing utilisation. In the mid-1990s there were several published trials that showed the use of intracoronary stents helped to reduce the occurrence of restenosis following PTCA, one of the major limitations of PTCA (Schömig *et al.*, 1996; Lincoff, 2000). Following the publication of these trials there was a noticeable increase in the proportion of PTCA using stents and this has had a positive effect in increasing the use of PTCA (see Moïse and Jacobzone, 2002).

Finally, one of the issues not dealt with in this paper is the issue of substitution of PTCA for CABG. As a whole, the number of revascularisation procedures being performed is increasing, but utilisation of PTCA is growing faster than CABG (see Moïse and Jacobzone, 2002). These data suggest that PTCA is replacing CABG as the means of revascularisation used most often, especially with the advent of stents, but without information on case-mix it is difficult to measure this effect.

4. Outcomes: the consequences of dealing with IHD

The analysis on health outcomes focuses on two indicators: fatality and readmissions. Data from both event-based and patient-based hospital inpatient databases were collected, but only the patient-based data are described here. Case fatality rates were measured as inhospital fatality, 90-day case fatality and one-year case fatality rates for AMI patients.

An analysis of health outcomes linked to the treatments data extracted from hospital inpatient databases examined in the previous section is an important part of a comparison of how successful various health systems are in dealing with IHD. Ideally, this analysis would be based on as homogenous a group of patients in terms of case severity as possible,

however, collecting this information was beyond the scope of the study. The use of outcomes data based on AMI admissions rather than IHD admissions increases the homogeneity of the patient population since AMI cases are less diverse in terms of severity than IHD, the latter including severe conditions such as AMI with milder forms such as angina pectoris (see Note 6). The focus in this paper is on one-year case fatality rates, calculated as the proportion of patients admitted for AMI who died within one year from the initial admission and are shown in Table 2.5.

Table 2.5. **One year case fatality rates**

Percentage of persons admitted to hospital for AMI

	Men						Women					
	40-64			85-90			40-64			85-90		
	1990	1996	% annual change	1990	1996	% annual change	1990	1996	% annual change	1990	1996	% annual change
AUS	9.1	6.0	–8.0	62.8	35.3	–10.9	8.7	13.8	9.6	50.0	48.1	–0.8
CAN	8.1	6.5	–5.4	56.4	52.1	–2.0	13.9	7.5	–14.4	52.2	48.2	–2.0
DNK	20.4	11.8	–8.8	61.6	57.5	–1.1	23.0	12.9	–9.2	65.7	53.4	–3.4
FIN	14.5	12.0	–3.1	66.7	60.6	–1.6	15.4	8.9	–8.8	63.5	62.1	–0.4
SWE	11.5	8.3	–5.3	61.0	55.3	–1.6	13.3	10.9	–3.2	58.3	52.2	–1.8
GBR	8.7	11.3	4.5	57.5	59.5	0.6	13.0	15.3	2.8	57.0	54.9	–0.6
USA	12.9	8.0	–7.7	54.2	48.3	–1.9	12.2	12.8	0.7	50.7	45.0	–2.0

AMI: Acute myocardial infarction.

1. Data for persons aged 85-90 are for 1990 and 1995.
2. Data are for 1992 and 1996.

Source: The data for Canada (Ontario), Finland, Sweden and the US were provided by the TECH Global Research Network (see TECH, 2001 and Atella, Part IV in this volume for more details on the TECH Global Research Network). The data for Australia (Perth) and UK (Oxford) were collected by the experts in the participating countries.

With the exception of the Oxford region in the United Kingdom, case fatality rates decreased or remained virtually the same between 1990 and 1996 (data for 1998 for Oxford, available in the technical report but not shown here, show fatality rates declined). Not surprisingly, case fatality rates are much greater for people aged 85-90 than for persons aged 40-64. The general trend by gender is somewhat more mixed. Case fatality rates for men aged 85-90 were generally greater than for women in the same age group, but case fatality rates for women aged 40-64 were greater than for men aged 40-64.[13] These results are consistent with the results obtained from the data on inhospital, and 90-day case fatality rates.

Cross-country comparisons of one-year case fatality rates show Denmark and Finland to generally have the highest rates and Perth (Australia) the lowest. The United States is an interesting case. For the youngest age group, case fatality rates for both men and women in the US place it about in the middle of the countries in Table 2.5 (these data are based on hospitalisations in California and may not be representative of the rest of the country). However, for the oldest age group, case fatality rates for US men and women are generally lower than in other countries.

The other outcome measure collected was readmission (Table 2.6). Readmissions are another unintended negative consequence of acute-care interventions and are more indicative of quality of life following intervention for an AMI than case fatality. Readmissions were calculated as the proportion of AMI patients discharged alive who were readmitted within one year following the initial admission for any of the following conditions: AMI, IHD (excluding AMI), congestive heart failure and all causes.

Table 2.6. **Readmissions one year following initial admission for AMI, by sex**

Percentage of AMI patients readmitted

	Acute myocardial infarction			Ischaemic heart disease			Congestive heart failure			All causes		
	1990	1993	1996	1990	1993	1996	1990	1993	1996	1990	1993	1996
	Both genders											
Canada (Ontario)	–	5	5	–	18	16	–	6	5	–	37	34
Denmark	8	7	6	18	21	26	3	4	4	33	37	42
Finland	7	7	6	22	25	27	1	0	3	32	34	37
Sweden	8	7	7	15	19	20	–	–	–	29	34	34
United Kingdom (Oxford)[1]	4	3	4	9	12	20	0	0	7	25	32	36
United States	6	6	6	12	11	11	9	9	8	39	39	38
	Men											
Canada (Ontario)	–	5	4	–	23	20	–	4	3	–	38	34
Denmark	8	7	6	19	22	28	3	4	4	34	37	43
Finland	6	6	6	22	27	27	1	0	3	33	36	36
Sweden	8	7	7	16	21	22	–	–	–	30	35	35
United Kingdom (Oxford)[1]	5	4	5	10	14	22	0	0	6	26	31	38
United States	6	6	5	12	11	11	8	8	8	38	38	37
	Women											
Canada (Ontario)	–	6	6	–	17	17	–	7	5	–	38	36
Denmark	7	7	6	16	19	22	4	5	5	32	36	40
Finland	7	7	6	23	23	27	1	1	4	32	33	38
Sweden	8	8	8	13	16	17	–	–	–	29	33	33
United Kingdom (Oxford)[1]	4	3	3	9	11	17	0	0	9	24	33	33
United States	6	6	6	12	12	11	10	10	10	39	40	41

AMI: Acute myocardial infarction.

Note: Denominator: persons admitted to hospital with a main diagnosis of AMI. Numerator: number of persons admitted to hospital for each of the four disease categories indicated in the table one year following initial admission for AMI. Data on Ischaemic Heart Disease refer to ICD-9 codes 411 (other acute and subacute forms of ischemic heart disease), 413 (angina) and 414 (other forms of chronic IHD), except 414.1x.

1. People aged 40 to 89.

Source: The data were provided by the TECH Global Research Network (see TECH, 2001 and Atella, Part IV in this volume for more details on the TECH Global Research Network).

Cross-country comparisons of readmission rates reveal little variation, except for IHD for which there is considerable variation. For example, in the US, 11% of AMI patients were readmitted for IHD in 1996 compared to 27% for Sweden. This result may reflect the greater reliance in the US on PTCA for treating AMI, which has been shown to reduce angina, a significant sub-category of IHD as measured in the ARD study. It may also be attributable to differences in coding, patients readmitted for AMI being more likely to be classified as IHD patients in hospital discharge records.[14] Finally, this may reflect different approaches to treating IHD; more IHD patients may be treated outside hospitals in the US than in Sweden.

Differences in readmission rates between men and women were small. Most interesting is the fact readmissions on the whole remained virtually unchanged between 1990 and 1996. This is in contrast to the trend for declining case fatality rates over the same period. One explanation is that, as AMI care improved during this period, a significant number of patients who would have died in 1990 survived in 1996 and were readmitted, replenishing the pool of patients who would have been readmitted in 1990 but

were not readmitted in 1996 due to improvements in AMI care.[15] Another explanation may be that more people were treated as outpatients or in ambulatory care.

5. Economic aspects

Expenditure on IHD represents one of the largest components of health expenditures by disease. The greatest proportion of spending for treating IHD occurs in the hospital sector, where up to 75% of direct health expenditures can be attributed (Moore *et al.*, 1997; Hodgson and Cohen, 1999; Mathers and Penm, 1999). The economic consequences of IHD extend beyond direct costs. Indirect costs such as diminished or lost-worker productivity or the burden of care placed on family members of disabled persons also have a significant economic impact, although this aspect of the health care costs of IHD are difficult to estimate.

5.1. *Average length of stay*

For acute conditions that require hospitalisation such as AMI, measures of length of stay are positively correlated with the cost of providing treatment, therefore, they represent useful indicators of resource use for acute care.[16] The following focuses on the mean or average length of stay since it is the most readily available indicator of length of stay. Statistics on other measures of central tendency for length of stay were also collected and are presented in the main IHD report (see Moïse and Jacobzone, 2002).

There has been a gradual decline in average length of stay for AMI admissions in all countries during the 1990s. The largest declines are observed in Finland and Italy. In 1998, the average length of stay was largest in Finland (14.5 days) and Germany (13.8 days). Not shown in Table 2.7 is the average length of stay for Japan which in 1998 was 30 days. In the absence of data on the average costs for AMI hospital inpatient admissions, costs would be expected to be highest in Finland, Germany and Japan given the high and positive correlation between the length of stay and cost. There are several reasons to suggest this is not necessarily the case. First, the rapid and highly intensive intervention in treating AMI patients means a significant portion of the costs during a hospital stay are incurred within the first 2-3 days. The marginal cost of an extra day of hospitalisation will be significantly lower beyond these first few days, especially near the end of the stay when treatment is

Table 2.7. **Average length of stay for AMI admissions**

Number of days

	1990	1998	% annual change
Australia	8.5	6.5	–3.3
Belgium	–	9.6	
Canada	–	8.3	
Denmark	8.0	6.9	–1.8
Finland	22.3	14.5	–5.2
Germany	–	13.8	
Greece	11.0	8.0	–4.4
Hungary	–	11.6	
Italy	15.6	10.3	–5.1
Norway	8.6	7.8	–1.2
Spain	12.9	11.4	–1.5
Sweden	–	6.9	
Switzerland	15.1	–	
United Kingdom	9.7	–	
United States	8.4	5.9	–4.3

AMI: Acute myocardial infarction.
Source: OECD (2002).

more convalescence than acute care. Second, the price of resources used in treating AMI will affect the costs of treatment. The average length of stay in Finland is significantly higher than in the US, but higher prices for resources used in treating AMI in the US may lead to higher average costs despite an extra 8.6 days average length of stay. Third, in many countries, such as Japan, there is no distinction in the data between acute care beds and long-term care beds in acute care institutions. An excessive average length of stay, such as the 30 days in Japan which is twice as high as Finland, likely reflects a significant amount of hospitalisation stays unrelated to treating AMI.

5.2. Unit costs

In order to evaluate the economic implications of providers' treatment decisions, information was collected on *unit costs* for certain acute care treatment "bundles". The bundles of goods were based on diagnosis-related groups (DRGs) which allow for a certain level of comparability across countries. The unit costs were calculated as the average expenditure per bundle (see Box 2.1).

Finding comparable information on unit costs for the countries in the IHD study proved to be extremely difficult. Eight countries were able to provide information according to the treatment bundles selected, but there was considerable variation among these data. Three countries were able to provide information on average expenditures, three countries were able to provide information on costs and two countries provided information on charges. It was decided to supplement these data with cost information taken from cost-effectiveness studies. These studies were chosen as much as possible to be comparable with the information collected on average expenditures. For more details see Moïse and Jacobzone (2002).

In the end, the difficulties in collecting comparable cost data led to data that vary too widely to draw any meaningful conclusions. However, despite their relative incomparability, the unit costs data reflect a widely held view: that the cost of health care in the United States is larger than in other OECD countries. At best, the data should be viewed as indicators of the relative levels across countries of the costs of IHD treatments, rather than as precise measures of these costs.

6. Discussion

6.1. Does utilisation reflect demand?

In Section 2 countries were divided into two groups depending on their relative level of IHD, using IHD mortality rates as a proxy for the relative level of IHD. In the ensuing section a similar exercise grouped these countries according to their relative utilisation rates for revascularisation procedures (coronary artery bypass graft and percutaneous transluminal coronary angioplasty). The purpose is to obtain a picture of the relationship between the demand, relative level of IHD, and supply, relative level of utilisation per 100 000 inhabitants, for revascularisations. Dividing countries into two groups, high *versus* low level of IHD, rather than a league table of IHD mortality rates to reflect demand, avoids the pitfall of inferring that differences in IHD mortality rates imply proportionally equal differences in demand for IHD treatments.

The underlying level of IHD in a country should be a fairly reliable indicator of the demand for revascularisation in that country. Table 2.8 shows this to be the case for Australia, Germany and the United States, countries with relatively high levels of IHD and correspondingly high utilisation rates for revascularisation procedures. Conversely, the same relationship holds for Italy, which has a relatively low level of IHD and

Box 2.1. **Unit costs for IHD treatments**

The ideal cost measure would calculate the total cost for IHD treatments of all resources used during each patient stay. For acute care IHD treatments these resources would include the amount of physician and nurses time, time spent in the operating theatre, drugs consumed, etc. The total cost for each patient stay would then be calculated by multiplying the relevant price by the relevant unit of service. To make comparisons across countries, the average cost in each country for similar treatments would then be calculated and compared.

Unfortunately, relevant prices are generally rare and in countries where hospitals are financed through global budgets, units of service for resource use are generally not measured. There is in effect no standard measure for evaluating the costs of IHD treatments that allow for reasonable comparisons across countries.

The most reasonable comparable measure of costs currently available which could fulfil this role are Diagnosis-Related Groups (DRGs). DRGs categorise patients according to diagnosis and the intensity of resources consumed during a typical patient stay for that diagnosis. In actual fact, DRGs are not purely diagnosis related. It would be more accurate to state that most DRGs are diagnosis-related *treatment* groups since invariably they are defined for specific treatments. Even reasonably well-defined indicators such as DRGs are not homogenous across countries.

Another difficulty with comparing costs is that in many cases the data are not costs but are in fact *charges*. The charges payers pay for IHD treatments are not equal to, nor are they in some cases necessarily an accurate reflection of the actual cost of the resources consumed; hospital charges will not include physician charges where physicians are not salaried hospital employees, and charges are based on accounting procedures that for various reasons (cross-subsidies between departments, assignation of costs between department; assignation of costs to individual patients within departments) do not accurately reflect actual resources consumed (Finkler, 1982).

In order to compare costs for various IHD treatments across countries, a reasonable and comparable measure of costs was required. For the ARD study it was decided to approximate the average costs for IHD treatments by calculating the average expenditures for a standard set of "bundles of medical goods" related to the treatment of IHD. These expenditure bundles are composed of four items:

Per diem costs related to stay in ICU/CCU: the cost per day (a proxy for price) and the "standard" length of stay (a proxy for unit of service) in a Cardiac Care Unit (CCU) and/or an Intensive Care Unit (ICU).

Cost of major procedures: the cost related to the resources used during the stay. This information would be obtained from various sources: physician fee schedules, hospital accounting records or specific studies, DRGs, etc.

Overhead and administrative costs: due to the complexities of calculating these costs, experts were asked to provide an estimate of the proportion that overhead and administrative costs made up of total costs. To the best of their abilities, the experts were asked to provide a list of which items would be included.

Other related costs: these would include expenditures on drugs consumed and medical supplies used.

The French DRG grouping (Groupes homogènes de malades) were used as a guide to construct the treatment bundles. In all, the experts were asked to collect average expenditures for the following six bundles: 1) Uncomplicated AMI; 2) Complicated AMI, with PTCA, discharged alive; 3) Complicated AMI, without PTCA, discharged alive; 4) AMI, deceased; 5) Elective PTCA, excluding AMI patients; and 6) CABG.

Table 2.8. **Level of IHD, supply constraints and utilisation of revascularisations**

	Utilisation of revascularisation procedures		
	High	Medium	Low
High level of IHD	AUS, DEU, USA	CAN, DNK, FIN, NOR, SWE	*HUN, GBR*
Low level of IHD	*BEL, CHE*	ESP, GRC, JPN, KOR	ITA
Supply constraints			
Regulation of facilities			
Strong constraint		CAN, DNK, NOR	GBR
Medium constraint	AUS	FIN, GRC, ITA, SWE	
Low constraint	BEL, CHE, DEU, USA	ESP, JPN, KOR	HUN
Hospital payment methods			
Global budgets		CAN, DNK, ESP, GRC, NOR, SWE	GBR
Mixed financing	AUS, USA	FIN	HUN, ITA
Fee-for-service	BEL, CHE, DEU,	JPN, KOR	
Physician payment methods			
Salaried		DNK, ESP, FIN, JPN, NOR, SWE	HUN, ITA, GBR
Mixed remuneration	AUS, DEU	CAN, GRC	
Fee-for-service	BEL, CHE, USA	KOR	

IHD: Ischaemic heart disease.
Note: The categorisations according to level of IHD and utilisation of revascularisation procedures are to be found in Sections 2 and 3 respectively. For each category of supply-side constraints (regulation of facilities, hospital payment methods and physician payment methods), the constraints are arranged in order from top to bottom in terms of their limiting effect on utilisation of revascularisations, *i.e.* the countries with the strongest constraints on activity levels, for example where the majority of physicians are paid salary, are in the first row. The third row is for the countries with the weakest constraints, such as where the majority of physicians are paid fee-for-service.
Source: Moïse and Jacobzone (2003).

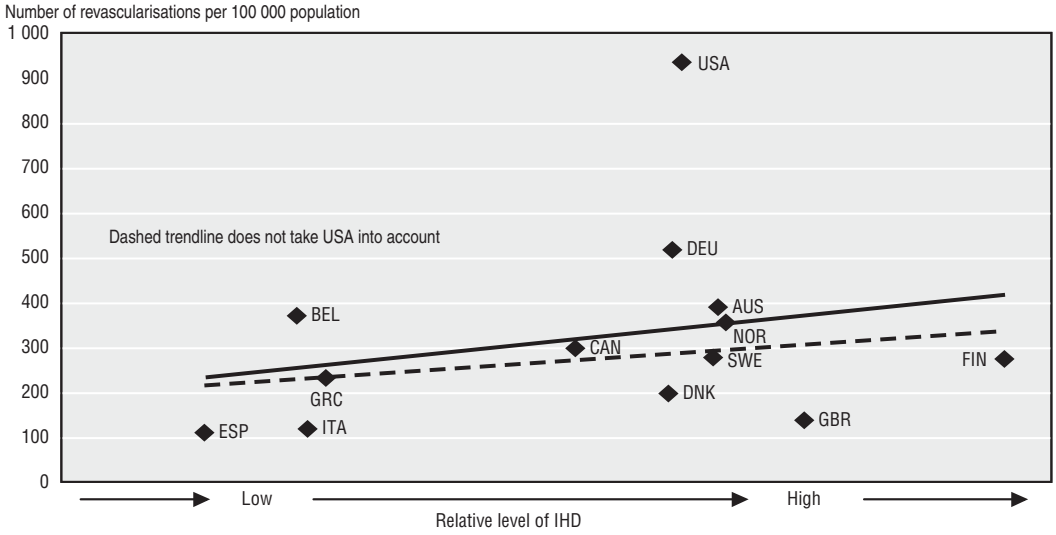
correspondingly low utilisation rate for revascularisations. However, Table 2.8 also shows that this relationship is not an exact one. For example, Belgium and Switzerland, two countries with relatively low levels of IHD have higher utilisation rates for revascularisations than most countries, higher even than the United Kingdom (GBR) and Hungary, two countries with much higher levels of IHD.

The evidence from Table 2.8 suggests the relationship between the level of IHD and utilisation rates for revascularisation procedures across countries may not be as strong as expected. How strong then is the relationship? Figure 2.1 plots utilisation rates for revascularisation procedures against the level of IHD for several countries.[17]

The trendline shows there to be a weak relationship between the level of IHD and utilisation rates for revascularisation procedures. The dashed trendline does not take into account the US data, which has much higher utilisation rates than any other country. Without making any inferences regarding what would be considered the optimal utilisation rate for a given level of IHD, countries significantly above the line can be considered as performing relatively higher numbers of revascularisations given their level of IHD. Countries significantly below the line can be considered as performing fewer revascularisations relative to other countries with similar levels of IHD.

In addition to the US, Belgium and Germany, and to a lesser extent Australia, also appear to be performing more revascularisations than one would expect given their respective levels of IHD. This reinforces the observation for these countries from Table 2.8. On the other hand, the data points representing Italy, Spain, the United Kingdom, Finland and Denmark are well below the trendline compared to other countries. For Italy and

Figure 2.1. **Utilisation rates of revascularisation procedures and relative level of IHD**



IHD: Ischaemic heart disease.

Note: Age-standardised IHD mortality rates are used as a proxy for relative levels of IHD. Belgium, Australia, Spain (1995); Denmark, Finland, Sweden (1996); Canada, Germany, Greece, United Kingdom, United States (1997); Italy: mortality (1995) and revascularisations (1996); Norway: CABG (1996), PTCA (1998), mortality (1995). Data standardised to the European population aged 40 and over.

Source: Revascularisations: see Table 2.4. IHD mortality: OECD Health Database (2002).

Spain, the fact utilisation rates for revascularisation procedures are low is not surprising given their relatively low levels of IHD. Given the relatively high levels of IHD in Denmark, Finland and the United Kingdom, they appear to be performing particularly lower numbers of revascularisations.

6.2. The influence of supply-side constraints

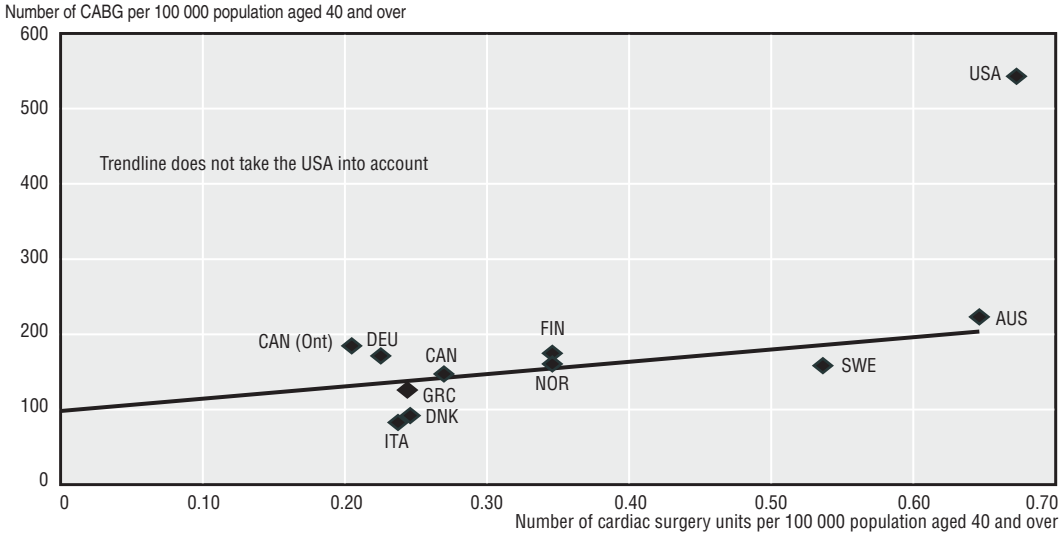
It is clear that something other than the level of IHD is driving the utilisation of revascularisation procedures. What are the main driving factors?

Both CABG and PTCA require special equipment, which not all hospitals are equipped to provide. It seems reasonable to assume that the number of facilities equipped to handle these two procedures is strongly correlated with the utilisation levels for these two procedures.

To examine the effect of facility availability on the utilisation of PTCA and CABG, an examination of the relationship between available facilities and the utilisation rates for each procedure was done. This is shown in Figures 2.2 and 2.3, where the number of facilities available for performing CABG and PTCA are plotted against the respective utilisation rates for each procedure. The trendlines in each graph represent the relationship across countries in terms of relative "production" levels; that is, they provide a rough approximation to an appropriate number of procedures given the stock of available facilities.

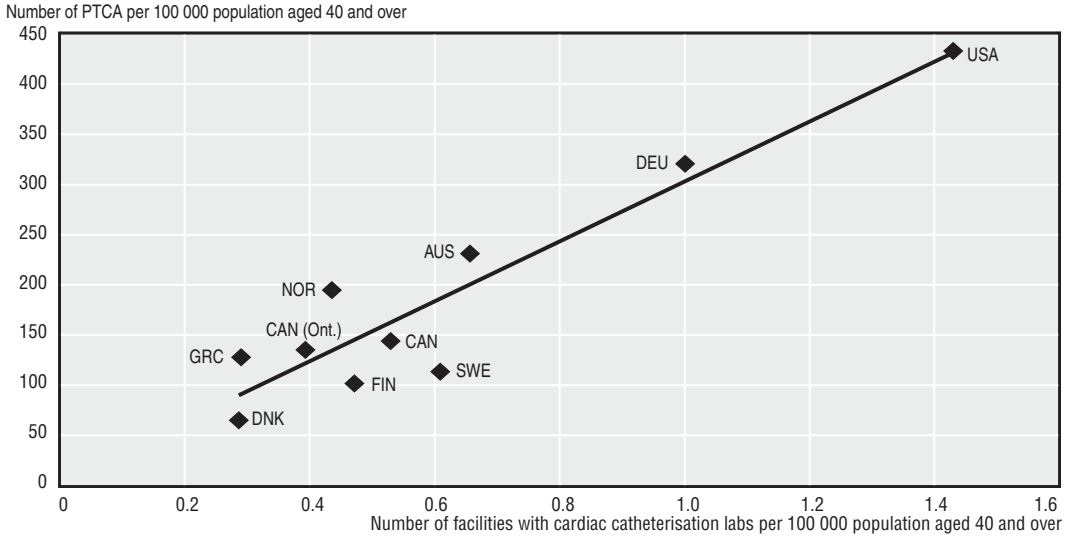
The United States performs a much larger number of CABG procedures per 100 000 inhabitants aged 40 and over than other countries (Table 2.3), which may be driven from the fact the United States also has the largest number of cardiac surgery facilities per 100 000 inhabitants aged 40 and over. Figure 2.2 shows that, even when taking into account the large number of cardiac surgery facilities, the US still performs more procedures than the other countries relative to the relationship between facility availability and procedure utilisation suggested by the trendline (which was calculated excluding the US).

Figure 2.2. **Utilisation rates for CABG and number of cardiac surgery units, per 100 000 inhabitants**



CABG: Coronary artery bypass graft.
Note: Canada, Denmark, Sweden (1995); United States (1996); Italy (1997); Australia (1998). For Ontario, Finland, Greece and Norway: CABG (1998), cardiac surgery units (2000). Refer to Figure 2.3 for additional notes.
Source: CABG per 100 000 population: see Table 2.4. Cardiac surgery units per 100 000 population: responses to OECD questionnaire "Core set of indicators for ischaemic heart disease" and ARD country reports.

Figure 2.3. **Utilisation rates for PTCA and number of catheterisation facilities per 100 000 inhabitants**



PTCA: Percutaneous transluminal coronary angioplasty.
Note: Canada, Ontario, Denmark, Sweden (1995); Germany, United States (1996); Greece (1999). For Australia, Finland and Norway: PTCA (1998), catheterisation laboratories (2000). The figures for facilities includes all facilities able to do cardiac catheterisation due to the difficulty of separating these facilities from those additionally equipped to do PTCA.
Source: PTCA per 100 000 population, see Table 2.4. Catheterisation laboratories per 100 000 population: responses to OECD questionnaire "Core set of indicators for ischaemic heart disease" and ARD country reports.

The relationship between available facilities and the number of procedures performed is much stronger for PTCA (Figure 2.3). Similar to the situation with CABG utilisation, the US performs more PTCA per 100 000 persons aged 40 and over than any other country, but

unlike PTCA, the number of PTCAs performed in the US given the available facilities is much closer to the relationship in other countries. In fact, judging from the trendline, Norway (for example) appears to be performing more PTCA procedures relative to available facilities than the US.

Figures 2.2 and 2.3 demonstrate that considerable variation across countries exists regarding the number of cardiac surgery facilities and catheterisation laboratories available. What then, is the cause of this variation? Section 1 provided some detail regarding the regulation of facilities. The Beveredgian countries tend to have stronger "constraints", that is greater regulation of facilities, than the social insurance countries, and they also have fewer facilities for revascularisation. In Table 2.8 countries are grouped into three rows according to the strength of the regulatory environments for facilities which is set against their relative levels of utilisation rates for revascularisations (see Moïse and Jacobzone, 2002, for more information regarding the grouping).

Not surprisingly, none of the countries with the strongest supply-side constraints, Canada, Denmark, Norway and the United Kingdom were among the group of countries with the highest utilisation rates for revascularisation procedures. Belgium, Germany, Switzerland and the United States, countries with much weaker regulation of facilities, have the highest utilisation rates for revascularisations. Three other countries, Hungary, Japan and Korea are also characterised as having weak constraints, but they differ because of their low utilisation levels. For Japan and Korea, this is probably due to their correspondingly low levels of IHD. In the case of Hungary, which has one of the highest levels of IHD, the issue is probably related to other factors as well, for example GDP per capita or physician payment methods, than facilities regulation.

When juxtaposed with the information from Figure 2.2 and Figure 2.3 the inter-relationship between constraints on facilities, the number of facilities and number of revascularisations performed is not as straightforward. Certainly for Canada and Denmark, strong constraints have created an environment that is less conducive to having a large number of facilities per population than the US. However, in Germany for example, there are fewer cardiac surgery facilities per 100 000 population aged 40 and over than in Denmark, yet CABG utilisation rates in Germany are higher. Why would Germany have a high number of catheterisation laboratories compared to other countries but not cardiac surgery facilities? One possibility is that the environment under which hospitals operate in Germany is more conducive to the establishment of high-volume cardiac surgery centres, hence a smaller number of centres are performing the same number of CABGs overall. Another possibility is that regulations in Germany for catheterisation laboratories are less stringent than for cardiac surgery facilities, creating an environment conducive to a greater number of catheterisation laboratories. Of course, less stringent regulations for catheterisation laboratories are also likely the case in other countries as well. This is because high capital and resource costs associated with cardiac surgery facilities would make them a likelier target of regulations than less costly catheterisation laboratories. An example of this can be seen in the increasing number of PTCA that are being done as outpatient procedures, a sector that is traditionally less regulated in many countries.[18] However, it is difficult to say since differentiated information regarding regulation of these different facility types was not collected.

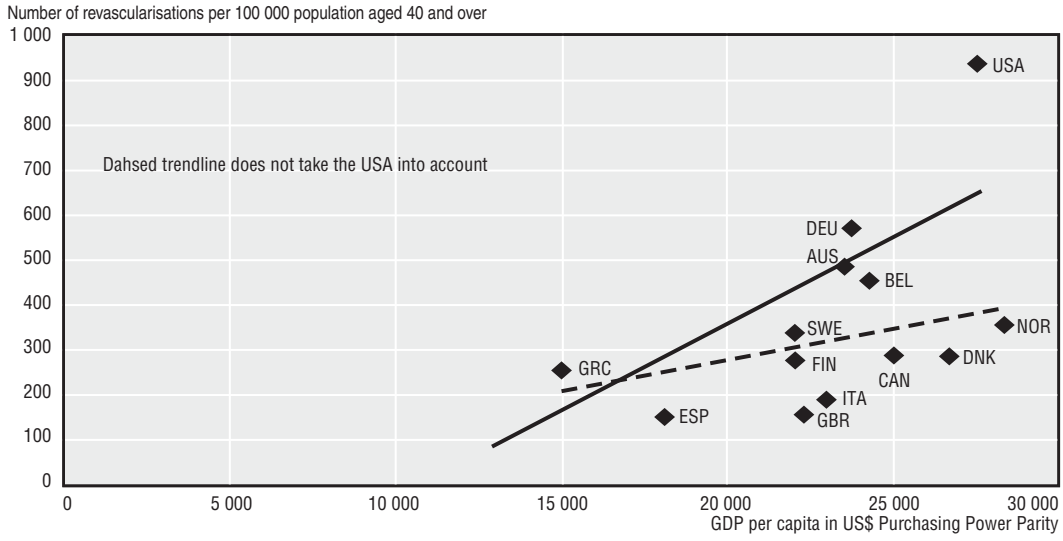
Table 2.8 provides supporting evidence that the combination of regulation of facilities and the subsequent effect on the number of facilities, especially PTCA, exert a stronger influence on treatment patterns than underlying demand (Figure 2.1), especially in

countries with relatively high levels of IHD. However, in cases such as Germany, where the relationship between regulation and the number of facilities is weaker, or Japan and Korea, where lax regulation has not meant higher utilisation rates for revascularisations, there must be other factors at work. Several studies have shown that how providers are financed is a significant determinant of utilisation levels for health care services (OECD, 1994; McClellan, 1997; Gilman, 1999; Or, 2000). Similar to what was done for facility regulation, preferred methods of remuneration for physicians and hospitals are shown in Table 2.8 alongside utilisation levels for revascularisations.

The story regarding provider payment methods is similar to what has been observed for facilities regulation. In Belgium and Switzerland, two countries where fee-for-service is the dominant method for paying hospitals and physicians, utilisation of revascularisation procedures is high. Conversely, in the United Kingdom, where global budgets for hospitals and salaries for physicians are the dominant forms of payment, revascularisation rates are among the lowest. Of particular note is the fact that the countries below the trendline in Figure 2.1, Spain, Denmark, Sweden and the United Kingdom are all countries where the majority of physicians are paid on a salaried basis.

The above discussion demonstrates the significant effect supply-side constraints have on utilisation rates for revascularisations. Another important determinant of utilisation is GDP per capita. As was shown in the case of Hungary, despite a high level of IHD and relatively weak constraints on hospital, utilisation of revascularisations are low compared to other high IHD level countries. Figure 2.4 shows that the relationship between the number of revascularisations and GDP per capita is strong.

Figure 2.4. **Utilisation rates for revascularisations and GDP per capita in US$ PPP, 1998**



CABG: Coronary artery bypass graft.
PTCA: Percutaneous transluminal coronary angioplasty.
Note: Number of revascularisations (CABG + PTCA) is calculated for the population aged 40 and over.
Source: Revascularisations: see Table 2.3. GDP per capita: *OECD Health Data 2002*.

A few words of caution regarding the above analysis should be noted. First, this production level analysis is limited to "throughputs", that is conclusions cannot be drawn from this in terms of the adequacy of care delivered with regard to potential needs, nor can any conclusions be drawn in terms of the effectiveness of the care delivered. Second, in the case of

PTCA, not all catheterisation laboratories are equipped to perform PTCA. If only the number of labs able to do PTCA were included, the data points would shift to the left, but not all to the same degree. The effect on the trendline would be more ambiguous; it would shift to the left, but it would not be a parallel shift since the proportion of catheterisation labs not equipped for PTCA to the total number of catheterisation laboratories would vary by country.[19]

It is difficult to analyse the interrelationships among the qualitative variables, supply-side constraints, and utilisation of revascularisations without an empirical analysis. In a paper on the diffusion of health technology and its effect on health care expenditures later in this volume (Moïse, 2002), this relationship is investigated through the estimation of regression equations. The results provide evidence of a strong influence of relative GDP per capita and supply-side constraints on the utilisation levels of CABG and PTCA, while relative demand, defined as IHD mortality, has a lesser influence, supporting the observation reported in this paper.

As mentioned above, the cross sectional nature of the analysis presented in this paper has some limits but fundamentally does not alter the story. The topic of the diffusion of health technology over time is also discussed in Moïse (2002). High per capita income coupled with the early adoption and rapid diffusion of health technologies can help explain why the United States is such an outlier in the utilisation of revascularisation procedures, even compared to other countries with similar supply-side characteristics (TECH, 2001; Slade and Anderson, 2001). This may also help explain the higher utilisation rates of Norway, *vis-à-vis* other countries such as Denmark and Sweden with similar supply-side characteristics and levels of IHD. The higher than expected utilisation of revascularisation procedures, particularly for PTCA (which is a newer procedure than CABG), compared to the other countries may be due to earlier adoption by Norway because of its higher per capita income (Slade and Anderson, 2001).

6.3. Can we determine the best value for money spent?

Which countries get the best value for the resources they expend in treating IHD? The parameters of the ARD study, to compare treatments, health outcomes and costs for IHD were chosen to try and answer this question. Thus far, the discussion has focussed on how the resources are used by comparing treatment trends and providing reasons why these differ across countries. To answer this question requires an assessment of how countries vary in the health outcomes and costs of these treatments.

For health outcomes, there was some variation across countries. Mainly these show that one-year case fatality rates in Finland generally tend to be the highest while they tend to be lowest in Perth, Australia. Whether the latter reflects all of Australia is unclear. Event-based data on inhospital case fatality was available for all of Australia, which showed fatality rates to be about the same as the three other countries for whom data were available. A more cautious interpretation of the implication of the Perth health outcomes data for Australia as a whole is that health outcomes for Australia are likely to be about the same as most countries, except Finland. The other main result is that health outcomes in the US, while in the middle range of countries for the youngest patients, tend to improve for older patients relative to other countries, so that for the oldest AMI patients, case fatality rates in the US were lowest.

For the costs of treating IHD, the main result from the data shows not much difference across countries, with the probable exception of the United States, for which costs are higher, at least with respect to treating complicated cases of AMI. The only question left unresolved is the magnitude of the difference.

The following scenario emerges when the three parameters, treatments, outcomes and costs are reconciled. Firstly, a reliance on more costly revascularisations for treating IHD, combined with higher costs for these treatments than in other countries, are likely to be a significant driving force in making the US the highest spender on health care for treating IHD (Moore *et al*., 1997; Hodgson and Cohen, 1999; Mathers and Penm, 1999).[20] Greater spending in the US on treating IHD may not have brought better health outcomes for younger persons, but the lower case fatality rates for older persons suggest greater spending on treating IHD in the US may have bought better health outcomes for the elderly. This assumes the costs for treating IHD do not differ by age, when in fact there is evidence to suggest otherwise (Lubitz and Riley, 1993; Richardson and Robertson, 1999; Brockman, 2002). More importantly, this assumes the marginal benefit of better health outcomes always outweighs the marginal cost of higher spending. In reality, decision-makers do not assume this to be the case. An assessment of the benefits and costs may conclude that the extra spending in the US is too expensive for the benefits it generates.

Secondly, it is more difficult to interpret the interrelationship of treatments, outcomes and costs across countries in general. For example, there appears to be no significant difference in the costs of treating AMI in Finland compared to other countries, except the US. However, case fatality rates for AMI patients in Finland are generally higher than in other countries. Is Finland not getting as good a value for the money it spends on treating AMI than what other countries are getting? Unfortunately, this question cannot be answered with the information collected; the poorer outcomes for Finnish AMI patients may be because they were sicker upon admission than patients in other countries, nor do similar costs for treatment bundles mean Finland spends the same on treating IHD since a lower rate of revascularisations means that Finland may actually spend less on treating IHD than most other countries.

Therefore, to answer the question of whether or not we can determine which countries get the best value for the money they spend on treating IHD remains speculative based on the cost data collected for this study. The strength of any future similar endeavours will depend on the reliability of the information. To improve on what has been discussed here will require improvements to the information on costs, outcomes and treatments in that order.

7. Conclusion

This study represents one of the first full-scale attempts at comparing health care system performance using a comprehensive disease-based framework, utilising large hospital administrative databases based on individual medical records, supplemented with other sources of relevant information. It is hoped that this study will serve as a reference for understanding patterns of care for ischaemic heart disease across OECD countries, and at a minimum, has laid the foundations for further studies comparing treatments, costs and outcomes of IHD. Of course, this study does have some limitations. Firstly, it is not a medical study, as such the analysis of medical interventions remains incomplete from a clinical perspective. In the interests of time and comparability, much of the available information from hospital administrative databases on clinical status, comorbidities and inpatient drug therapy treatments could not be used. Secondly, information on ambulatory care practices for treating IHD are extremely difficult to obtain for this type of study, thus, an important part of the IHD care spectrum remains incompletely analysed, although the paper did look at patterns of drug consumption for

treating chronic cases of IHD. Finally, mortality and readmission were the only measures of outcomes collected, thus the issue of quality-of-life was restricted to evaluation of readmissions data. Collecting data on this aspect of IHD would be an extremely resource intensive task, one that fell beyond the scope of the present study.

This study shows the importance of health information systems for evaluating health care systems. An enormous wealth of information, from a variety of sources was used to provide an extensive analysis of IHD treatment patterns in an international context, yet the assessment remains incomplete since not all data were available. Improvements in the utility of these information systems require long-term investments in money and stakeholder co-operation. The main stakeholders, patients and physicians, are more likely to participate if it can be demonstrated to them the costs, including non-monetary costs such as reduction in the privacy of personal information, are outweighed by the benefits of improved overall health.

The strength of this study is the demonstration of the link between health care system supply-side incentives and the level and diffusion of invasive revascularisation procedures. The paper shows that universal coverage does not necessarily guarantee the same utilisation rates for treatments across countries, since OECD countries devote very different levels of resources to health care, each within their own "universal system". However, the higher utilisation rates of revascularisation procedures observed in some countries do not necessarily translate into improvements in outcomes that parallel the concomitant higher investments in resources, as some lower spending countries are able to achieve similar or even better results. Future work on international comparisons of IHD treatments should focus on achieving a better understanding why some countries can achieve equal or better health outcomes with less spending.

Notes

1. An enormous amount of information was collected for the IHD part of the study. The enormity of this information limits a full presentation in this paper, therefore, this paper provides a summary of the trends in the data. See Moïse and Jabobzone (2003) for a more comprehensive exposition of the collected information.
2. Other factors, such as socioeconomic status, can affect access to health care. For example, see Alter *et al.* (1999).
3. PTCA is a sub-set of the more general category of these procedures, percutaneous coronary interventions (PCI).
4. This will depend on the time required per procedure since economic agents value time. For example, *ceteris paribus*, the financial incentives for physicians are greater for performing a PTCA procedure with a fee of US$50 that takes one hour to complete instead of a CABG procedure with a fee of US$125 that takes three hours to complete. In three hours the physician would have earned US$150 performing three PTCAs as opposed to US$125 for one CABG.
5. See OECD (1992) for a description of a typology of health systems (we refer to Beveredgian and social insurance countries in this paper).
6. Data on IHD mortality rates by age were also collected. The results show, as expected, that IHD mortality increases with age.
7. Discharge is defined for the purposes of the *OECD Health Data 2002* as "the formal release of an in-patient by an in-patient or acute care institution".
8. There is no strict differentiation in the data between thrombolytic drugs and the two revascularisation procedures since thrombolytic drugs are often used prior to the use of PTCA or CABG. When we refer to the use of thrombolytic drugs we mean the use of these drugs without subsequent PTCA or CABG.

9. For the ARD study, it was decided to collect information on the use of PTCA rather than all PCI since the former are more easily identifiable in data sources. International Classification of Diseases ninth revision (ICD-9) codes used for PTCA are ICD-9CM 36.01, 36.02 and 36.05 (see Appendix 3 of Moïse and Jacobzone, 2003 for more details).
10. It was decided at a meeting of experts involved in the IHD part of the ARD study to collect micro-data based on AMI hospitalisations rather than IHD. There were several reasons for doing this, but the main consideration was that cohorts based on AMI admissions provide a more homogenous group of patients, which facilitates comparisons. ICD-9 410 was used to define the cohorts (see Appendix 3 of Moïse and Jacobzone, 2003 for more details).
11. CABG is rarely used for treating AMI, only as a last resort or as a follow-up elective procedure. When it is used to treat AMI patients, CABG is used to treat the chronic manifestation of IHD, the underlying cause of AMI.
12. Data collected by the TECH Global Research Network for the US show that primary PTCA use in 1991 for the elderly was about 3% of AMI admissions and 10% for patients less than 65 years old. In 1996 use was 9% for the elderly and 18% for patients less than 65.
13. This result is not surprising. The protective effect of estrogen lowers the risk of IHD for women prior to menopause.
14. Several of the experts at the experts meeting pointed out that in some countries a significant percentage of patients admitted to hospital for AMI were in fact coded as IHD patients.
15. Readmission rates were also collected by age but are not shown in this paper. What is interesting is that these data showed no discernible age gradient for AMI readmissions. Several reasons for this trend are provided in the technical paper (see Moïse and Jacobzone, 2003).
16. Excessive lengths of stay for reasons unrelated to the original admission for AMI can lead to overestimating the true resource use for AMI admissions.
17. Much of the following analysis is based on cross-sections of data for 1997, but not all countries. This static analysis is not the most appropriate method given the fact utilisation rates for CABG and PTCA tend to increase over time. However, it is doubtful that utilisation rates, for countries with data prior to 1997, would have increased substantially enough to distort the analysis.
18. This was suggested by the reviewer of this paper.
19. Although this is restricted to a cross-sectional analysis, another complicating factor is the evolution of PTCA, which is becoming a less invasive procedure with each passing year.
20. Data on health spending by disease were only available for three countries, the US, Australia and Canada. These show that the US spends more per capita on IHD than the other two countries, which reflects the fact the US spends more per capita on health overall than any other country. Using these two facts, it is assumed that the US not only spends more on treating IHD than Australia and Canada, but that it also spends more than the other countries.

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PART I

Chapter 3

Stroke Treatment and Care:
A Comparison of Approaches in OECD Countries

by
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Abstract. *The burden from stroke in OECD countries is large, both in terms of disease burden and health system costs. This paper provides a summary of the main results from the stroke component of the OECD Ageing-Related Diseases study. The results show that variations exist in stroke epidemiology, treatments, health outcomes, expenditure and policy approaches in the 17 countries that participated in this study. Two key implications were identified. First, there is apparent benefit from a broad-based approach to managing stroke that includes prevention, acute care and rehabilitation. And second, there appears to be specific potential benefit from the use of stroke units that may not be fully realised in most of the countries included in this study.*

* Many thanks to Pierre Moïse and Veronique de Fontenay for valuable input into this paper. Thanks also to Elizabeth Docteur and an anonymous reviewer for helpful comments on an earlier draft. This work was undertaken in collaboration with the expert network on stroke care established for this project, and the input from that group is gratefully acknowledged. This work was supported by grants from the US National Institute on Aging and the Japanese Ministry of Health, Labour and Welfare.

Introduction

The burden from stroke in OECD countries is large, both in terms of disease burden and health system costs. Stroke deaths accounted for 10% of all deaths in OECD countries in 1997 (OECD, 2002). In addition, the disability burden from stroke is substantial. Combining both the mortality and disability from stroke it has been estimated that in developed countries 6% of the total disease burden (deaths and disability) in 2000 was due to stroke, making it the third leading disease in terms of total burden after ischaemic heart disease and depression (WHO, 2002b). Because of the large burden from stroke in terms of deaths and disability, the resulting health system costs are also high, with estimates of stoke expenditure ranging between 2 and 4% of total health system expenditure. Significant costs also accrue outside the health system, largely due to the significant disability associated with stroke.

The purpose of this paper is to provide a summary of the main results of the stroke study undertaken as part of the Ageing-Related Diseases (ARD) project,[1] and to provide an initial discussion of the implications of the study. This paper is indented to be largely descriptive rather than analytic. Presentation of some relationships in the data later in this paper are included to initiate discussion, and are largely exploratory. Further analysis of the results of this and other parts of the ARD study are presented in other papers (Moïse, see Part IV; Moon, see Part V; Jacobzone, see Part VI in this volume).

This analysis of the treatment, costs and outcomes from stroke care in 17 countries largely focused on the most common type of stroke – ischaemic stroke[2] – although other types are discussed in some sections. This summary is based on the full report of the stroke study (Moon *et al.*, 2003), which contains further qualitative and quantitative information obtained from the country reports and literature review that formed the basis of the study. This summary has two main sections, organised as follows:

- Section 1: A summary of the main results obtained from the country submissions from participating countries on the treatments, costs and outcomes from stroke care:
  - a brief overview of the epidemiological data on stroke;
  - the key results from our comparison between countries of stroke treatments;
  - the main findings in relation to health outcomes;
  - an overview of available data in relation to the economic aspects of stroke treatment;
  - an outline of the main policies, incentives and regulations impacting stroke treatment.
- Section 2: A discussion section outlining the main policy issues, and exploring some of the relationships among treatments, costs and outcomes.

1. Summary of results

1.1. *Epidemiological background*

Information is presented here on stroke incidence, mortality and risk factors. This is to assess whether there is variation in the level of stroke between countries, which would be an important contextual factor in our examination of treatment variations between countries.

Incidence

Incidence is the number of new cases of "stroke" for a given year, presented here as the number per 100 000 population. Due to the difficulties involved in collecting incidence data, we only have information from epidemiological studies for a relatively small number of the countries included in this study, which may not be generalisable to the other countries in this study. The data we do have shows that there is variation in stroke incidence between countries. For example, incidence rates for ischaemic stroke in Sweden for males and females were around 2.5 times those in Australia.

In general terms among the countries with data included in our study, Sweden has the highest incidence rates, followed by Norway, Italy, Denmark and Japan. The United Kingdom and Australia have the lowest incidence rates among these countries. As expected, the incidence of stroke increases with age, with by far the largest incidence rates occurring in the 75 years and over age group.

Recent studies have demonstrated declining stroke incidence in some centres, though the decline has sometimes been small and not statistically significant (Thorvaldsen *et al.*, 1997). Using age-standardised trends in ischaemic stroke incidence (for persons aged 40 years and over) where available, we found that one country demonstrates declining incidence (Australia), two countries increasing incidence (Denmark and Norway) and the remaining two having relatively stable incidence (Italy and Sweden).

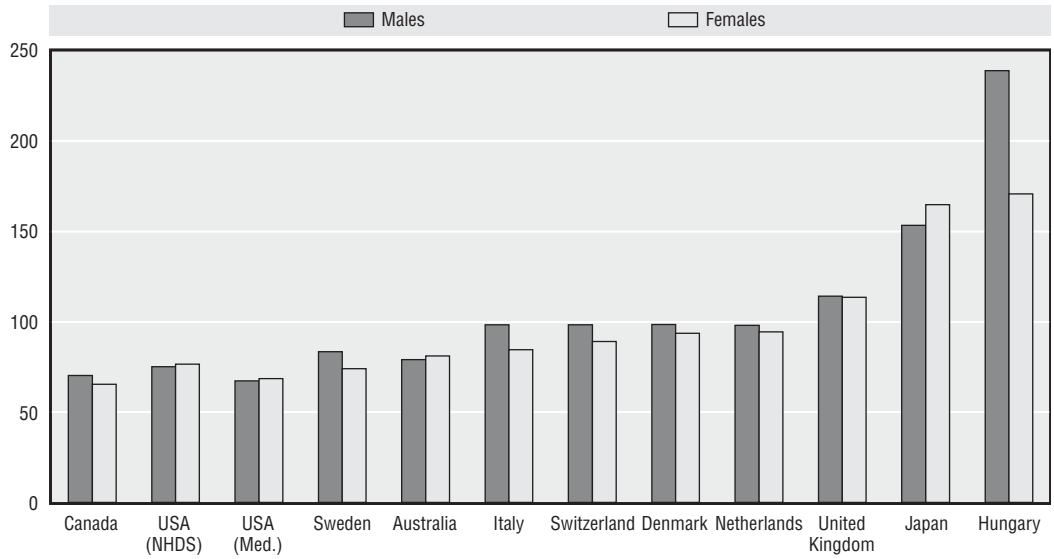
Mortality

Compared to incidence, it is easier to obtain information on mortality as most OECD countries maintain routine death registration data indicating the cause of death. Figure 3.1 shows the age-standardised ischaemic stroke mortality rates for persons aged 40 years and over. The rates in Hungary and Japan are highest; the United Kingdom, Denmark, Switzerland, Hungary and the Netherlands are in the next group, while the rates in the United States, Sweden, Australia and Canada are in the lowest group.

Table 3.1 summarises the trends over time in ischaemic stroke mortality for persons aged 40 years and over, showing two groups of countries. The first group includes those displaying decreasing trends in stroke mortality. For these countries, the male mortality rate has fallen to 70-100 per 100 000 in recent years. For females, the rates have fallen to around 65-105 per 100 000. The second group includes the other countries: those with steady or increasing trends. In this group, the two countries with the lower rates (Denmark and Sweden) currently have rates at similar levels to those countries with decreasing trends. The main exception is Hungary, where the rate has remained high at around 200 per 100 000. The mortality rates in Japan have remained at levels between Hungary and the other countries. These two distinct patterns in stroke mortality have also been identified in the research literature, which was attributed to differing trends in risk factors (Sarti *et al.*, 2000).

Figure 3.1. **Ischaemic stroke mortality rates,[1] 1997**

Per 100 000 aged 40 years and over



Note: Two primary sources for the United States: NHDS from the National Hospital Discharge Survey, and Med. from Medicare data.

1. Age-standardised to the European standard population.

Source: ARD stroke study, OECD.

Table 3.1. **Trends in ischaemic stroke mortality rates**[1]

Per 100 000 population aged 40 and over

	Males				Females			
	1980	1990	1997	% decrease[2]	1980	1990	1997	% decrease[2]
Decreasing trends								
United Kingdom	184	150	114	2.2	167	142	114	1.9
Switzerland	183	165	98	2.7	153	126	89	2.5
Italy	189	129	98	2.8	151	110	85	2.6
Netherlands	124	98	98	1.2	109	93	95	0.8
Australia	173	104	79	3.2	160	107	81	2.9
United States (NCHS)		92[3]	75	2.6		80[3]	77	0.5
United States (Med.)		78	67	2.0		73	69	0.8
Canada	113	80	70	2.2	94	70	66	1.8
Stable or increasing trends								
Hungary	237	256	239	0.0	175	185	171	0.1
Japan	151	117	156[3]	–0.2	150	127	167[3]	–0.7
Denmark	95	99	99	–0.2	77	86	94	–1.3
Sweden	68	81	83	–1.3	55	70	74	–2.0

1. Age-standardised to the European standard population.
2. Average annual percentage decrease (over the period 1980-97, except for the United States where the period is only 1990-97).
3. Extrapolated for given year based on available data from adjacent years.

Source: ARD stroke study, OECD. Two primary sources for the United States: NCHS from the National Center for Health Statistics, and Med. from Medicare data.

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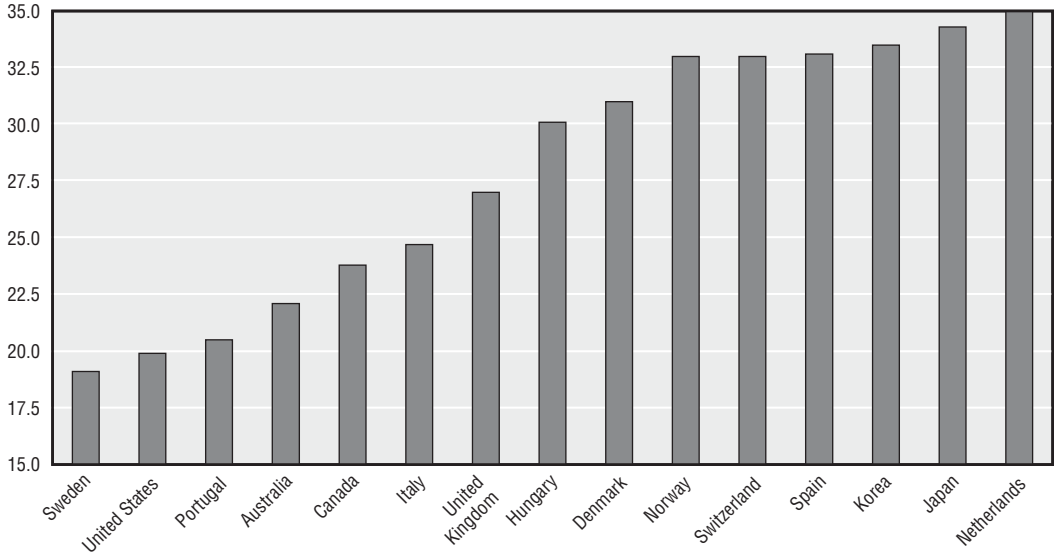
Risk factors

Tobacco smoking and hypertension are the main modifiable risk factors for stroke (Stegmayr *et al.*, 1997). Other risk factors include high blood cholesterol, overweight, heavy alcohol consumption, low socio-economic status, genetic factors, and a number of medical conditions.

Countries included in this study differ substantially both in terms of current smoking rates, as well as those observed in the past. The percentage of the population aged 15 years and over who reported to be daily smokers (Figure 3.2) ranged between about 18 and 35%, with the highest rates found in the Netherlands, Japan, Korea, Spain, Switzerland and Norway. The lowest rates were in Sweden, the United States and Portugal.

Figure 3.2. **Tobacco consumption, 1997-2000**

% population aged 15 years and over who reported to be daily smokers



Source: OECD Health Data 2002.

Hypertension, or high blood pressure, is defined here as persons having systolic blood pressure > = 140 mm hg and diastolic blood pressure > = 90 mm hg. The percentage of the population with hypertension increases with age. For the countries with data available for our study, around 20-30% of males and around 10-20% of females aged in their 40s were classified as having hypertension. In contrast, for people aged in their 70s, the proportions were between 30-60%.

1.2. Treatments

Despite the increasingly global nature of information diffusion in the treatment of stroke, differences remain in the care received by stroke patients (Beech *et al.*, 1996; Wolfe *et al.*, 1999). These may relate to aspects such as underlying population differences in stroke types and severity, differences in practitioner preferences, or differences in health system characteristics. The continuum of care is important for stroke patients, as many receive both acute and longer-term care including rehabilitation and assistance with any resulting disabilities. While each phase in this continuum is important – including prevention, acute care, and ongoing care – data are more commonly available in relation to the acute phase.

The main objective of the disease studies that form the basis of the ARD project was to compare treatment approaches in participating countries. This section therefore includes an overview of the main results found in this comparison, including information on prevention, hospitalisations, the use of stroke units, diagnostic tests, surgical treatments, and drug treatment.

Prevention

Prevention of strokes, as well as prevention of second or subsequent strokes, occur both at the individual level (usually care provided for a patient by a medical practitioner) and at a population level (such as public health programs aimed at particular risk factors). In relation to stroke, an important preventative measure aimed at individuals is the management of hypertension, including through drug treatment. Control of hypertension has been shown to be highly effective in reducing the risk of stroke for all age groups. Population-level preventive measures are aimed at groups of people, rather than individuals. Countries differ both in their involvement in and the approach taken for these population-level measures (see for example, WHO, 2002a).

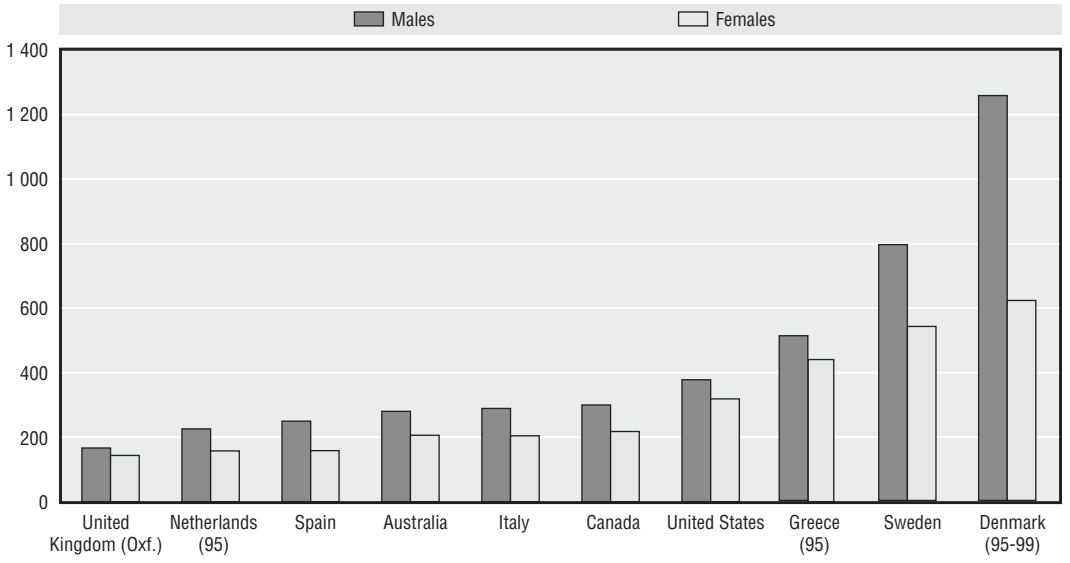
Hospitalisations

The majority of ischaemic stroke patients who do not die at the time of the stroke event are admitted to hospital for treatment. This treatment may include assessment, diagnostic procedures, drug treatment, early rehabilitation, and long-term planning to reduce the risk of further strokes and to provide support if some level of disability remains.

Figure 3.3 shows age-standardised hospitalisation rates for ischaemic stroke where available. There is considerable variation in these hospitalisation rates, with the highest rates observed in the Scandinavian countries, and the lowest rates in the United Kingdom (Oxford), the Netherlands and Spain. There is around a 4-fold difference between these two extremes.

Figure 3.3. **Ischaemic stroke hospitalisation rates,[1] 1997**

Per 100 000 population aged 40 and over



Note: United Kingdom data sourced from the Oxford region only.
1. Age standardised to the European standard population.
Source: ARD stroke study, OECD.

Although not shown, trend data were also available for many of these countries (Moon *et al*., 2003). The hospitalisation rates at the country level in Australia, Canada and the United States appear to have declined in recent years, while the rates in the Netherlands, the United Kingdom (Oxford) and Sweden have remained largely unchanged. However, the rates in Greece and Italy show evidence of having increased over time.

Stroke units

Stroke units (organised, specialist inpatient stroke care) have been demonstrated to result in a positive outcome for stroke patients, both in terms of survival and disability (*Cochrane Review*, 2002; Stroke Unit Trialists' Collaboration, 1997a). In addition, evidence is emerging suggesting that stroke units are also cost-effective (Jorgenson *et al*., 1995; Grieve *et al*., 2000). Stroke units have been shown to benefit a wide range of patients in a variety of ways (Indredavik *et al*., 1999; Jorgenson *et al*., 2000; Stroke Unit Trialists' Collaboration, 1997b).

The studies that have examined the benefits of stroke units have taken steps to use a clear definition of a stroke unit, however a standard definition across studies has not yet emerged. Aspects of the definitions used in some of these studies include multidisciplinary staffing, access to technology such as computed tomography (CT) scanners, organised care in a dedicated unit with dedicated staff, which usually includes both acute and rehabilitation care.

Definitional aspects are an issue when comparing the use of stroke units as demonstrated in the data collection undertaken for this study, and comprehensive data are not available using a specific definition. Nevertheless, it is still valuable to make general comparisons between the use of stroke units in the various countries with data available. Information is available on the use of stroke units in seven of the countries participating in this study, and is summarised in Table 3.2.

Table 3.2. **Available information on the use of stroke units**

		Stroke units (per 100 000)	Stroke unit beds (per 100 000)	% of patients cared for in stroke unit	Comments
Denmark	1998	0.93	10.4		49 hospitals with 550 beds
Netherlands	2000	0.42	1.7		67 hospitals with 268 beds
Australia	1999	0.23	1.8[1]		44 stroke units with defined beds
Sweden	1998	0.78	5.8	70%	SU at 70 of 84 hospitals, 518 beds, % patients cared for in SU rose from 54% to 70% between 1995 and 1998
Hungary	2000	0.15		Approx. 15%	4 SU in 1992, 15 in 2000
United Kingdom				26% at least ½ admission	1999, 45% of trusts had SU
Norway				Approx. 60%	

SU: Stroke units.
1. Estimated from survey data based on hospital size.
Source: ARD stroke study, OECD.

Stroke units are being implemented in many countries. However, the extent to which stroke units are used differs between countries. A crude measure of the supply of stroke units, the number per 100 000 population, shows variation from 0.15 in Hungary to 0.93 in Denmark. The percentage of stroke patients receiving care in a stroke unit also differed markedly between countries, ranging from 15% in Hungary to 70% in Sweden. From information supplied as part of this project, it also appears that the use of organised stroke units is tending to increase over time.

Diagnostic tests and surgical procedures

Diagnostic procedures are used to determine the stroke type and severity, which impact on treatment options. The main diagnostic procedures examined in this study were CT scans and Magnetic Resonance Imaging (MRI). Data were available from seven of the countries participating in the study. The three main points apparent from this analysis on the use of diagnostic tests for ischaemic stroke and Transient Ischaemic Attack[3] (TIA) patients are:

- *Variation between countries:* there is considerable variation in the use of these procedures, both in the percentage of patients receiving the test, as well as in which test is used most often.
- *Increasing use:* there is quite marked increase in the use of CT scans in some cases (such as in Sweden, Australia and Ontario). In addition, the use of MRI has increased substantially in Alberta.
- *Age patterns:* the use of CT scans is generally constant across the age groups. However, MRI are used more commonly in the younger age groups compared to the older age groups.

Carotid endarterectomy (CEA) is used as a preventive measure in some individuals at high risk of stroke or recurrent stroke because of a stenosis of this major artery. Currently, CEAs are not a common procedure in most OECD countries.[4] Of the countries with data available for this study, the United States had the highest number of procedures per population at around 80 per 100 000, followed by Australia at around 60 per 100 000 and Canada with nearly 45 per 100 000. The procedure was used more moderately in Sweden, Norway, Hungary and the United Kingdom, while the procedure was used very rarely in the remaining countries with data available (Spain, Japan, Italy and Korea). Note that the measure used here is relatively crude, and does not take account of differing proportions of populations who are potential candidates for the procedure.

Time trends over five or more years are only available for three of these countries – Sweden, Australia and Canada (Ontario). From these data there is evidence of a gradual increase in the use of the procedure until about the mid-1990s, with the rates remaining stable or perhaps even declining after that. There is no evidence of any dramatic increases in the use of this procedure.

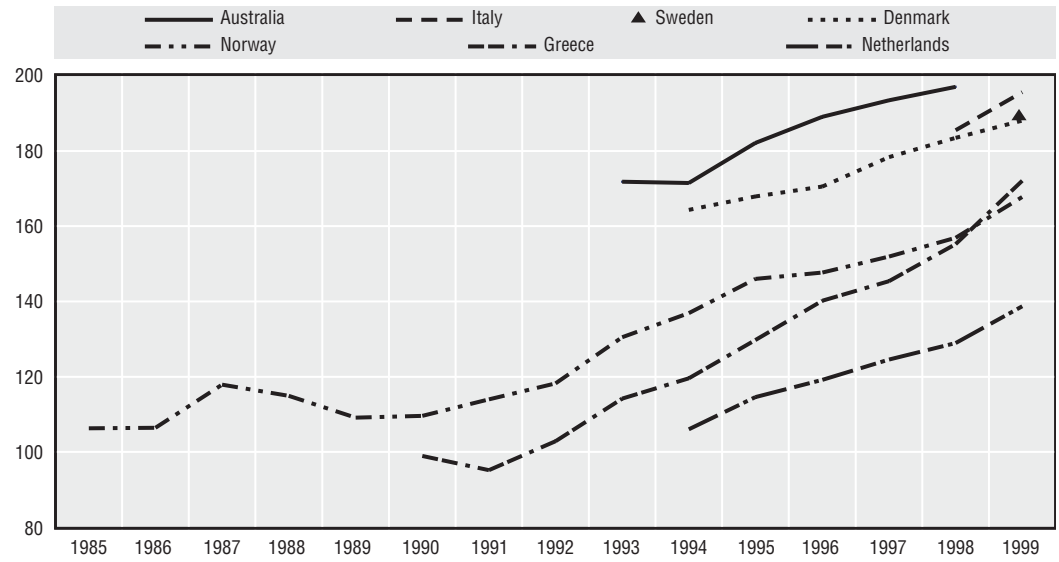
Drug treatment

Drug therapy is significant in the prevention and treatment of stroke. While there are specific drug treatments for stroke such as aspirin or warfarin, data were not available that could isolate the use of these drugs specifically for stroke patients.

Another important drug treatment is the use of drugs to control high blood pressure. The total use of anti-hypertension drugs[5] has been rising steadily in all the countries able to supply drug consumption data as part of this project (Figure 3.4). In Denmark, Norway and Australia, consumption of these drugs rose by between 12 and 15% between 1994 and 1998. In the Netherlands, consumption rose by around 20% during this period, but still remains below that of the other three countries. The largest increase during this period occurred in Greece with a 30% increase. In Italy, consumption rose by 5% between 1998 and 1999, and is now close to the highest rate along with Australia. Sweden (no trend data) and Denmark have the next highest consumption rates.

Figure 3.4. **Trends in the use of antihypertension drugs**

DDDs per 1 000 population per day



Note: DDDs = Defined daily dosage. See *www.whocc.no/atcddd* for more information.
Source: ARD stroke study, OECD.

The percentage share of each of the six types of antihypertension drugs accounted for varied among countries. The drugs most commonly used were diuretics, calcium-channel blockers and ACE inhibitors. Beta-blockers were also relatively frequently used. Countries fell into one of two groups depending on which class of antihypertensives were most commonly used. Denmark, Sweden, Switzerland and the Netherlands used diuretics more than any other class of these drugs. In Norway, Italy, Greece and Australia, ACE inhibitors were most commonly used.

1.3. Health outcomes

After comparing treatment approaches in the participating countries, the next objective was to determine whether there were any variations in health outcomes. A summary of the available information for a subset of the health outcome measures collected as part of the study is presented below. Unfortunately, current restrictions in data availability limit the conclusions that can be drawn on the relationship between treatment variations for stroke and the resulting health outcomes.

Health outcomes can be defined as "those changes in health status strictly attributable to the activities of the health system" (Hurst, 2002). However, available data can rarely disentangle the health system effects from other effects (such as those related to the natural course of the disease, housing, employment, or social services for example). The particular focus here is on outcomes that may be, to some degree, attributable to health care interventions and the quality of the interventions, or the lack of them. Ideally we would like to have outcome measures that cover the following: the risk of stroke (first and subsequent strokes), deaths from stroke, complications from stroke, and functioning levels and health-related quality of life after stroke.

As for most diseases, stroke outcome measures are not widely available on a country basis. The main outcome measures available for this study relate to death rates, measured

as in-hospital or case fatality rates (the percentage of patients who died within certain time periods following admission).

In-hospital fatality

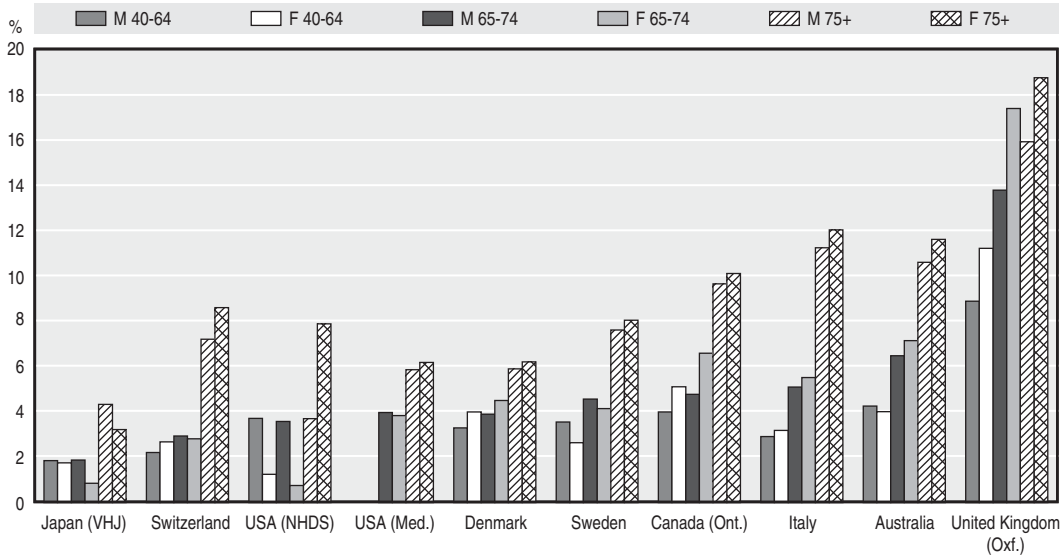
This section deals with the proportion of patients who died in hospital, information which is available as specified for approximately half of the countries involved in this study. Here we present information on case-fatality rates which relate to a distinct period of time: seven days. This provides a measure of the fatality rate in the very acute phase, and represents the number of deaths occurring in the first seven days in hospital as a percentage of all stroke admissions.

Where differences are observed at the aggregate level, it is not possible to determine the causes of these differences from this analysis. The major factor that has not been controlled for is the severity of cases being admitted. As the severity may differ between countries, as well as over time, it is not possible to determine any causal links between the treatment received and the outcome measure. In addition, differing admission practices among countries may also affect the relative comparisons between countries.

The percentage of ischaemic stroke patients admitted to hospital who died within the first seven days of their stay is fairly consistent across most of the countries able to supply these data (Figure 3.5). The main exception is in the United Kingdom (Oxford) where the hospital fatality rates stand out as being higher for all age groups than in the other countries. In most countries, generally around 4-6% of these patients aged between 40 and 64 years died within the first week of their hospital stay. There was more variation in the hospital fatality rates in the oldest age group examined. Approximately 8-10% of these patients died within the first week.

Figure 3.5. **Seven-day hospital fatality rates for ischaemic stroke, 1998**

% of patients who died in first seven days in hospital



Note: Japanese data comes from a subset of tertiary teaching hospitals only. Two primary sources for the United States: NHDS from the National Hospital Discharge Survey, and Med. from Medicare data. Canada data from province of Ontario only, and United Kingdom data from Oxford region only.
Source: ARD stroke study, OECD.

Case fatality

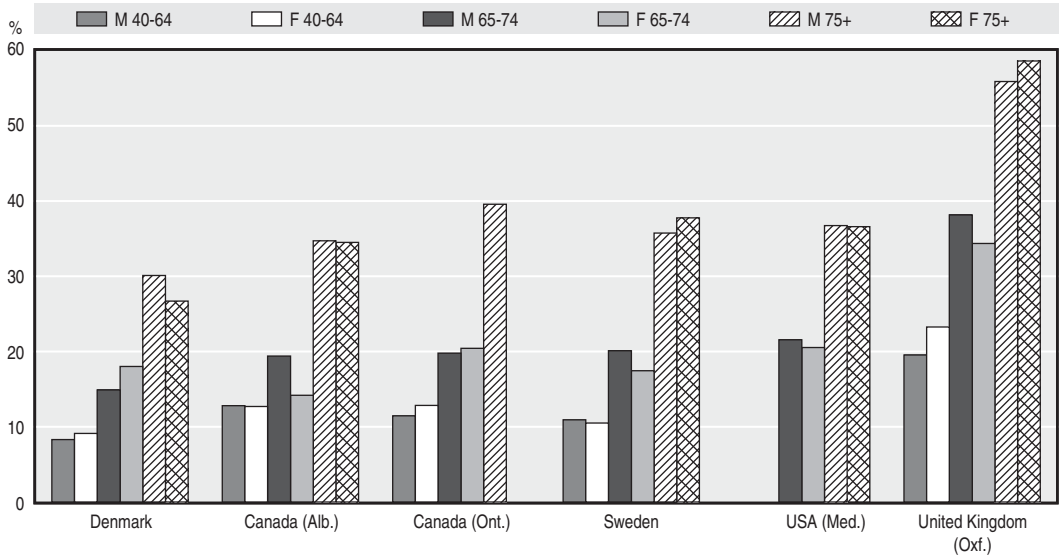
The hospital fatality rates discussed in the previous section do not reflect the total continuum of care which includes treatment and care outside the hospital setting. To do that, we need to also account for non-hospital deaths by using case fatality rates. That is, during a specified period, the number of deaths as a percentage of the number of cases. Case fatality rates are presented here for the first year following initial treatment.

The same cautions in relation to attribution for these outcome measures apply as for the hospital fatality rates. While health care does affect these outcome measures, there will be other influences outside of the health care system. In addition, these outcome measures do not control for casemix or severity of the stroke, thus judgements cannot be made from these data on the relative quality of different health care systems in treating stroke patients.

Figure 3.6 displays the one year case fatality rates, using data from Canada (Alberta and Ontario), Denmark, Sweden, the United Kingdom (Oxford) and the United States (for person aged 65 years and over). Around 10% of ischaemic stroke patients aged 40-64 years died within one year of their stroke, compared to around 30-40% of those in the oldest age group. This represents a risk four times higher in the oldest age groups compared to the youngest. Again, the United Kingdom (Oxford) rates fall outside these ranges demonstrating higher rates that in the other countries. Little difference is apparent between males and females.

Figure 3.6. **One-year case fatality rates for ischaemic stroke, 1998**

% of patients who died within first year following admission



Note: Canadian data from Alberta and Ontario, United States data from Medicare data, and the United Kingdom data from the Oxford region only.
Source: ARD stroke study, OECD.

1.4. Economic aspects of stroke care

As well as examining variations in treatments and health outcomes, it is also important to examine variations in the costs associated with stroke. A summary of currently available information collected as part of this study is provided below. Although data availability limits the assessment of the impact of treatment choices at the country level on costs and outcomes, the long-term aim is to collect information that will allow

more sophisticated assessment of the value for money obtained from different population treatment approaches.

Aggregate expenditure

The health care of stroke patients has significant economic impact in OECD countries. In 1995, the direct health care expenditure on cerebrovascular disease in the United States was over US$20 billion (Hodgson and Cohan, 1999), which is equivalent to 3% of total health care expenditure. Similar information is available for three of the other countries in our study – Canada, the Netherlands and Australia – where between 2 and 4% of total health care expenditure was attributed to the care of stroke patients (Mathers and Penm, 1999; Moore *et al.*, 1997; Evers *et al.*, 1997).

For each of the four countries, the largest share of expenditure was on hospital and nursing home care combined, accounting for at least 70%, and generally between 80 and 90% of total expenditure. Within this category, the United States and Australia spent slightly more on hospitals than on nursing homes, while in the Netherlands nursing home care was almost double that of hospital care. This reflects high expenditure in long-term care provided in nursing homes in the Netherlands (OECD, 1999). The split between hospital and nursing home care expenditure in Canada is not available for cerebrovascular disease.

Length of stay in hospital

It has been shown that, for stroke, length of stay in hospital is a good proxy for direct costs (Jorgenson *et al.*, 1997). This is because expensive high technology is not a significant component of expenditure per patient, and thus staff and other regular daily costs are the main driver of expenditure. Consequently, information on length of stay is included here as a proxy for expenditure on the hospital component of stroke care.

The length of a stroke patient's stay in hospital is dependent on a number of factors, including the severity of the stroke, whether they die in hospital, and whether they received rehabilitation or long-term care whilst in the hospital. Therefore, within a particular health system, there is potential for considerable variation in the length of stay for stroke patients.

It is important to keep in mind that direct comparisons of the absolute length of stay between countries needs to be undertaken with caution due to underlying differences in definitions. Nevertheless, it is still useful to make general observations about patterns in the available data. In general, the majority of means and/or medians of length of stay were around 10-15 days for ischaemic stroke patients. The main country with length of stays longer than this was Japan, where the mean length of stay was around 90 days, which is related to the inclusion of some long-term care in the episode. The countries that are notable for lower lengths of stays are Denmark and the United States (mean around 5-6 days). Over recent years, the length of stay for stroke patients has decreased in all countries with trend data available.

Relative unit expenditure on stroke admissions

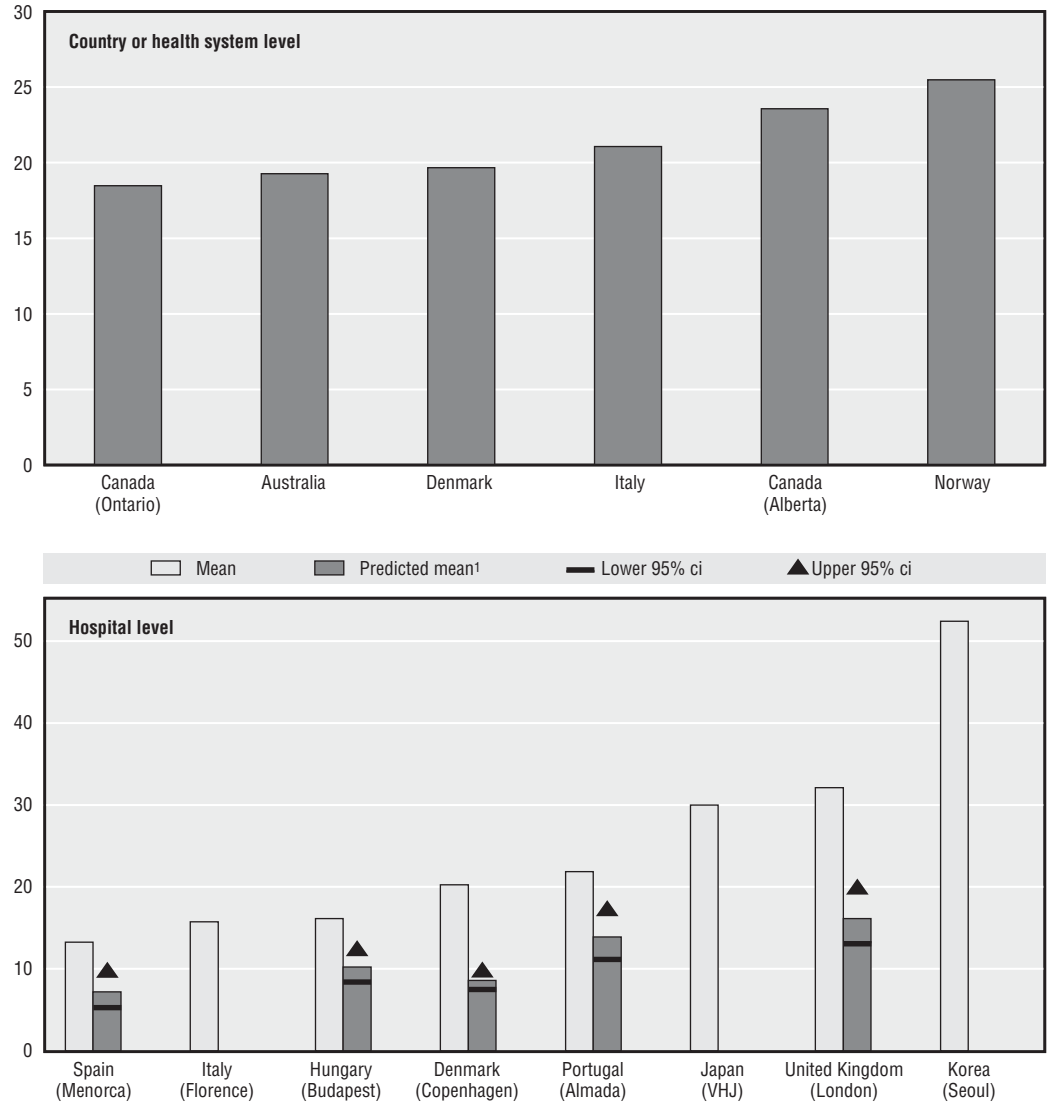
Results from two main types of studies on the expenditure for stroke-related treatment are presented here, distinguished by their scope. The scope of information for the first group is "national" or "system-wide" expenditure assessment for different groups of treatments for stroke. The second group of studies are those from smaller, usually research-based, studies providing information nevertheless related to that from the larger studies.

The measure used here is mean expenditure per treatment bundle ("unit expenditure") expressed as a percentage of GDP per capita. This provides a measure of the unit expenditure relative to an indicator of average income per person. This is therefore a measure of relative expenditure, not absolute expenditure. The measure is referred to in this section as relative unit expenditure.

Information on the relative unit expenditure for ischaemic stroke admissions for four countries and two provinces in Canada is shown in the first panel of Figure 3.7. The relative unit expenditure estimates for ischaemic stroke admissions are relatively constant, ranging between 19% and 26% of GDP per capita. Two countries, Australia and Norway, were able to supply data separately for patients who died in hospital and for those who were discharged alive. In these two cases, little difference was found between the two groups of patients.

Figure 3.7. **Relative unit expenditure for stroke admissions, 1996-99**

% of GDP per capita



1. Predicted mean calculated for constant casemix: for men aged over 74 who were conscious and continent.

Source: ARD stroke study, OECD; and Grieve *et al.* (2001).

The second panel in Figure 3.7 provides similar information sourced from studies with a smaller scope. The majority of these relate to one hospital with the exception of Japan where the data come from nine tertiary level hospitals. Due to these limitations, the data are not likely to be representative of the whole country. For the majority of cases here, the relative unit expenditure is within the same range as for the health system level result in the first panel.

At least some of the variation in the second panel is likely to be due to differences in the casemix in the different sites. For the five results from Grieve *et al.* (2001), we also show the predicted unit expenditure for a constant casemix – for treating a man aged over 74 years who was conscious and continent on admission. This adjustment for casemix reduces the variability from 13-32% to 7-16% of GDP per capita.

1.5. *Policies, incentives and regulations*

Policies, incentives and regulations – whether stroke specific or more general – influence stroke treatment in two main ways: through demand-side and supply-side effects. On the demand side, information on health insurance and cost-sharing were included in the study. On the supply side, data were collected on the supply of relevant specialists, and on the supply of machines used for two of the main diagnostic tests relevant to stroke patients. The key effects are summarised below.

Demand-side

The majority of countries in our survey have universal health insurance coverage, meaning few limitations on access to medically necessary health care exist. Acute stroke care is generally well covered. However, this may be less the case for some ambulatory care treatments, including drugs for primary and secondary prevention, or follow-up treatment such as rehabilitation.

In general, the availability of private health insurance does not have a significant impact on access for most stroke care services, though it may play a significant role in providing coverage for some of these services in Mexico, the Netherlands, Switzerland and the United States. In addition, it may be used to cover services left out of the public health insurance programme such as outpatient drugs, to cover (or partly cover) the co-payment required when a person decides to be admitted as a private patient, or to allow choice of doctor.

Cost sharing for ambulatory care drugs is a frequent characteristic of the health systems compared in this study. In fact, apart from exemptions for various identified population groups within a country, cost sharing is an integral part of insurance coverage for ambulatory care drugs in all the countries included in our study. Thus, the potential impact on the financial burden to patients prescribed ambulatory care drugs for stroke is greater than for non-drug related treatments, especially for the treatment of related risk factors such as hypertension.

Supply-side

Two important supply-side incentives for which we have data are the size of the medical workforce, and the supply of machines used for diagnostic tests.

In relation to the supply of doctors, our analysis included a comparison of the number of neurologists in our participating countries. Italy has by far the largest number of neurologists with 10.4 per 100 000 population, but these may include many non-practising

physicians and neurologists who are in reality practising as general practitioners. Excluding Italy, Denmark has the largest number of neurologists per 100 000 (4.6) in 1999, followed by the Netherlands. Hungary and the United Kingdom have the lowest number of neurologists, 0.4 per 100 000 population, likely reflecting the lower spending on health care of these two countries. These figures need to be treated with caution since the definitions of neurologists varies significantly across countries.

Computed tomography (CT) scanning is the older of the two diagnostic technologies we examined in this study. Japan (71.8), Australia (23.9) and Korea (22.1) are the only countries with more than 20 scanners per 1 000 000 population (based on data from the late 1990s). Waiting for CT scans was not identified as a problem in any of these countries, which is expected given the number of scanners relative to other countries. Mexico had the lowest number of CT scanners per 1 000 000 population (2.0), which is likely a reflection of its lower per capita income.

Magnetic Resonance Imaging (MRI) is a newer diagnostic technology. The countries with the greatest number of MRI scanners per 1 000 000 population are Japan (18.8), Sweden (8.0), United States (7.6) and Switzerland (6.9). The United States and Switzerland are the richest countries in the study in terms of per capita income, so they may be early adopters of this relatively new technology which may help to explain why they have more machines than most other countries (Slade and Anderson, 2001; TECH, 2001). However, this does not explain why Japan or Sweden, two countries with lower per capita incomes have more MRIs per capita than the United States or Switzerland. Nor does it explain why Canada, with the fourth highest per capita income respectively of the countries included, has the fourth lowest number of MRIs per capita. However, it was reported in this study that waiting times for MRIs in Canada is a significant problem.

2. Discussion

The primary goal of the ARD study is to determine whether there are treatment variations among countries, and further whether these are related to differing policy approaches and economic incentives. A second area of focus is to examine the implications of any treatment variations in terms of costs and health outcomes. This section provides a discussion of the results of the stroke disease study in relation to these two broad goals.

Here we highlight the main policy-relevant relationships among treatments (interventions), costs and outcomes. The context of the discussion here is exploratory rather than conclusive. Within this section, a number of examples are given based on the data for males only, and at times for only a subset of the age groups included in the analyses. The use of examples based on a subset of the study data is undertaken to simplify the discussion.

The key issues identified through the combined analysis of all components of the stroke study – including literature review, data collection, and submissions from country experts – are twofold. Firstly, the importance of a broad-based policy for stroke care, that includes a focus on prevention as well as the treatment phase, has been identified. And secondly, the organisation of care within the treatment (and particularly acute) phase is a significant component of quality care, notably through the use of specialised stroke units. The policy implications of these themes are relevant to both public health policy (prevention) and the design and operation of the treatment phase. Both of these findings relate to the co-ordination and organisation of health systems over the whole continuum of care. This is

in contrast to the main issues identified in the breast cancer and ischaemic heart disease components of the ARD study where use of technology in screening and treatment were dominant policy issues (see contributions by Hughes and by Moïse, Part I in this volume).

2.1. Policy perspective on treatment variations

Are there variations in stroke prevention and treatment?

This study has reported substantial variations in the treatment and care of stroke patients in the 17 countries included in the study. These variations occur over the whole continuum of care. Firstly, in the area of prevention, countries differ in their approaches, emphasis and success in reducing the risk of stroke through one of its major determinants: tobacco smoking. Secondly, the use of hospitalisation for stroke patients varies among countries, particularly in relation to TIA patients. Thirdly, the organisation of stroke care within the inpatient setting also varies, the main issue being the use of stroke units. Fourthly, there appears to be variation in the use of technology for stroke patients, demonstrated through the use of the surgical procedure carotid endarterectomy. And finally, drug treatment for another key risk factor, high blood pressure, varies both in volume of use and in the types of antihypertensive drugs used.

The interpretation of these variations is not straightforward. Notably, levels of use are affected by the underlying rates of the disease, which determine the clinical "need" for treatment. Ideally, measures of incidence (new cases) or prevalence (all cases at a particular point in time) would provide a good indication of need in each country. However, consistent incidence or prevalence data were only available for approximately half of the countries in our study.

Management of risk factors

Tobacco smoking is one of the major risk factors for stroke. While it is acknowledged that countries with high proportions of smokers are likely to have a resulting effect on stroke incidence and prevalence rates, it is also useful to examine the success of countries in reducing the numbers of smokers in their populations.

As an indication of the recent success of countries in lowering population risk from smoking, countries were grouped based on the percentage reduction in the proportion of male and female smokers between 1990 and 1995 (the choice of these years was determined by data availability). In general, Denmark and the United States have been relatively more successful in reducing smoking, though smoking rates in Denmark are still quite high compared to other countries in this study. The other Nordic countries in the study (Norway and Sweden), Australia, Canada, the United Kingdom, and Switzerland have had moderate success in reducing smoking compared to other countries. The Mediterranean countries in the study (Greece, Portugal and Spain), the two Asian countries (Japan and Korea) and the Netherlands have had small reductions or even an increase. Combined with low reductions, high levels of smoking remain in Korea, Japan, Greece and the Netherlands, making this risk factor a significant issue in these countries.

Use of stroke units

A key issue for the care of stroke patients is the organisation of care, notably with the use of inpatient stroke units, with the general characteristic of specialised, multidisciplinary care in a dedicated setting. As indicated earlier, the availability of data on

the use of stroke units in different countries is currently limited. Nevertheless, it is apparent that the use of stroke units varies among the countries in our study.

Despite their proven efficacy in treating stroke patients, few guidelines exist regarding the planning, establishment or utilisation of dedicated stroke units. Where guidelines do exist, they are at times local rather than national guidelines. Furthermore, for the most part stroke units are not yet considered an important component in the operation of acute care hospitals in the sense that coronary care units are in treating acute myocardial infarction.

If stroke units are as effective as studies indicate then why are they not a part of the regular organisation of hospitals? There are several possible explanations. First, it may be a matter of definition. There is no standardised definition of what constitutes a stroke unit, apart from a common understanding that a stroke unit is a pool of dedicated human and technological resources used in the treatment of stroke. The definition of a stroke unit differs from country to country; even within countries different definitions are found. There are at least two consequences of not having a standard definition for a stroke unit. The first consequence may simply be that the number of stroke units are underestimated or overestimated in some countries. The other consequence is that it complicates the planning process for creating stroke units. If a standard definition of a stroke unit is not available, then it is likely that health care planners will be reticent about establishing stroke units.

A second possible explanation is that the use of stroke units is still evolving, with some countries further along in the standard use of stroke units compared to others. In the 1970s it was recognised that organised stroke care, from acute care to rehabilitation could result in beneficial outcomes for stroke patients (Indredavik *et al.*, 1999). Since then the development of stroke units has been relatively slow to take root. It is only within the last few years, as evidence continues to mount supporting the efficacy of stroke units, that we have witnessed a significant growth in stroke units, particularly in the Scandinavian countries. It is likely that the number of stroke units will continue to grow as the evidence base regarding their efficacy continues to grow.

A third possible explanation is the lack of an established evidence base (Wolfe, 2001). Wolfe states that practice in the United Kingdom, focuses on "evidence from clinical trials and meta-analysis", which is in contrast to mainland Europe which puts more emphasis on "physiological observation and so called common sense". If the proliferation of stroke units in the United Kingdom has been retarded by a lack of trial evidence, and this applies to other countries as well, than this may possibly explain the lack of stroke units. However, as evidence appears to be mounting supporting the efficacy of stroke units (for example *Cochrane Review*, 2002), this explanation is likely to be less of an issue in the future.

From the information provided as part of this study, variation in the level of use of stroke units does appear to exist between countries. The adoption of this approach for the care of stroke patients has occurred earlier and faster in countries with more integrated[6] models for delivery of hospital care, notably the Scandinavian countries. These countries tended to have integrated models for delivery of all hospital care, in contrast to some countries that have integrated care for public hospitals and contracted care in private hospitals, and others that have contracted care for all hospital services. It is possible that the integrated approach facilitates earlier adoption of different models of care, of which stroke units are an example. This theory needs to be validated with more data from a wider range of countries before a definitive observation can be made.

The decision to hospitalise

Also relevant to the organisation of care is the use of hospitalisation in relation to stroke. We found that, where data were available, there appears to be quite a strong link between hospitalisation for ischaemic stroke and the corresponding incidence rate for countries (Moon *et al*., 2003). However, we expect that there may be more of a discretionary element around the decision to admit patients with TIAs to hospital. Therefore it is possible that different approaches in relation to hospitalising TIA patients may reflect differing policies and incentives among countries. It is also possible that there is variation among countries in the diagnosis rate of TIAs, as it is a condition that may not always be identified.

The ARD stroke study has found evidence of variations in hospitalisation for TIA patients which appears to be related to differing incentives and policies. To illustrate this point, data are presented in Figure 3.8 showing the relationship between hospitalisation rates for ischaemic stroke compared to those for TIA. If there was no variation due to the discretionary element in the decision to admit TIA patients, we would expect to see a direct relationship between the two hospitalisation rates. Countries with higher relative incidence of stroke (and thus higher hospitalisation for ischaemic stroke) would be expected to have relatively high incidence and hospitalisation for TIA. This expected relationship appears to exist fairly well for younger patients (aged 40-64 years), but not for older patients (aged 75+ years). This suggests that some countries are more likely than others to admit TIA patients to hospital. That is, they have more TIA admissions per stroke admission compared to other countries. These countries are represented on the graph as those above the average ratio lines.

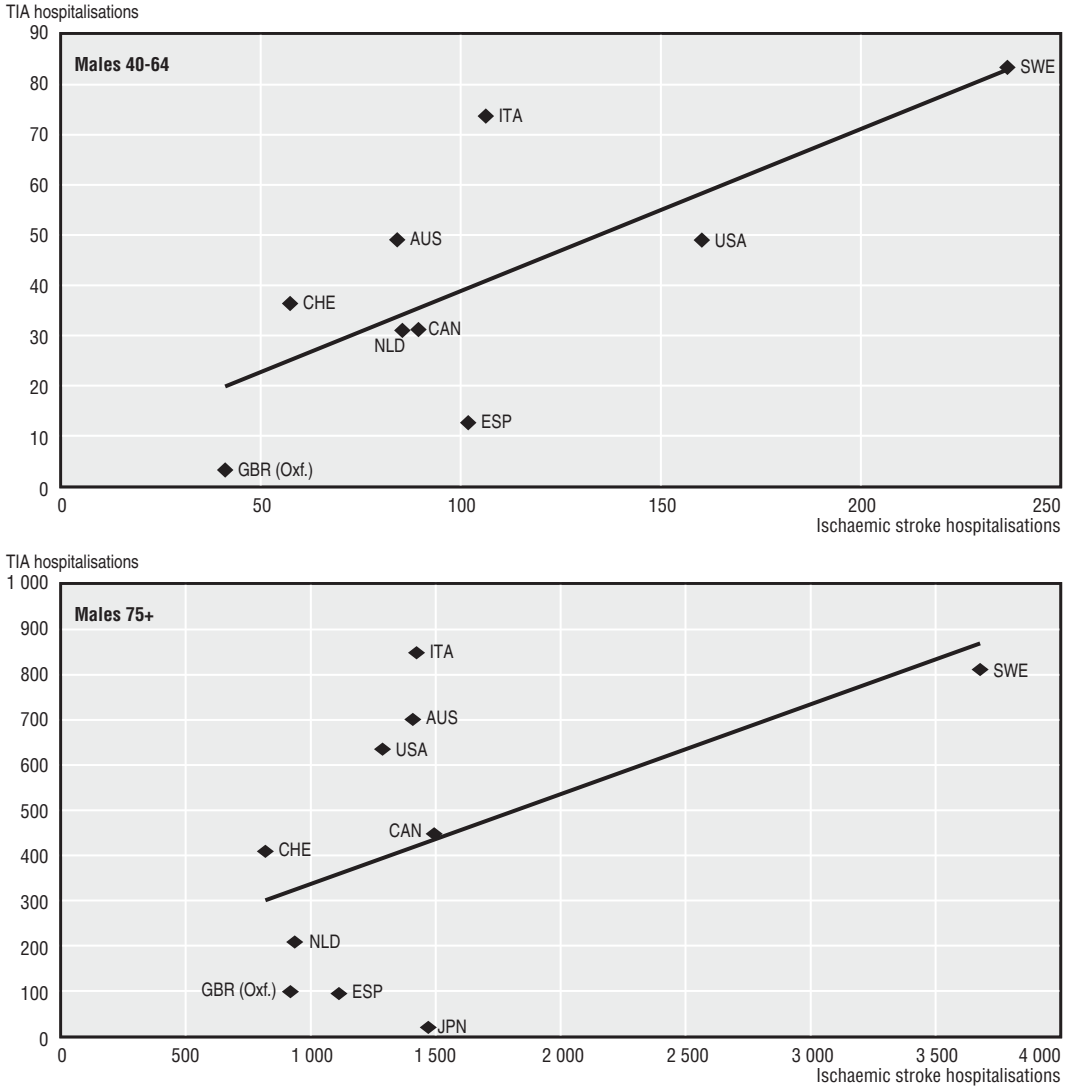
In both age-group graphs, the countries with higher TIA hospitalisation rates relative to their ischaemic stroke hospitalisation rates are also those with less constraints on hospital financing and payments (for example, fee-for-service type systems rather than global budgets). These countries "above the line" for the younger age group are Italy, Switzerland and Australia. These countries also appear "above the line" for the older age group, also joined by the United States. Countries "below the line" include the United Kingdom (Oxford), Netherlands and Spain, countries with stronger constraints on hospital payments. This link between supply-side constraints and utilisation rates has also been demonstrated in the Ischaemic Heart Disease component of the ARD study.

Use of technology

Carotid endarterectomy (CEA) is a surgical procedure used for only a very small proportion of individuals at risk of stroke. The measure of CEA use reported in this study is the number of procedures per 100 000 population aged 40 years and over. Hence, this measure does not control for the relative levels of the disease, which we know does vary among countries, thus resulting in differing levels of clinical "need" for the procedure. Nor does it control for the proportion of these individuals at risk of stroke who are appropriate candidates for CEA. It is surprising, however, that the countries that have the highest usage of the procedure – the United States, Australia and Canada – are also the countries with relatively low incidence rates. The study has not found a link between the existence of specific guidelines/policies and the variations in the use of the procedure, partly due to lack of information. However, the existence of variation in guidelines for the use of CE suggests that there is again a discretionary element in the use of the procedure. The variation in use of the procedure does not appear to be related to either clinical "need" or economic incentives. It could be that practice variation exists among countries, with physicians in some countries more likely than those in other countries to use surgical intervention.

Figure 3.8. **Hospitalisations for ischaemic stroke and TIA, 1998-99**

Per 100 000 population



TIA: Transient ischaemic attack.

Note: The estimated linear regression lines have been included to differentiate those countries with higher rates of TIA admission to ischaemic stroke admissions (those countries "above the line") compared to other countries. US data comes from the National Hospital Discharge Survey. United Kingdom data comes from the Oxford region only.

Source: ARD stroke study, OECD.

2.2. Link between treatment variations, health outcomes and costs

Health outcomes and policies

Using the health outcome measures collected in this study – hospital and case fatality rates for ischaemic stroke patients – the 11 countries can be qualitatively grouped as follows:

- Low fatality rates: Denmark, Sweden, Switzerland, Japan.[7]
- Medium fatality rates: Norway, United States, Australia, Canada, Italy, Spain.
- High fatality rates: United Kingdom.

Comparable data were not available for the following countries:

- Portugal, Hungary, Korea, Mexico, Netherlands, Greece.

As these health outcome measures do account to a large degree for differing incidence and prevalence rates by reporting the proportion of hospitalised patients who died, they can therefore be viewed as general measures of effectiveness. Importantly however, these measures do not account for differences in the severity of stroke cases. Thus, if the casemix for any country is more severe than in others, this is not controlled for in the results presented here.

A recent multi-centre study that examined stroke outcomes (mortality and disability) in 12 sites and seven European countries reports results relevant to our discussion (Wolfe *et al*., 1999). The first aspect to note is that the ranking of health outcomes measures in that study match those found in the ARD study (for the overlapping countries). Further, the study was also able to adjust for casemix (severity) differences. It was found that there were significant differences in severity among centres, though it is not apparent whether this was due to differing hospital admission practices, or other factors. From their analysis the authors conclude that, even after controlling for severity, there are true differences in outcomes. However, the aspects of care that need to be altered in order to realise the residual potential for health gain were not clear.

Of particular interest in the Wolfe *et al*. study were the results from the United Kingdom, given the relatively high fatality rates found for that country in the ARD study. The results from Wolfe *et al*. show that cases were more severe in the United Kingdom compared to other countries. However, after controlling for these differences in severity, the centres in the United Kingdom still displayed worse outcomes than for the other centres in the study. This implies that some, but not all, of the difference between outcomes in the United Kingdom and other countries is due to a casemix differences.

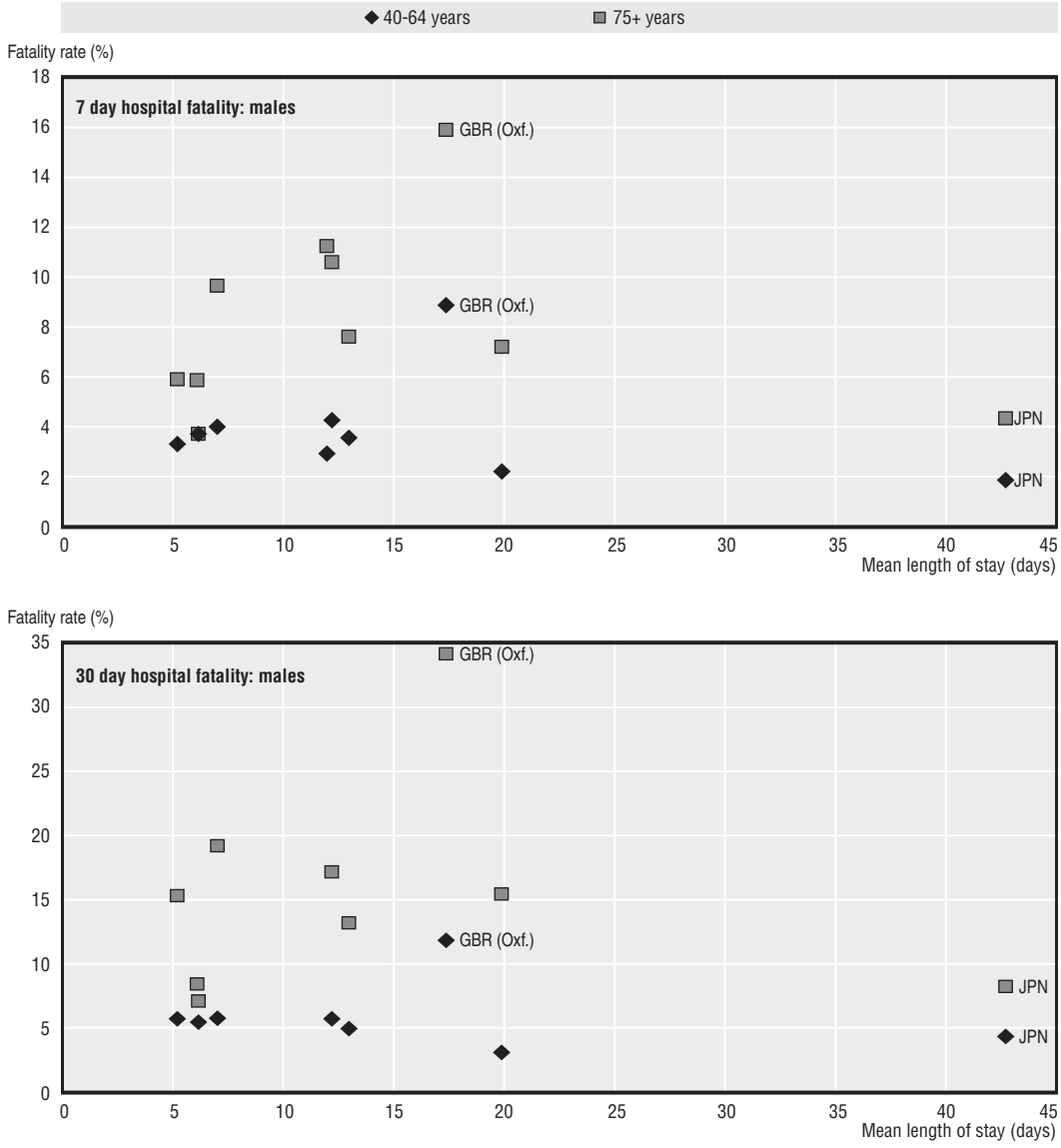
The final issue in relation to health outcomes is their relationship to variations in the use of stroke units and technology. Given the demonstrated importance in the research literature of the organisation of stroke care through the use of stroke units, it would have been of interest to be able to compare the use of stroke units to our health outcome measures. However, this was not possible as part of this study, due to the relatively small amount of currently available data on stroke units. In addition, again due to limitations in the data, the analytical component of this study was not able to investigate the relationship between technology use and health outcomes.

Costs and outcomes

It has been demonstrated that for stroke, there is a strong relationship between length of stay in hospital and total expenditure for the hospital admission (Jorgenson *et al*., 1997). This is due to the fact that, for ischaemic stroke patients in particular, use of high technology is not a large component of the care, resulting in total costs being largely driven by staff costs. Therefore, by using length of stay as a proxy for expenditure, we have corresponding data for almost all the countries in our study. The strong relationship between length of stay and expenditure may not always hold (for example there are large differences in unit costs between countries), but nevertheless this proxy can be used as a general indicator of expenditure.

The critical relationship we wish to examine is between expenditure and health outcomes. Figure 3.9 displays this relationship using length of stay against 7-day and 30-day hospital fatality rates. From these graphs there appears to be a weak relationship between these two variables, with increasing length of stay being associated to some degree with lower fatality rates. The United Kingdom is the very prominent exception, having much

Figure 3.9. **Length of stay and hospital fatality rates, 1998-99**



Note: United Kingdom data relates to the Oxford region only.
Source: ARD stroke study, OECD.

higher fatality rates given the level of expenditure proxied by length of stay. Even if the actual expenditure levels in the United Kingdom were much lower than proxied by length of stay, the United Kingdom would still be well above the other countries, indicating relatively high fatality rates per unit expenditure. Note however the earlier discussion on the effect of severity differences when comparing the fatality rate results. Although evidence appears to suggest that severity differences only partly account for the higher fatality rates in the United Kingdom, questions still remain around the comparability of the United Kingdom data to that from other countries in our study.

Further evidence relevant to this relationship between costs and outcomes is available from a multi-country European study undertaken by Grieve *et al.* (2001). This study used health outcome measures taking into account both the death and disability components.

In this study it was found that the rankings of countries based on health outcome results, after controlling for severity and differing input costs, matched that of the country rankings for costs in most cases. Thus, in most cases increasing costs were associated with better health outcomes. The main exception to the observed relationship was again in the United Kingdom. The authors concluded that spending more on stroke care does not necessarily improve outcomes, but instead careful consideration needs to be given to using the resources in a cost-effective way.

The general conclusion that can be drawn from evidence both in the literature and coming from the ARD study is that there appears to be some relationship between use of resources and health outcomes. However, while there is general evidence to support this, there are a number of important exceptions. This implies that it is not only how much is spent on stroke care that is important, but also how the money is spent. Further research is required to determine which are the most cost-effective treatments for stroke patients.

3. Summary and conclusion

Results from the stroke component of the ARD study provide evidence of differences across countries in the epidemiology of stroke. Countries were found to differ in the prevalence of various risk factors and in the incidence of stroke. Levels of ischaemic stroke mortality vary, as do the trends in mortality rates over time with some countries displaying declining mortality rates and others steady or increasing rates. Countries also vary in hospitalisation rates and in the use of stroke units, diagnostic and surgical treatments, and drug treatments. Some variation across countries in levels of expenditure on stroke care was also documented.

A definitive examination of the nature and extent of the relationship among stroke treatments, spending, and health outcomes was beyond the capacity of the current study, although an initial exploration was undertaken to provide a foundation for future work. From the results of this study complemented by the research literature, the current consensus is that it is not necessarily how much is spent that is important, but how it is spent.

In addition to describing cross-country differences in various aspects of stroke care and outcomes, this study has shed some light on the implications of those differences. The qualitative and quantitative information collected, viewed alongside results in the literature and the opinions provided from the experts advising this study, revealed two broad implications for stroke management. Firstly, there appears to be a need for a broad-based approach to managing stroke in OECD countries that addresses all aspects of the care continuum including prevention, acute care, and rehabilitation. Secondly, within the actual treatment phase, the use of stroke units appears to be important. In addition, the study suggests that the use of stroke units is still developing in many countries, and thus is a potential area where further benefits may still possible.

This study represents an important contribution to developing policy-relevant evidence on the management of a key disease for OECD countries. But it is also important to recognise that we are still at a relatively early stage in building the evidence based on cross-national comparisons. While a significant amount of new data has been collected that has enabled some general conclusions to be drawn, significant scope still remains for improving the evidence base. In collecting the quantitative information for this study, key areas identified where data improvement is still needed include the care setting (such as in stroke units), non-fatal health outcomes (such as disability-related measures), and further information on expenditures and costs. As well as improvements to redress these

deficiencies to achieve comparable data from a reasonable number of countries, there is a significant gap in information on the severity of cases, though the best way to fill this gap is not clear at this stage. It was also observed that the countries and/or regions within countries that were able to supply the most useful information did so with the use of data linkage within and between health information systems.

In conclusion, this study is an important step in the development of cross-national health information relevant to policy makers. It provides new results on stroke epidemiology, treatment, costs and outcomes, as well as a review of the policy approaches relevant to stroke care. Further, taken together with the other two disease studies in the ARD project, it contributes to important lessons about health system performance at a broader level. It is important, however, that information and evidence continue to develop in the future to improve the evidence basis for informed decision making that is available for policy makers in the national administrations.

Notes

1. Further information on the background and methods used can be found in the introduction to the study (Jacobzone, see Part I in this volume).
2. The subset of stroke, ischaemic stroke, was chosen as the focus of this study in order to increase the homogeneity of the cases and thus increase the validity of the comparisons. Ischaemic stroke also accounts for a large proportion of strokes (around 80%), and thus the largest proportion of direct expenditure on stroke care. These types of stroke also tend to be more amenable to treatment. The International Classification of Disease codes (Version 9) used in this report to define "ischaemic stroke" are 434 and 436.
3. A "temporary" stroke event.
4. For example, in the United States in 1999 there were 4 times as many coronary bypasses and 8 times as many coronary angioplasties, as there were CEAs. In Australia and Canada there were 4-5 times as many of these two coronary procedures as there were CEAs (OECD, 2002).
5. Which includes antihypertensives, diuretics, peripheral vasodilators, beta-blocking agents, calcium-channel blockers, and ACE inhibitors as defined in the Anatomic Therapeutic Chemical (ATC) classification (see *www.whocc.no/atcddd* for information).
6. Integrated models are defined in OECD (1994) as those where the same body asks as both purchaser and provider, in contrast to contracted models.
7. For a subset of tertiary-level hospitals only.

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PART I

Chapter 4

Summary of Results from Breast Cancer Disease Study*

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Abstract. *Breast cancer is the one of the most common cancer sites for women across OECD countries. Despite widely published and generally accepted results of clinical trials, OECD countries vary considerably in standards of treatment care for breast cancer and five-year survival rates, particularly for older people. Determinants of these variations in care and outcomes are not well understood. This paper begins to explore the possible impact of clinical, economic and regulatory factors on patterns of breast cancer care and survival rates across countries.*

* This work has benefited from the collaborative work of a network of experts. The ARD study was supported by grants from the US National Institute of Aging (Y1-AG-9363-9364) and the Japanese Ministry of Health, Labour and Welfare.

Introduction

There is growing concern that we do not completely understand how health care systems are performing in return for the level of human and financial investments made in them. While much of our understanding is based on an abundance of studies comparing aggregate spending on health care as a measure of resources and life expectancy or potential years of life lost as outcome measures, these are often inadequate for understanding a health care system's performance. The OECD embarked on answering this question through a trio of micro-level, disease-specific studies focusing on Ageing-Related Diseases – one of which is breast cancer.

Breast cancer is the most common cancer site for women across OECD women and the incidence rate of breast cancer has been increasing steadily, particularly for those women over 50 years of age. There exists variation in standard of care treatment for breast cancer across countries, despite published results from clinical trials. There is also marked variation in five-year survival rates from breast cancer on an international level. These differences in treatment patterns and outcomes are significant among the older populations across the OECD. Along with a variety of clinical factors, economic and regulatory factors may be contributing to the different patterns of care and outcome rates that exist across countries.

Two other studies have examined this topic. The first study by the McKinsey Global Institute examined variations in productivity at a disease level and recent trends to variations in incentives and supply constraints for three countries (Germany, the United Kingdom and the United States) (Baily and Garber, 1997). Baily and Garber found that differences in productive efficiency between the US and UK were inconclusive in terms of care for breast cancer; however, the UK did devote fewer inputs for lower outcomes. Screening, in particular, had an effect on the differences in input consumption and overall productive efficiency. In addition, McClellan presents cross-national estimates of differences in high technology related treatment rates that are closely linked to supply side incentives in countries' health care systems (TECH Research Network, 2001). A team of European and US researchers have also explored trends in rates of survival in American and European Cancer patients (Gatta *et al*., 2000). They found the survival rates to be higher in the United States than in Europe, particularly for those cancers, such as breast cancer, where treatment and screening can make a difference.

To examine the possible impact that differences in incentives related to regulatory and economic constraints may have on patterns of breast cancer care and survival rates across countries, we conducted a qualitative and quantitative study of 13 OECD countries. We compiled information on a country's health care system as it relates to breast cancer and registry and/or linked administrative and registry data on treatment and outcomes. We focused primarily on the use of breast-conserving therapy and mastectomy for breast cancer treatment. We then sought to explore whether variations in economic and regulatory factors in the health care delivery and financing systems could explain any differences in treatment use and outcomes.

1. Cross-national patterns of breast cancer care

As part of this study, treatment data were obtained using either administrative, cancer registry or linked registry-administrative datasets from the following countries: Belgium, Canada, Canada (Manitoba and Ontario), France, Italy, Sweden, United Kingdom, and the United States. Registry data collect surgical therapy up until 6 months post diagnosis, but radiation therapy data needs to be interpreted with caution since it is difficult to obtain treatment information if the patient received radiation therapy outside of the hospital setting. Between 1980 and late 1990s (year when most recent data was available), treatment data are presented as: 1) proportion of women receiving *mastectomies* as their definitive surgery; 2) proportion of women receiving *breast conserving therapy* (BCS) as their definitive surgery; and 3) proportion of women receiving *breast conserving therapy and post operative radiation therapy* (RT after BCS) according to current standard of care recommendations.

1.1. *Breast conserving therapy with radiation therapy vs. mastectomy*

In 1985, randomised controlled trials published in the medical literature reported that most women who were diagnosed with early stage breast cancer could avoid mastectomy by undergoing BCS plus radiotherapy. Both types of treatment demonstrate similar local recurrent-free and overall survival rates, while BCS allows for preservation of the breast (Fisher *et al.*, 1985; Veronesi *et al.*, 1981).

The proportion of women over 40 who receive breast-conserving surgery compared to mastectomy as primary surgical treatment varies dramatically across countries (Table 4.1). Proportion of women receiving mastectomies ranged from above 75% of women diagnosed with breast cancer in Japan and Norway to about 20% in the United Kingdom. Uptake of

Table 4.1. **Proportion of women diagnosed with breast cancer and received type of treatment**

	Breast conserving surgery		Mastectomy			Breast conserving surgery and radiotherapy			
	As a proportion of women diagnosed with breast cancer					As a proportion of women receiving breast conserving surgery			
	1985-87	1990-93	1995-97	1985-87	1990-93	1995-97	1985-87	1990-93	1995-97
Belgium	n.a.	46	64		61	53	n.a.	n.a.	90
Canada[1]	39	46	43	54	49	39	n.a.	n.a.	n.a.
Canada (Manitoba)	39	57	70	76	71	55	80	74	74
Canada (Ontario)[2]	34	43	54	45	39	31	45	67	76
France	n.a.	58	65	n.a.	35	32	n.a.	95	93
Italy	n.a.	31	n.a.	n.a.	62	n.a.	n.a.	57	n.a.
Japan[3]	1	7	22	98	90	77	n.a.	n.a.	n.a.
Norway	n.a.	23	24	n.a.	78	76	n.a.	n.a.	n.a.
Sweden	n.a.	29	43	n.a.	62	48		81	60
United Kingdom (England)	35	49	47	31	22	23	78	70	72
United States	26	40	51	69	55	43	64	68	69

1. For the 1995-1997 data, breast conserving surgery number is underestimated since day surgeries are not included.
2. For the "Breast conserving surgery and radiotherapy" column only: one clinic with incomplete radiation treatment information was excluded; it represents the number of women diagnosed with breast cancer, receiving a breast conserving surgery and a radiotherapy as a proportion of *only* women *diagnosed with breast cancer.*
3. Crude proportion for breast conserving surgery and mastectomy; standardised for breast conserving surgery and radiotherapy.

Source: Data collected by the experts in the countries participating in the breast cancer part of the ARD study.

breast conserving surgery was faster in France, Belgium, and United States – where BCS was the treatment of choice for more than 50% of women diagnosed with breast cancer in 1995. Japan and Norway clearly have adopted BCS at a slower rate than other countries, with only 20% of women diagnosed with breast cancer receiving BCS.

The proportion of women 70 years and older receiving BCS was lower than younger age groups in the countries included in this study (Table 4.2). Clearly, younger women are more likely to receive breast conserving surgery treatment. The gap between younger and older age groups' utilisation of BCS varies widely across countries. Belgium, Canada, France, Italy, Norway, and United States all observe slightly lower levels of BCS utilisation in the older age groups, starting at 70 to 79 years of age, in comparison to the younger age groups. A more significant drop in BCS utilisation across older age groups is evident in Sweden and the UK. Women who are 80 years and older in Sweden and the UK tend to be twice less likely than women 70 to 79 years to receive BCS (about 15% *vs.* 30%, respectively) in 1994-95.

Table 4.2. **Women receiving breast conserving surgery as a percentage of women diagnosed with breast cancer**

	Age 40-49	Age 50-59	Age 60-64	Age 65-69	Age 70-79	Age 80+
Belgium (1997)	67	69	64	59	51	44
Canada (1995)	45	45	42	42	38	29
Canada Manitoba (1995-98)	71	75	67	71	62	54
Canada Ontario (1995)	53	56	56	53	51	44
France (1997)	66	71	65	65	53	39
Italy (1990-91)	38	26	31	26	21	21
Norway (1995)	26	30	19	17	13	23
Sweden (1994)[1]	49	51	43	n.a.	32	13
United Kingdom – England (1995)	56	56	55	45	34	14
United States (1995-97)[2]	n.a.	54	52	50	48	43

1. Sweden estimates for 60-64 years reflect 60-69 years.
2. United States estimates are not available for 40-49 years.

Source: Data collected by the experts in the countries participating in the breast cancer part of the ARD study.

One notable difference in surgical treatment rates is in the UK where both mastectomy and BCS rates for older women of age 80+ are at much lower levels than other countries (Tables 4.2 and 4.3). Mastectomy rates tend to increase with age across countries; while the UK reports rates around 10% for those over 80 undergoing a mastectomy. While most countries show a wide age differential in use for BCS, across both younger and older age groups, the UK has one of the lowest levels of BCS use with only 15% receiving the procedure. Surgery in older patients may be discouraged in the UK, while there might be a greater reliance on tamoxifen to control breast cancer in advanced ages.

Use of adjuvant breast RT after BCS varies across countries – ranging from 57% in Italy to 95% in France between 1990-97 (Table 4.4). Lower rates of RT after BCS in some countries suggest that many women are not receiving radiation, despite recommended standards of care. Women who choose BCS over mastectomy usually understand that they must proceed with post-operative radiotherapy to achieve equal survival benefits with mastectomy, and therefore, have already taken into account if RT is not readily accessible or contraindicated. Therefore, the level of receipt of RT after BCS likely reflects more the issue of quality of care rather than the issue of patient preferences.

Table 4.3. **Women receiving a mastectomy as a percentage of women diagnosed with breast cancer**

	Age 40-49	Age 50-59	Age 60-64	Age 65-69	Age 70-79	Age 80+
Belgium (1997)	52	46	51	57	62	66
Canada (1995)	39	39	40	39	42	40
Canada Manitoba (1995-98)	57	50	57	57	57	42
Canada Ontario (1995)	33	30	29	31	33	29
France (1997)	31	26	32	33	43	49
Italy (1990-91)	56	69	58	67	68	47
Norway (1995)	74	70	81	83	88	77
Sweden (1994)[1]	47	45	51	n.a.	60	58
United Kingdom – England (1995)	24	21	22	22	25	11
United States (1995-97)[2]	n.a.	42	43	45	46	42

1. Sweden estimates for 60-64 years reflect 60-69 years.
2. United States estimates are not available for 40-49 years.

Source: Data collected by the experts in the countries participating in the breast cancer part of the ARD study.

Table 4.4. **Women receiving breast conserving surgery and radiation therapy as a percentage of women receiving a breast conserving surgery**

	Age 40-49	Age 50-59	Age 60-64	Age 65-69	Age 70-79	Age 80+	All ages (standardised)
Belgium (1997)	87	92	91	94	98	56	90
Canada Manitoba (1995-98)	71	82	83	81	64	18	74
France (1997)	91	97	94	95	93	63	93
Italy (1990-91)	65	58	65	43	39	9	57
Sweden (1994)[1]	73	73	62	n.a.	38	6	60
United Kingdom – England (1995)	73	74	76	79	65	28	72
United States (1995-97)[2]	n.a.	71	72	71	66	36	43

1. Sweden estimates for 60-64 years reflect 60-69 years.
2. United States estimates are not available for 40-49 years.

Source: Data collected by the experts in the countries participating in the breast cancer part of the ARD study.

Use of radiotherapy among those who received BCS varies dramatically by age, with a sharp decline in use for those over 70 or 80 years of age across countries, though there have been increases in RT use over time. The age gradient is not as pronounced in all countries. Some countries observe a more significant drop at 70 [Canada (Manitoba), Italy, Sweden, and UK] in the use of RT after BCS compared to other countries. However, in Belgium, France, and the US, women aged 70 to 79 years receive RT after BCS at a similar rate on average as the younger age groups and those women 80 years and older receive RT after BCS much less often.

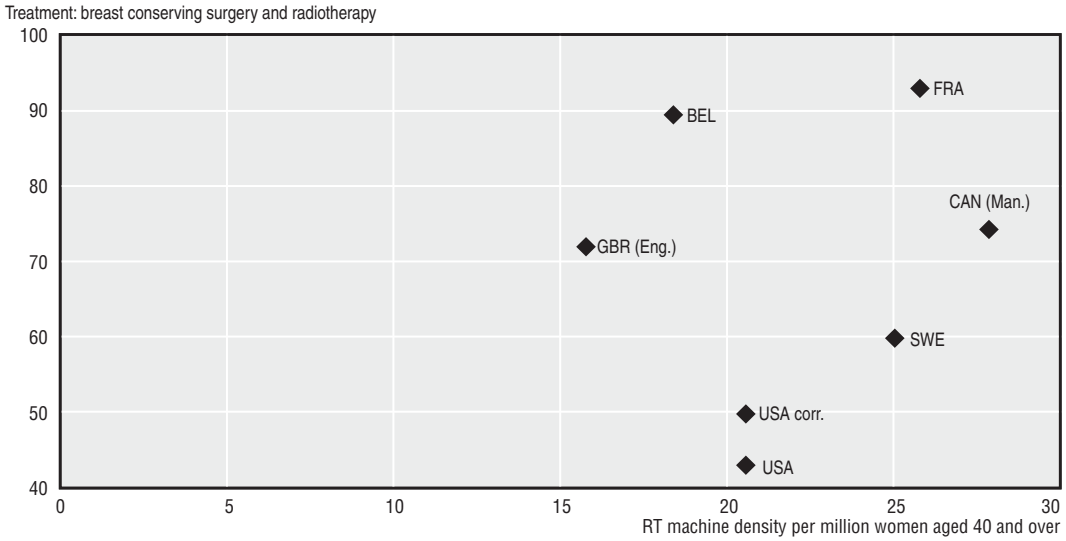
Several factors can explain the differences in treatment patterns such as patient age, sociodemographic characteristics, hospital characteristics, geographic area, comorbidity, marital status, physician and patient preferences, type of health care system, availability and proximity to radiation therapy and costs (Farrow *et al.*, 1992; Nattinger *et al.*, 1992; Samet *et al.*, 1994; Lazovich *et al.*, 1991; Barlow *et al.*, 2001). We first examined whether demand or supply side constraints might be a barrier or an influence on breast cancer treatment choice. We then specifically explored possible associations with BCS rates and RT rates after BCS and independent variables such as type of health care system and reimbursement levels and availability of radiation therapy centres.

Based on the country reports' description of their health care systems, there is little evidence of any constraint on the demand for health care related to breast cancer. However, access barriers due to supply side constraints such as payment system, supply of providers, availability of technological resources may exist. For example, many experts in OECD countries are concerned that the number of cancer specialists and resources for RT are too low to meet the current and future demands of cancer care. In several country reports, experts cited serious problems with delays in radiation therapy (*e.g.* Canada, Norway, Sweden and the United Kingdom) that can be related to resource availability and productive efficiency (Grunefeld *et al.*, 2000; Sainsbury *et al.*, 1995; Royal College of Radiologists, 1991). Data obtained from countries was not comprehensive for supply of cancer specialists such as oncologists so we were unable to explore an association with this independent variable.

We were able to test the hypothesis that there is a relationship between the overall proportion of women diagnosed with breast cancer receiving RT after BCS and the availability of radiation therapy machines. Researchers have found lower rates of radiation therapy after breast conserving surgery to be associated with poor distribution and supply of specialised treatment centres with capacity for radiotherapy (Iscoe *et al.*, 1994; Guadagnoli *et al.*, 1998; Nattinger 1996). Rates of radiation therapy machines across countries vary. There has been an increase in the number since 1980s to meet the increasing demands. However, from our data there does not appear to be a strong relationship between the availability of RT machines and proportion of women receiving RT after BCS for those over 40 years of age (Figure 4.1).

In countries with fixed payment systems there may be a disincentive to pursue more complicated and costly treatments such as BCS and series of subsequent RT. In contrast, in countries with more flexible payment systems such as France, Belgium and US, each

Figure 4.1. **Proportion of women diagnosed with breast cancer and treated with BCS, who also received RT and availability of RT machines, 1995-99**



BCS: Breast conserving surgery.
RT: Radiation therapy.
Note: A corrected point has been inserted for the US (+16 %). See Du *et al.* (1999).
Source: Data collected by the experts in the countries participating in the breast cancer part of the ARD study.

patient is a source of revenue so there is more incentive to refer. Interestingly, based on initial review, countries that use global budgets (Norway, Sweden, Canada, and United Kingdom) tend to demonstrate lower rates (generally less than 50%) of BCS utilisation than those that rely on fee-for-service or diagnostic-related group (DRG) payment methods (France, Belgium, and the United States). In the United States, studies have reported that higher reimbursement levels for BCS influenced providers' propensity to choose breast conserving surgery (Mandelblatt *et al.*, 2001). Recent European studies also found that reimbursement practices varied and influenced the extent of treatment across European countries (Lievens *et al.*, 2000; Norum *et al.*, 1997). In countries, or in hospitals where global budgets or per diem payment are used, the total number of fractions for radiation therapy was lower, and the total dose was lower. On the contrary in countries with fee-for-service systems, treatments tended to be more aggressive and higher dosed.

Generally, the data available from participating countries appear to show that older patients might be treated less frequently and less intensively than younger patients. Most countries have lower RT utilisation rates among the 80+ age-group, though there have been relative improvements over time in some countries – where utilisation rates have reached the level of their younger counterparts. The lower rates of BCS and RT among older women based on cross-national estimates presented here are consistent with the literature in the US and other countries (Farrow *et al.*, 1992; Samet *et al.*, 1994; Ballard-Barbash *et al.*, 1996; Paszat *et al.*, 1998; Mandelblatt *et al.*, 2000; Tyldesley *et al.*, 2000). Many of these studies have shown that older women do not receive recommended treatments for breast cancer as frequently as younger women, even when controlling for comorbidity. Many hypothesise that older women receive different therapy than younger women for reasons unrelated to their disease, despite findings that older women equally tolerate and benefit from these treatments (Greenfield *et al.*, 1987). Silliman *et al.* (1989) found that age had a significant impact on the probability of receiving follow-up treatment, such as radiation therapy, after BCS, and adjuvant chemotherapy for patients with a regional disease and undergoing a mastectomy. A more recent study, on a larger cohort of 18 000 patients based on US SEER data linked with Medicare claims (Ballard-Barbash *et al.*, 1996), shows that, after adjustment for multiple clinical and non-clinical factors, chronological age remains an important factor associated with a lower probability of receiving radiation therapy after breast-conserving surgery among women aged 65 years or more who were diagnosed with early-stage breast cancer. Further research is needed to determine what are the reasons behind the fact that older women are getting treated less aggressively – and perhaps, providers are not feeling confident on how to treat the older population effectively due to a lack of clinical evidence on how to treat breast cancer for this age group.

2. Performance: description of costs and outcomes

2.1. Costs of care

Overall, most countries tend to spend about 0.5 to 0.6% of total health expenditures on breast cancer. However, when analysing the unit costs for initial treatment, countries' spending is variable. Initial treatment is defined often as all therapies that occurred six months post diagnosis which typically includes surgery, any preoperative therapies, and sometimes the start of any adjuvant chemotherapy or radiation therapy if no chemotherapy is involved. Cross-national estimates are based on country-specific studies that calculated costs with different methodologies. Unit costs of initial phase of breast cancer treatment are presented as per cent of GDP per capita. Norway tends to have the

lowest costs among those observed at 26.4% of GDP per capita. Unit costs are slightly higher in France and in Canada for women more than 50 years of age (34.4% and 32.8%), with the US studies presenting the highest unit costs (41% to 62.4%).

Costs of breast cancer treatment may also differ by type of treatment. In most cases, breast-conserving surgery associated with radiotherapy appears to be more expensive than a mastectomy, when considering the initial six-month episode of care. It seems that in some countries, such as Norway, the higher costs related to breast-conserving surgery, when compared with mastectomies, might be influencing treatment patterns (Norum *et al.*, 1997). However, a recent US study found that mastectomy in fact may be more expensive, when a longer time period is analysed (Barlow *et al.*, 2001). When analysed over a five-year period. higher expenses are often incurred for continuing care after a mastectomy, that is likely to include reconstruction surgery and adjuvant therapies. Breast conserving surgery appears to be relatively more cost effective, when examined over a five year period, even when radiation or adjuvant therapy are taken into account.

Although results by age groups could not be presented due to the heterogeneity of data, most studies show that costs are higher in the younger age groups (Fireman *et al.*, 1997). In addition, in most countries costs for more advanced stages are higher than for earlier stages. Such data have been obtained for a number of countries. The gradient in costs by stage exists for all countries, but with different patterns. The country rankings from the initial costs comparison remain largely unchanged when examining costs by stage, with the United States spending more than Australia and France, and Canada spending less. Some partial Italian data were available, which suggest that Italy is among the lower spending countries.

2.2. Five-year relative breast cancer survival rates

Outcomes data collected as part of this study include relative five-year survival rates, adjusted using the World Standard Cancer Patient Population (Black *et al.*, 1998). Most of the data presented in this study was calculated as part of the EUROCARE project (Berrino *et al.*, 1999). Similar methods have been used for the countries participating in the EUROCARE project (Berrino *et al.*, 1999; Quinn *et al.*, 1998). Several countries who have not participated in the EUROCARE project have provided survival rate estimates, that are likely to not be comparable to the EUROCARE estimates so cross-national interpretation should be undertaken with caution.

Table 4.5 displays overall five-year relative breast cancer survival rates in the mid-1990s, or latest available data. There are marked variations in breast cancer survival rates, ranging from 72% in England to 84 and 85% in United Status and Japan. Data from the EUROCARE studies, from 1978 to 1985 and 1985 to 1989 present similar differences (Berrino *et al.*, 1999; Quinn *et al.*, 1998). Survival was above the European average (73% in 1985-89) in Iceland, Finland, Sweden, Switzerland, France and Italy; while Denmark, the Netherlands, Germany, and Spain were around the average and England, Scotland were below average.

Older women have lower breast cancer survival rates than their younger counterparts in several countries. For example, England and Wales experience a stable survival rate at around 80% in the younger age groups up until 50-59 years, when there is a fairly dramatic decline to 53% for those women 80 years and older. Older women in the United States, however, experience fairly equal outcomes as compared to their younger counterparts in 1989-95 (at around 82%).

Table 4.5. **Relative five-year survival rates**

Percentage

	Age 40-49	Age 50-59	Age 60-64	Age 65-69	Age 70-79	Age 80+	Adjusted overall
Canada (Manitoba) (1985-89)	78.5	76.5	76.9	82.1	77.7	79.4	78.4
Canada (Ontario) (1985-89)	79.4	75.7	75.9	80.9	77.5	68.4	76.5
France (1985-89)	82.6	79.6	88.0	81.2	83.2	78.4	82.0
Italy (1985-89)	82.2	75.8	77.6	78.6	82.2	75.7	79.0
Japan (1992)[1]	90.5	85.9	86.3	n.a.	81.4	76.4	84.9
Norway (1990-94)	80.5	79.2	75.2	79.8	74.1	74.6	77.9
Sweden (1989)[1]	81	79	88	n.a.	85	73	82.2
United Kingdom – England (1993-95)[1]	79.5	81.7	77.5	n.a.	69.6	53	74.1
United States (1989-95)[2]	82.6	82.5	84.7	n.a.	82.7	n.a.	83.8

1. Estimate for 60-64 years reflects 60-69 years.
2. United States' estimates for 40-49, 50-59, 60-64, and 70-79 reflect 45-54, 55-64,65-74, 75+ respectively.

Source: Data collected by the experts in the countries participating in the breast cancer part of the ARD study.

Since the mid-1980s, overall and age-specific five-year relative survival rates improved for breast cancer across countries. Most countries experienced dramatic increases in survival rates among the younger age groups between 40 to 65 years. This differential improvement in survival across age groups may reflect the increased use of mammography and more aggressive treatment in the younger age groups. Sweden and Norway both observed notable increases among female breast cancer patients aged 50 to 59 years.

Older women, over time, have been living longer with breast cancer in some countries. Sweden has made the largest relative improvement among its female breast cancer patients aged 80 years and older, increasing their five-year survival rate to the level of their younger female breast cancer population at 87%. England and Wales, however, demonstrated no survival improvement between 1986-90 and 1991-93 for the oldest age groups (70% for 70-79 age group and 53% for the 80+ group).

3. Discussion

These marked differences in the levels and improvement of the rates of breast cancer survival across OECD countries highlight the need to understand the determinants behind these variations. Possible contributing factors include overall stage distribution, patterns of cancer care utilisation including screening and treatment, and socio-economic factors such as income and education.* While much of the survival improvement is mediated through changes in the stage distribution, it is very difficult to disentangle the relative contribution of the remaining factors in influencing access to and availability of appropriate and timely health care. Below, we seek to explore each of these topics separately, based on the data and reports in the country studies for the OECD project.

3.1. Screening

Breast cancer screening influences survival rates as it has a direct impact on the stage distribution of cases in a country as well as the number of newly diagnosed cases. Stage distribution across countries – particularly when examined across age groups – is an important explanatory factor when examining estimates of survival rates over time. Based

* Research is underway to assess the various role of these factors. See Quaglia project on understanding survival patterns in Europe. Capocaccia, Micheli and others for a US/Europe comparison.

on the data available from country reports, significant increases in the percentage of milder cases are evident in many of the participating countries in more recent years, likely due to the implementation of organised screening programmes and improvements in technology. This trend is coupled with a reduction of the number of cases with more advanced disease over time in the same countries. However, dramatic increases or decreases were not observed in those diagnosed with the most advanced disease with largest tumour size and distant metastases across these countries. Generally, over 50% of newly diagnosed breast cancer patients have early stage disease and less than 10% are diagnosed with distant metastases across OECD countries.

Sant *et al.* (1998) present findings that suggest that in the UK, advanced stage is an important factor in explaining its low survival rates. Excess risk of death for breast cancer patients within the first six months of diagnosis was higher in the UK than for Europe overall; while after the six-month diagnosis period, the difference in excess risk of death narrowed. Patients with breast cancer who die within six months of diagnosis typically have advanced stage disease. Countries with more severe stage distribution might be experiencing lack of access to mammography screening and other diagnostic services – whether it is the supply of machines or human resources that causes delays in diagnosis.

The increasing proportion of early stage breast cancer cases has not just shifted the stage distribution observed in countries over time, but also has boosted the overall number of incident breast cancer cases. Cross national variations in survival might correspond to differences in incidence and stage distribution of breast cancer – that in turn reflects the level of screening activity in the country. Therefore, countries with higher incidence tend to have higher survival rates. So-called "minimal breast cancers" such as those less than 5 mm, are being detected more and more frequently mammographically. These are in fact not likely to result in death due to breast cancer, but are included in the numbers of incidence and the calculations of survival rates. Experts argue that real survival rate differences may be due to these type of statistical or registration artefacts, lead time bias due to earlier tumour detection and length bias where screening will pick up indolent cancers that may never become clinically apparent or result in death due to breast cancer. It is difficult, therefore, to draw any significant associations between survival and stage at diagnosis or higher incidence.

Age differentials in stage at diagnosis across countries were observed in the data available from countries, where older age groups had a higher likelihood of being diagnosed with advanced disease. These trends are likely to be a key factor behind the lower breast cancer survival rates for the older age groups. Older women may not be receiving timely mammography screening. Most of the country's organised screening programmes do not target older women over 70 years, and it appears that older women are having a mammogram less often than their younger counterparts. In Canada and the US, 65 to 70% of women between ages 50-69 surveyed in their national health survey reported receiving a mammogram in the past two years. This percentage dropped to about 44 to 49% of women aged 70 years and older in Canada. Wider age differentials were found in countries such as the United Kingdom with only 3.2% of women surveyed over 70 years reporting having a mammogram in the past year in comparison to 40% of women between 50 to 59 years of age; in Belgium, with only 10.5% of women over 70 years old, as compared to 32.2% of younger women; and finally, Sweden with 20% of women over 70 years old, as compared to 70% of women between 50 to 59 years of age. Though these

estimates of screening levels in the population are not comparable cross-nationally, the data highlight the infrequent use of mammography in countries such as UK and the possible contribution to the low survival rate in those countries.

Overall participation rates of mammography screening are only weakly related to the overall availability of mammography machines. Wide variation in the rate of mammography machines per million women over 40 years of age exists across countries, with France and United States having the highest supply of mammography machines. Countries with explicit regulatory constraints on technology diffusion tend to have lower rates of mammography machines per capita such as Canada, Norway and the United Kingdom. Other countries such as Hungary and Japan also have lower rates of mammography machines when compared to other OECD countries.

3.2. Access and quality of care

The second factor that can help explain the cross-national survival differences is access and quality of care of breast cancer-related treatment. However, several factors contribute to the differences in treatment patterns, including the availability of screening and diagnostic examinations; availability of agreed-upon treatment protocols and rate of adoption of these recommended treatments; provider and patient preferences; and supply of technology and manpower. The relationship between stage at diagnosis and survival is discussed above. Differences in stage distributions across countries are due in large part to the participation rates in screening programmes. Stage at diagnosis determines the type of treatment that can be offered by the provider, the response to treatment, and ultimately the prognosis. In addition, lack of agreed-upon treatment protocols might explain some of the cross-national variations in survival – particularly in the 1980s – when very few consensus statements on therapeutic interventions for breast cancer existed. Since the mid-1980s, more and more consensus statements and treatment protocols have been developed based on recent clinical trial findings on this topic on a national and international level. This movement has encouraged a more unified approach to breast cancer treatment than in earlier years. For instance, there has been much discussion on the positive impact of tamoxifen – once evidence of its effectiveness was published in the literature in the early 1990s – on survival (EBCTCG, 1992).

Further exploration should be given to other possible factors related to the organisation of the health care systems, such as supply of oncologists and other cancer-related specialists as well as RT resources. As an exploratory analysis, we examined above if there is any relationship between the overall proportion of women diagnosed with breast cancer receiving additional radiation therapy after BCS and the availability of radiation therapy machines. There does not seem to be a strong relationship overall. Looking specifically at the 70-79 age group, a stronger relationship between the availability of radiation therapy machines and rates of RT after BCS exists that should be explored once more detailed data are obtained (see Figure 4.1).

3.3. Socioeconomic and demographic factors

Finally, socioeconomic factors have been researched as a determinant of poor cancer survival (Kogevinas *et al.*, 1997) where these factors have created barriers to access of care – specifically in reports focusing on variations within their country. Several studies have found that low socioeconomic status could explain the differences in survival, after controlling for stage, histological type and type of treatment received. For instance,

patients living in affluent areas within specific regions had higher survival than those living less affluent areas of the same region (Coleman *et al*., 1999). Similar findings have provided supporting evidence that the socioeconomic level of a country is an important determinant of cancer survival – presumably through its impact on inequality of access to and availability of health facilities (Sant *et al*., 1999).

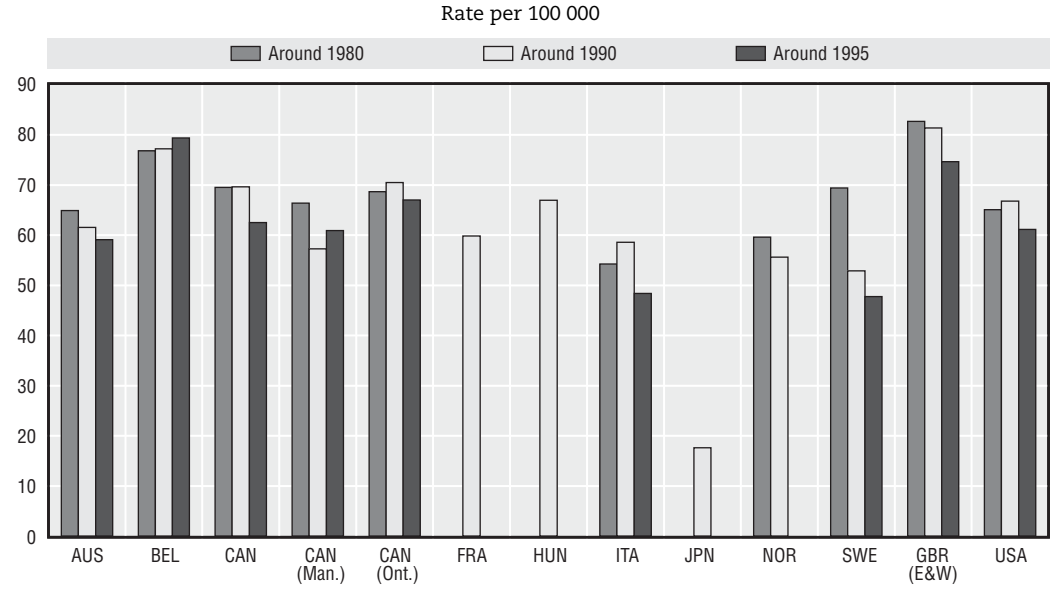
The decline in survival among older women is one area of concern, which needs further research. Differences in survival from breast cancer across ages is likely due to several issues covered in this paper such as stage at diagnosis and screening and treatment patterns where we also observed significant age differentials. First of all, stage at diagnosis may prove to be even more important prognostic factor in treatment planning for older women (Vercelli *et al*., 1998). There is an even wider age differential in one-year survival rates than five-year survival rates among older women, suggesting that older women are being diagnosed with much more advanced disease and experiencing a worse prognosis than younger women.

3.4. Mortality rates and screening

Mortality rates can be used to provide an additional perspective on health outcomes, particularly given the complexities involved with interpreting survival rates in the presence of lead time and length time biases. However, while mortality rates do not have these biases, they have other limitations (such as they do not control for variations in incidence, and they are more affected by influences outside the health care system). While neither the mortality nor the survival data are able to establish a causal link between screening and mortality, it is nevertheless useful to examine mortality rate levels and trends in the context of differing screening practices.

In countries such as Sweden, Italy, Australia, US, and Canada, there have been moderate levels of mortality overall, with strong reductions in levels of mortality for women aged 40 and over in the 1990s (Figure 4.2). All these countries have aggressive screening

Figure 4.2. **Trends in age-standardised mortality rates for breast cancer**



Source: Data collected by the experts in the countries participating in the breast cancer part of the ARD study.

programmes, either through organised programmes such as in Australia, Sweden, and Manitoba, or through aggressive opportunistic screening in the United States, or through a mixture of both in Italy and most Canadian provinces. In the United States, a decrease in mortality is observed for all age groups, with modest decreases for the youngest age groups. However, the US also has significant reductions in the 70-79 age group, which may also reflect more aggressive treatment for women in this age group.

The United Kingdom has one of the highest mortality rates, yet at the same time experienced a minor reduction in mortality according to the data available for this study. (For a more detailed earlier account, see Quinn and Allen, 1995.) The data needs to be updated before making a final conclusion, but it is possible that these reductions reflect the introduction of organised screening in this country at the end of the 1980s following the Forrest report in 1986 (Patnick, 2000). Further publications (Moss *et al.* 1995; Blanks *et al.*, 2000) provide an account of the NHS Breast Cancer Screening Programme with a majority of targets being met. The programme detected more carcinoma *in situ* at the beginning of the programme (1988-93), but fewer invasive cancers than expected. It has been estimated that the programme has been responsible for a third of the fall in the death rate from breast cancer among women aged between 55 and 69 years (Patnick, 2000).

More definitive observations regarding the link between treatment variations (including screening) and health outcomes would be possible if internationally comparable data were available on survival rates classified by the stage of the cancer. This would allow differences in the stage distribution between countries to be controlled for in the analysis of the data. Thus, the confounding effect of some countries having higher proportions of early cancers detected compared to other countries (because they are better at detecting them either through higher participation rates in screening programs or better screening techniques) could be removed.

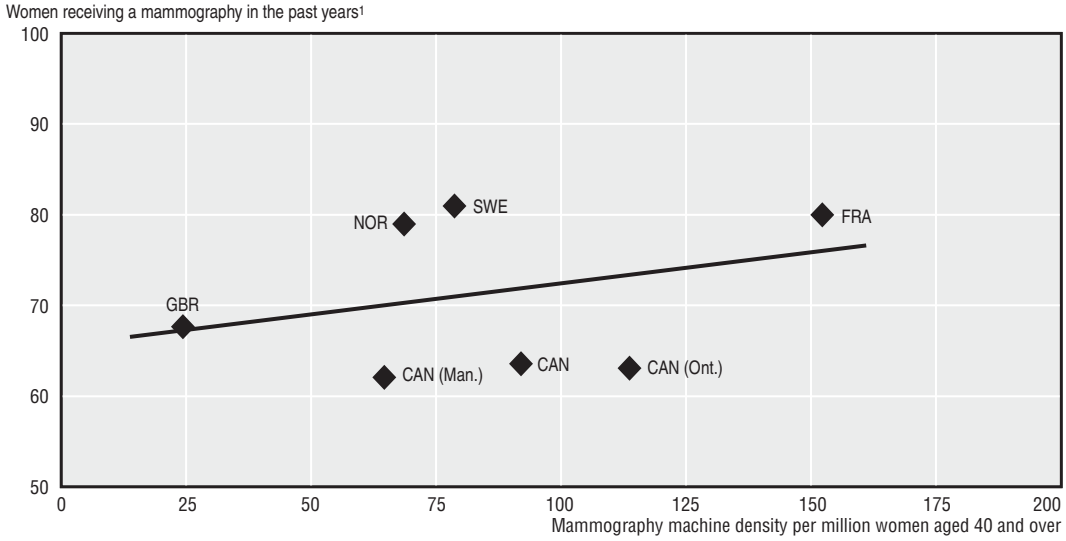
4. Conclusion

One of the objectives of the ARD project in bringing together information on health policy, epidemiology, treatments, costs and outcomes was to determine which countries were getting the best value for their health care spending. The first objective in determining which countries are getting the best value for their health care spending is to determine the relative performances of their health care systems.

In terms of breast cancer, assessing performance is a complex task, which would involve multivariate analysis of variations in survival; however, the data available to us for international comparison is very limited. We attempted to examine the impact of technological inputs (*e.g.* mammography machines or RT machines) on a variety of outcomes: recommended treatment, screening rate, and finally survival rates as a preliminary step (Figures 4.1, 4.3, 4.5). No conclusions can be drawn, except for the UK, with a much lower availability of machines and poorer survival, similar to the findings made by Baily and Garber. Survival rates do not seem to depend on the availability of state-of-the-art technology.

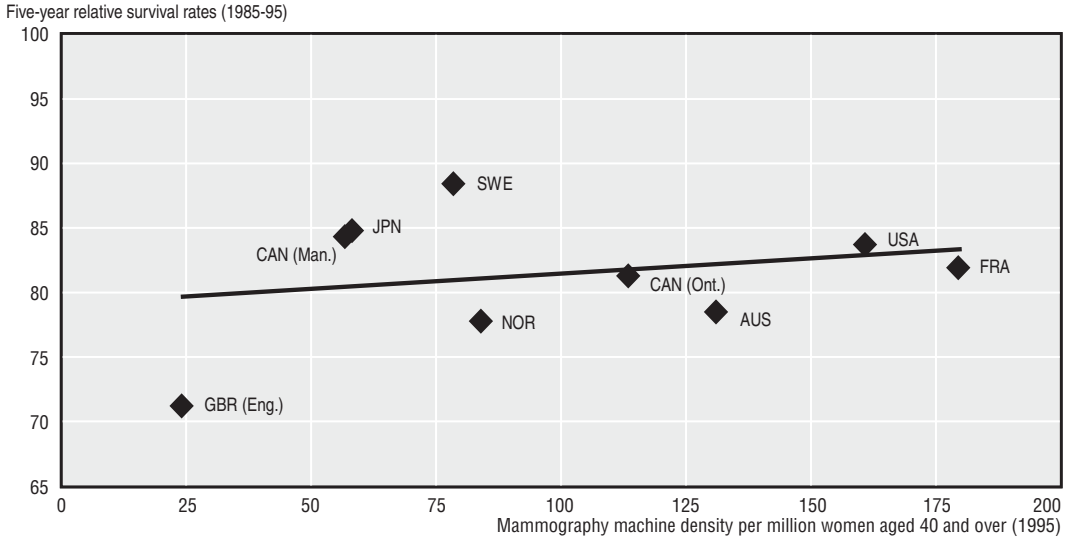
This study, however, confirms the variation in treatment patterns that persist, despite protocols for recommended care. Screening seems to be impacting the survival rates of several countries, evident in Europe. However, the UK is one country which clearly stands out, with a poorer survival rate. It would seem, from available evidence that, given the restrictions in terms of the availability of qualified medical staff, screening and radiation treatment equipment, financial constraints on treatment availability may have had an impact on outcomes.

Figure 4.3. **Proportion of women receiving a mammography and availability of mammography machines**



1. For United Kingdom, proportion of English women aged 50 to 64 receiving a mammography in the past years.
Source: Data collected by the experts in the countries participating in the breast cancer part of the ARD study.

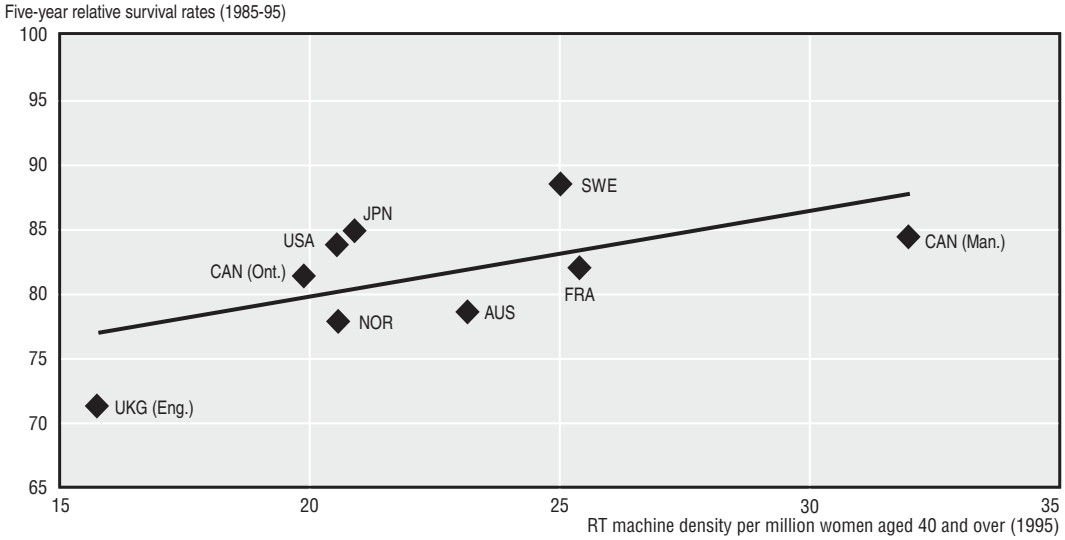
Figure 4.4. **5-year relative survival rate and availability of mammography machines in a recent year**



Source: Data collected by the experts in the countries participating in the breast cancer part of the ARD study.

As some essential pieces of the puzzle are still missing, an analysis of this sort, unfortunately, remains highly limited since the data gathered as part of this study is not patient level data linked for all variables under question (*e.g.* treatment, stage, survival) and the data available on potentially important independent variables (*e.g.* on economic factors) is fragmented. In addition, some of the country data only reflects portions of the country and therefore, treatment patterns or survival cannot be generalised to the entire country. Studies examining international comparisons face huge hurdles as it is difficult to

Figure 4.5. **5-year relative survival rate and availability of radiotherapy machines in a recent year**



RT: Radiotherapy.
Source: Data collected by the experts in the countries participating in the breast cancer part of the ARD study.

present available data in a standard manner. To assess the performance rates of health care systems, the present exercise is limited by the availability of current data: several of the key data sources are still in their infancy from a cross national perspective and require further development. In a recent article, Irwig *et al.* (2000) propose some alternative steps that are likely to provide more information for future debate:

- Further development of registry data, to include standardised data on cancer stage or extent of disease, and also on initial and follow up treatment.
- Further development of infrastructure and a legal climate to encourage links between registry data, hospital separation data and physician claims data as well as death records. Such links are currently available in some countries (the United States, Canada at the Provincial level, and Sweden), but could be developed further as they provide invaluable results.
- A systematic population-based measurement of women's participation in either organised, or timely breast cancer screening.
- Large cost-effectiveness trials assessing the relevance of cancer screening programmes, and the various options for treatment.

The "*ex post*" evaluation allowed by population-based assessment programmes, such as breast cancer registries, is invaluable and should be continued together with further cost-effectiveness trials. These help raise public awareness and, in a number of countries, have played a significant step in the renewal of the general health policy agenda, such as in the United Kingdom.

The study has for the first time compiled information on health care system factors, treatment, costs, and outcomes on breast cancer. In addition, the study's preliminary results generate several hypotheses and identify where further data needs to collected that can then be studied. Better performance seems to be achieved through a mix of rigorously-organised population- based breast cancer screening programmes, combined with treatment protocols that follow the most recent clinical guidelines, and are not unnecessarily limited by

economic constraints. However, the availability of up-to-date, state-of-the-art technology appears to be insufficient in itself to achieve high performance rates in OECD's health care systems.

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PART I

Chapter 5

Comparing Health Care Systems from the Disease-specific Perspective

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Abstract. *The McKinsey Health Care Productivity study sought to learn about system factors that might influence health care productivity by comparing the costs and outcomes of care in Germany, the United Kingdom, and the United States in the management of four specific conditions: breast cancer, lung cancer, cholelithiasis, and diabetes mellitus. The study assessed productivity in the management of these conditions by measuring the levels of inputs used, rather than expenditures on inputs. The US health care system, despite its much greater expenditures, tended to be more productive than Germany and the UK, except in diabetes care, where the UK experienced better outcomes at lower costs than in the US Several system features may have been responsible for these performance findings. The OECD Ageing-Related Diseases project is leading to similar insights in a range of conditions.*

Introduction

Many nations face the complex and challenging problem of maximizing the value of investments in health care. What are the effects of various health care financing, regulatory, and organisational designs on medical decisions? How do these medical decisions, in turn, change health outcomes and expenditures? Answers to these questions can come, at least in part, from a comparison of the experiences of nations that have adopted different approaches to financing and delivering health care.

Nearly all the developed world is grappling with rising health expenditures. Neither the causes nor the consequences of rising expenditures are uniform across countries, yet many of the forces – the introduction of new medical technologies, the growing sophistication of the consumers of health care, and the rising demand for care that accompanies rising income – are common across many OECD countries.

One way to measure health system performance is to examine its productivity. Productivity is often defined as the level of output obtained from a given input mix (or, alternatively, how little input is needed to produce a given output). One of the most accessible indicators of productivity is the relationship between aggregate health outcomes and aggregate health expenditures. Most studies that compare health expenditures across multiple nations are based on aggregate or "macro" statistics such as per capita medical spending, or GDP shares devoted to health care, and aggregate health outcomes such as life expectancy at birth. There is considerable variation in both, as the OECD demonstrates in its periodic comparisons of aggregate measured spending on health care. For example, per capita spending in Japan in 1995 was approximately US$1 500, less than half as much as in the United States.

Standardized measures of population health, such as life expectancy in middle or old age or disability-adjusted life expectancy also vary across countries, but are imperfectly correlated with health expenditures. Over time, health outcomes have improved as health expenditures have increased, particularly for the elderly (OECD, 1997). Yet life expectancy improved substantially in some countries that experienced only modest increases in health care spending. Are these countries producing more health for less money? The answer is obscured by many important confounding factors – cultural, and genetic differences, as well as differences in public health, educational, and income redistribution policies that lead to behavioral differences.

Aggregate statistics provide little direct evidence on the factors responsible for expenditure growth and health improvements, and thus leave many critical health policy issues unresolved. Does an expensive new medical technology provide enough added quantity and/or quality of life to justify its use when compared to less costly alternatives? How do the public and private sectors encourage or limit adoption and diffusion of new technologies and innovative organisational structures? How does the interaction of economics and politics effect medical decisions, and ultimately the health and well-being of citizens and employees?

These are questions addressed by the OECD's Ageing-Related Diseases project, and have also been addressed by other international comparative projects, such as Stanford's TECH (Technological Change in Healthcare) project and its GHP (Global Healthcare Productivity) project. In each of these projects, the investigators have sought to overcome the limitations of aggregate data. All of them have focused on specific diseases, in the belief that disease-level analyses are far more likely to reveal the forces at work and their consequences than highly aggregated studies. Their hope is that analyses of time trends and of more detailed (particularly individual-level) data pertaining to specific health conditions will illuminate the interconnected aspects (*i.e.,* financing, organisational structures, medical technology choices) responsible for health system performance (*i.e.,* health outcomes and expenditures).

Each of these projects is predicated on the assumption that financing mechanisms and the rules under which the health systems operate create incentives, which in turn influence the patterns of care, costs, and outcomes. These studies, therefore, are about the effects of incentives embedded in health policy choices that nations have made.

Below I discuss some of the rationale underlying such studies, emphasizing the measurement of productivity and the inferences that can be drawn about productivity from limited data. I review the methods and findings of McKinsey's Health Care Productivity project, a comparison of the management of four conditions in Germany, the UK, and the US, and close with a discussion of the prospects of disease-specific studies like the Ageing-Related Diseases project of the OECD.

1. Productivity and measurement of efficiency

The concept of efficiency, particularly when applied to health system performance, can be both a value-laden and ambiguous term, used very differently by different people. For the purposes of this discussion, I mean by efficiency a measure of how much output is obtained from a given input.

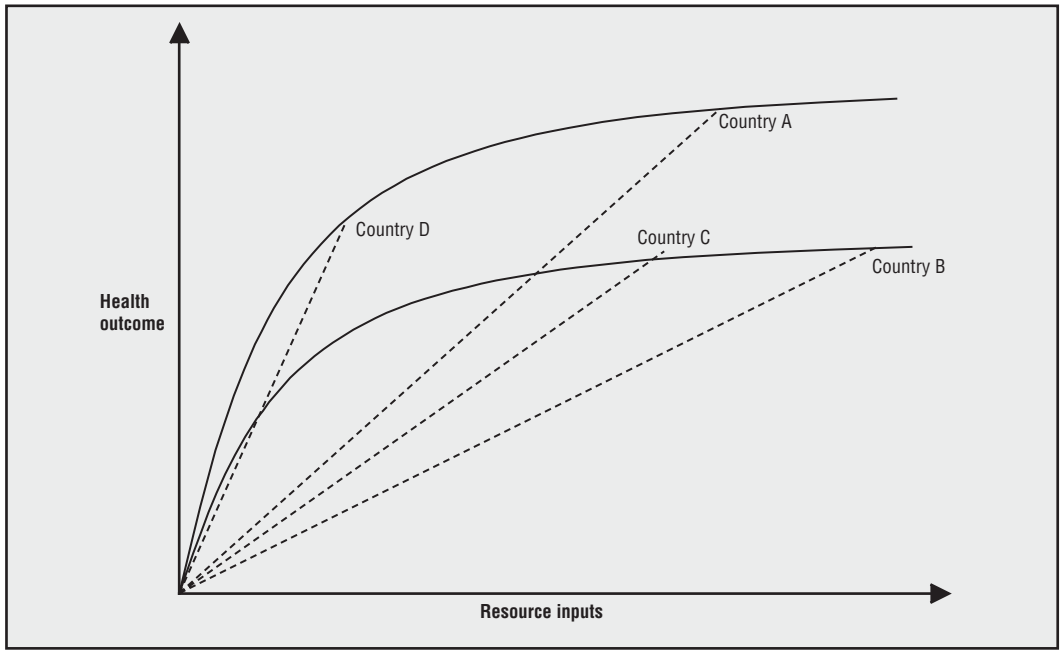
Even this definition admits of some ambiguity. For example, allocative efficiency in economics is often measured by Pareto optimality – *i.e.,* a state in which any redistribution that would make anyone better off must of necessity make someone else worse off. If it is possible to make someone better off without making another worse off, the current allocation is not Pareto efficient.

Ordinarily there is an infinite number of possible Pareto optimal distributions, so there is no unique solution to Pareto optimality. Thus observation that one country spends more than another and achieves a greater level of health outcomes can be consistent with Pareto optimality in both countries, but it can also be consistent with inefficiency in one of the countries.

The conditions for determining that a distribution is Pareto optimal are more stringent than can ordinarily be met in international comparative studies. Productivity alone is not sufficient for Pareto optimality, yet productivity can shed some light on economic efficiency without requiring the level of information or strong assumptions needed to draw conclusions about Pareto optimality.

The conclusions about productivity that can be drawn from international comparisons are illustrated from the figure, which was produced as part of the McKinsey Healthcare Productivity project (McKinsey Global Institute, 1996; Baily and Garber, 1997). Figure 5.1 displays points corresponding to outcomes and expenditures for a given condition (think of these as per patient or per capita numbers).

Figure 5.1. **Productivity in four nations**



Source: Adapted from McKinsey Global Institute (1996).

Note that the production possibility frontiers displayed here, the curve on which A and D lie, and the curve on which B and C lie, are not observed, but the points are. The AD curve represents countries that are clearly more productive because they produce greater output (health) at any given input than the countries on the BC curve.

No further information is needed to infer that Country A is more productive than Country B, because it achieves equal or better outcomes with less input (A strictly dominates B). Countries A and B are not operating on the same production function; B could be said to suffer from "x-inefficiency".

It is not possible to draw firm conclusions about the comparison between A and C unless we know something about the production function. But if the production of health (*i.e.,* the treatment process) does not show increasing returns, A is more productive than C because it has higher average productivity (ratio of outcomes to inputs).

It also may not be possible to draw conclusions *a priori* about the relative productivity of C and D. C has higher inputs and outcomes but lower average productivity; this result could be obtained if C and D were on the same production possibility frontier and C merely represented a point at which treatment is more intensive than in D.

The comparison of B and C is observationally similar to C *vs.* D. Since B and C are on the same production curve, this figure demonstrates that two countries could be producing with the same efficiency (same production curve) while spending different amounts per unit health outcome. With diminishing marginal returns to health expenditures for a condition, average productivity will decline with rising quantity. Although the two countries may, in this sense, have comparable productive efficiency, one could be overconsuming (or underconsuming) care.

2. The McKinsey health care productivity study

The McKinsey study was motivated in part by the observation that aggregate health outcomes, such as life expectancy at birth, did not closely correspond to a nation's per capita health expenditures. The McKinsey team believed that a productivity framework could be applied to health care at the national level in order to discern the factors associated with greater or lesser productivity of health care systems, and that such a framework would be most useful if applied at the disease level.* Variation between nations in financing, regulations, and organisation of care, the investigators hypothesized, gave rise to different patterns of care with potentially different productivity in improving health.

The McKinsey study included three nations – Germany, the United Kingdom, and the United States – and selected the following four conditions for study: diabetes mellitus, cholelithiasis (gall stones), lung cancer, and breast cancer. For the two cancers, the principal interest was in differences in disease mortality, so the health outcome used to measure productivity was life-years saved with the diagnosis. For the other two conditions, improved quality of life was believed to be the principal goal of therapy, so the investigators sought to measure changes in quality-adjusted life years.

A key challenge for any productivity study is measurement of the resources used in production. For each health condition studied, the McKinsey team measured resource inputs in terms of physician hours, nursing hours, medications, capital, and so on. From these measures, it was necessary to produce an overall index of resources used. Ordinarily, total cost would be the appropriate measure, but since total cost is a function of the cost per unit input, and the input costs varied across countries, it was possible that one country would seem to have lower cost than another using its own price weights, while the relative costs might be reversed when using the other country's prices. Indeed, if each country operated in an efficient manner, a country with relatively low prices for physician services would use more of these services and less of substitutes, such as nursing and ancillary services. The McKinsey team calculated total costs using each country's price weights, and also using an average of prices across all three countries. No conclusions were drawn about relative productivity in the instances in which the productivity rankings depended upon the set of price weights used.

In addition to the information it collected about disease prevalence, treatments, and costs, the McKinsey team explored characteristics of the health care systems in each country, such as key regulations, modes of financing, and the organisation of care. By linking patterns of practice to system incentives, this added information provided an important context for the productivity findings.

* A large number of people participated in the study. The McKinsey working team included Lynn Dorsey, Cuong Do, Andrew Gengos, Elise Russi, John Goree, Frank Basile, Paul Brody, David Crawley, Alexis Dormandy, Thomas Gerstner, Nicolaus Henke, Dolores Heras, Michele Holcomb, Debbie Kelsey, Keiko Kin, Karl Krista, Joan Mehn, Uma Muthu, Vikram Narasimhan, Sheryl Sandberg, Mary Ann Aitken, Julie Eskay, Diane Gutheil, Donna Gregory, Ruby Kapadia, Kathy Knauss, and Doreen Welborn. An external Advisory Committee, consisting of Kenneth Arrow, Martin Baily, Axel Borsch Supan, Ted Hall, and me, reviewed project progress and made suggestions throughout the course of the project. Three McKinsey leaders, Bernard Ferrari, Bill Lewis, and Charles Schetter, oversaw the completion of the project.

2.1. Breast cancer

There are several ways in which medical practices can influence the outcomes of breast cancer. The detection of breast cancer, unlike the other conditions studied as part of the McKinsey project, usually begins with screening. Screening can be conducted by breast self-examination, physician examination of breast tissue, and an x-ray technique (mammography). After detection of a suspicious lump or lesion, diagnosis can be made by different biopsy techniques, and finally, the treatment options range from limited surgical excision (lumpectomy) to extensive surgical resection, to non-surgical techniques like radiation therapy and chemotherapy, which are often used in addition to surgery. Productivity in the management of breast cancer across nations, therefore, reflects the choice of management strategy as well as productivity in each of these components of detection and care.

The McKinsey project used mortality as the principal measure of outcome for breast cancer. Differences in rates at which mammography was used in screening programs (common in the US in the 1980s, much less so in Germany, and not at all in the UK) made it necessary to adjust outcomes for differences in detection rates. The analysis showed that the US used fewer resources and had better outcomes than Germany. The UK used fewer resources than the US, but it had worse outcomes (the OECD study also reported higher survival rates in the US than in the UK; Germany was not included in the comparison). The differences in outcomes were large compared to the difference in costs. Whether inputs were measured in UK or US prices, the cost per life-year saved in the comparison between the US and the UK was less than US$32 000. Although much of the cost-effectiveness literature suggests that this figure represents good value, the acceptability of the cost-effectiveness ratio undoubtedly varies around the world, and it is possible that US$32 000 per life-year was acceptable in the US but not the UK.

The use of screening in the US raised costs substantially and may also have improved outcomes. Diagnostic procedures performed on suspected breast abnormalities were often done at lower cost in the US, in part because a greater percentage was performed on an outpatient basis. Furthermore, resource use for surgery was similar in the US and the UK and was much greater in Germany. Other treatment modalities (radiation therapy and chemotherapy) appeared to contribute little to differences in resource use across the nations.

2.2. Lung cancer

Lung cancer is usually diagnosed very late in the course of the disease, when median survival is only about a year. The hope for cure comes from early detection, and the goal of therapy is in large part to ensure that the disease is treated appropriately – *i.e.,* surgery is performed primarily to remove localized cancer. Surgery is usually avoided, except for palliative purposes, when the cancer has spread beyond a small area of the lung.

Recognizing the high mortality from lung cancer, the McKinsey team chose survival as the principal outcome measure. The US had better outcomes and used fewer resources than Germany in the management of lung cancer, while the UK used 24% fewer inputs and had 58% worse outcomes than the US. Average productivity in the treatment of lung cancer was higher in the US than in the UK, so unless the treatment of lung cancer was characterized by increasing returns to scale, the US was more productive than the UK. The US had much shorter post-operative hospital stays and was more likely to use outpatient settings for chemotherapy than either Germany or the UK. This accounted for much of its

greater productivity in the treatment of lung cancer. In addition, diagnostic and staging evaluations were less extensive in the UK than in the US or Germany. The parsimonious use of diagnostic resources may have been offset by increased treatment intensity; for example, failure to detect a distant (metastatic) lesion or the full extent of local disease may lead surgeons to operate on "inoperable" tumors.

2.3. Cholelithiasis (gallstone disease)

Cholelithiasis, or stones in the gall bladder, is a common and often asymptomatic condition. However, it can cause symptoms that may become severe or frequent enough to lead to surgery. During the 1980s, the introduction of laparascopic cholecystectomy revolutionized the surgical removal of the gall bladder. Because this procedure was performed through a very small incision, it was much less invasive. It shortened the duration of convalescence, and typically required fewer resources than traditional open cholecystectomy.

There were substantial differences in the rates at which each of the countries adopted this new technology, with the US being the first to use laparoscopic cholecystectomy, and the UK last. The US used fewer resources per cholecystectomy than either Germany or the UK, and the outcomes of surgically treated patients were similar in the three countries. An important reason for lower resource utilization per case in the US was the more rapid adoption and dissemination of laparoscopic cholecystectomy. Although Germany used fewer resources for each open (traditional) cholecystectomy, the US shifted patients more rapidly to the less expensive laparoscopic procedure. Germany was the most likely to operate on cholelithiasis, the UK the least so. The UK had a lower operative rate than the other countries, and therefore had lower costs per case of gall bladder disease. However, it did not have the greatest productive efficiency in the management of gall bladder disease because outcomes were worse on a per case of disease basis.

2.4. Diabetes mellitus

Because adequate data were not available from Germany, the diabetes case study compared treatment only in the US and the UK. To minimize unmeasured epidemiological differences between the study populations of the two countries, the analysis was restricted to white populations. For the case study, multiple complications of diabetes, including diabetic ketoacidosis, retinopathy, blindness, and lower extremity amputation were measured as outcomes. Utility levels were assigned to each complication, making it possible to estimate the effects of differences in complication rates on quality-adjusted life years (QALYs).

The United Kingdom used about ⅓ less input than the United States, while outcomes in quality-adjusted life years were about 27% greater in the United Kingdom. The differences in outcomes resulted from substantially lower complication rates in the United Kingdom. The difference in outcomes, according to the McKinsey study, resulted from the highly intensive treatment selectively administered to the most severe diabetics in the UK, administered in part by specialized multi-disciplinary diabetes care teams. There was a large disparity between the treatment administered to patients with relatively mild forms of Type II diabetes in the UK and in the US; fewer than 60% of Type II diabetics received regular office-based physician's care in the UK, compared to 93% in the United States. However, English patients treated in specialized diabetes care clinics received more intensive care than American diabetics. The diabetes care in the UK was less expensive in part because it combined extensive self-management with triaging of care.

2.5. *Lessons learned*

The implications drawn from the McKinsey study must be qualified because data in key areas, such as clinical characteristics and detailed input measurements, were limited. Data limitations also meant that some of the assumptions could not be fully tested (*e.g.,* that the quality of each physician or nurse hour is similar across nations, that the epidemiology of the health conditions is similar across nations). Nevertheless, the major results suggest that practice patterns – and productivity – directly follow incentives embedded in each country's health care system.

Although the three countries have broadly similar populations, relatively high GDP per capita, and are culturally similar to one another, they are far from identical. It is therefore striking that practice patterns so directly reflect incentives. The impact of the incentives on productivity varies. For example, the British National Health Service of the late 1980s was characterized by barriers to capital acquisition, relatively tight control of costs, and incentives that discouraged overutilization of services. This led to a generally parsimonious approach to the treatment of the conditions studied here. But for lung cancer, it appeared that the less extensive staging evaluation led to excessive surgery for advanced stage disease. In the 1980s, the UK health system was more capable than the US system of forming multidisciplinary care teams that were well-suited for the management of chronic conditions like diabetes. In the US, in the sector of the health care system characterized by fee-for-service reimbursement, there were few incentives to provide non-covered services, such as patient education in diabetes care. In this case, the UK had better outcomes and used fewer resources to achieve them. Some of the incentives to limit services in health maintenance organisations are similar to those of the National Health Service, so these organisations may have achieved outcomes and cost savings intermediate between those of the US and the UK. The McKinsey study combined both HMO and fee-for-service care.

The US had stronger incentives to limit hospital utilization, and to a great extent, it succeeded in discharging hospitalized patients much more rapidly than in the other countries studied. Some of the potential savings that might have been realized from shortened stays were offset by higher staffing levels in US hospitals. There is little or no evidence to suggest that shorter hospitalizations were associated with inferior health outcomes.

Germany's health care system contained a large number of regulatory and systemic features, such as the pay arrangements for heads of hospital departments and disincentives for outpatient surgery, that tended to lead to excessive hospitalization, lengthy convalescence, and high rates of treatment with inpatient surgery. In general, this led to greater resource utilization than in the other countries. Many of the distorting incentives present in Germany during the period of the study, however, were eliminated or modified by subsequent reforms. Information on how incentives were modified and subsequent effects of the modifications were not collected as part of the study.

Why, despite the relatively high productivity of the United States in all but the diabetes case, did the US have much higher per capita health expenditures than the other nations? Expenditure analyses in the disease cases suggest one potential explanation: prices of the inputs to care were much higher in the US. If these findings are valid more generally, the US might spend more despite using inputs into care more efficiently than some other nations.

3. Prospects for disease-specific international comparative studies

The Ageing-Related Diseases project of the OECD has succeeded in capturing some of the most comprehensive comparative data ever assembled for international studies of ischemic heart disease, stroke, and breast cancer. These cases offer novel insights into variation in practice patterns for the management of specific diseases, and offer clues to the productivity associated with different systems for organizing and financing health care. The large number of countries included in each case makes it likely that the results generalize to other settings, or at least to other wealthy nations. The ARD project finds, like the McKinsey study and the TECH project (McClellan and Kessler, 2002), that practice patterns closely track system incentives.

The variation between nations in incentives and practices is the key reason why international comparative studies are so valuable – because the variation is substantial, there is indeed a "natural experiment" that offers a potential window into the consequences of the policies adopted by the different countries. Within-country studies have additional uses, but there is usually less within-country variation in incentives (exceptions include countries with provincial health systems, in which the province can serve as a unit of analysis comparable to a country, and nations like the United States that have diverse financing systems).

Such studies could be improved by better, more comprehensive data on the clinical conditions, outcomes of treatment, input factors, and costs. Such data would better establish the validity of the research findings. Beyond refinements of the data, the important next step for international studies is to ascertain which policy implications reliably follow from the analyses. Such studies cannot tell us how much money each country should devote to health care – which is largely a question of values and priorities – but they can help to identify the policies that are most likely to lead to appropriate use of health care resources, and the costs that come from being slower or faster in making new medical procedures available. These clues, despite the caveats that inevitably accompany large observational studies with less-than-ideal data, can be immensely valuable for formulating health policy.

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PART II

Why do Different Countries Spend Different Amounts on Health Care?

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What is Best and at What Cost?
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PART II

Chapter 6

Why do Different Countries Spend Different Amounts on Health Care?

Macroeconomic Analysis of Differences in Health Care Expenditure

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Abstract. *International comparisons of health expenditures have attracted considerable interest among health economists, among others. Many studies have demonstrated that aggregate income appears to be the most important factor in explaining health expenditure variation among countries. This paper presents a brief summary of the findings discussed in the literature on international comparisons of health care expenditure. It also presents a regression analysis of health care expenditures in 1998 in the OECD countries. Data on the relation between age, mortality and health care costs are presented and discussed. The paper ends with some concluding remarks on the need for further research.*

Introduction

Since the early 1970s, international comparisons of health expenditures have attracted considerable interest among health economists, among others. One reason is that comparisons of this kind permit a systematic investigation of the impact of various organisational structures and other explanatory variables. Many studies have demonstrated that aggregate income appears to be the most important factor in explaining health expenditure variation among countries. It is also a common result that the income elasticity is high and even higher than unity, indicating that health care is a luxury good. This seems to be the case independently of how the health care system is organised and financed.

The objective of this paper is to present and discuss the answers provided to the question in the title. The next section is a brief summary of the findings discussed in the literature on international comparisons of health care expenditure. It also presents a regression analysis of health care expenditures in 1998 in the OECD countries. Section 2 deals with what can be learned from such comparative studies. In Section 3 some data on the relation between age, mortality and health care costs are presented and discussed. The paper ends with some concluding remarks on the need for further research.

1. Health care expenditure – international comparisons

1.1. The basics

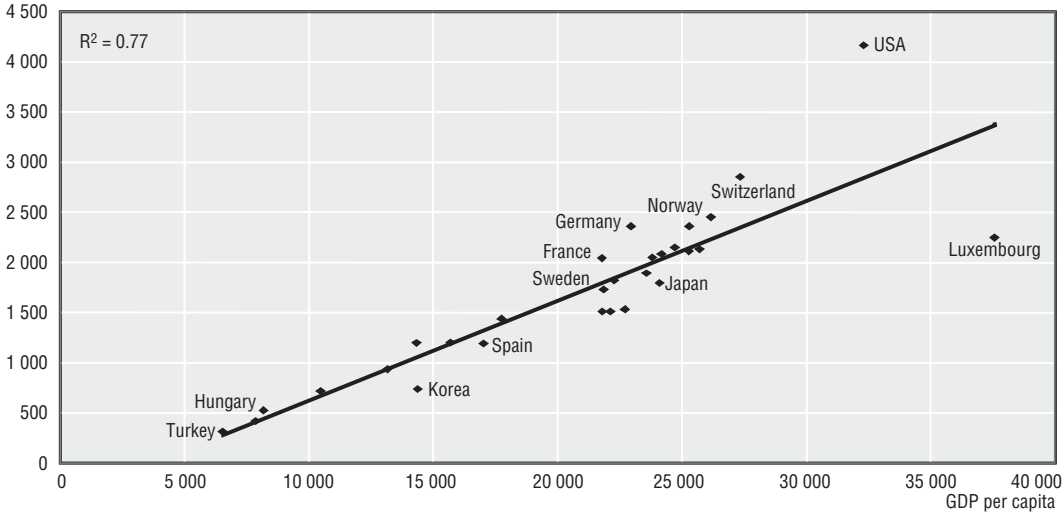
In a seminal article, Newhouse (1977), compared health care expenditure and GDP per capita at exchange rates for 13 developed countries using 1971 OECD data. The two principal results were that aggregate income explains almost all, about 92%, of the variation in health care expenditure between countries, and that the income elasticity exceeded one. On the basis of this result, Newhouse concluded that factors other than income, for example out-of-pocket payments and the method of reimbursing physicians were of marginal significance and that health care is a luxury good. These results have been thoroughly researched and debated, but seems to have been able to stand up to challenges (Barros, 1998; Gerdtham *et al.*, 1998), although some studies have questioned the importance of aggregate income (OECD, 1995; Kanavos and Yfantopolous, 1999).

Later, Newhouse has emphasized the role of "technology" as an explanation of the increase in health expenditure (Newhouse, 1992). Other, more recent articles have also discussed the role of technology and made the observation that the effect of technological change is likely to depend on institutional arrangements (Blomqvist and Carter, 1997). However, it is difficult to judge if technology is the cause of the increase in costs or a consequence of increased spending on health care, a problem exacerbated by the difficulty in obtaining a measurable proxy for technology.

Before we dig into the details of these studies and arguments, let us look at a similar analysis using the latest OECD data set. Figure 6.1 shows health expenditures and GDP per capita in the OECD countries in 1998, expressed in purchasing power parity US dollars.

Figure 6.1. **Health expenditures and GDP per capita, 1998**

US dollars PPP



Source: OECD Health Data 2001.

There is a large variation among the OECD countries in health expenditure as well as in GDP. Health expenditure per capita is nearly three times as high in United States as in United Kingdom, and the GDP per capita of Luxembourg is more than five times that of Turkey. Health expenditure per capita in Sweden is equal to that in Finland but lower than in Norway and Denmark (see Table 6.1 for more details).

As can be seen in Figure 6.1, there is a relatively strong correlation between GDP per capita and health expenditure per capita. Around 77% of the variation in health expenditure per capita can be explained by the variation in GDP per capita. The correlation is lower than the one observed by Newhouse, which may be explained by the greater number of countries included, but if we exclude the "outliers", United States and Luxembourg, it will increase to the same level ($R^2 = 0.90$).

1.2. Review of the empirical evidence on the determinants of health care expenditure

Gerdtham and Jönsson (2000) reviewed the literature on international comparisons of health expenditure until 1998. The review includes both cross-section studies using multivariate regressions and panel-data studies. The main findings are summarised below:

- A common and extremely robust result of international comparisons is that the effect of per capita GDP (income) on expenditure is clearly positive and significant and, further, that the estimated income elasticity is clearly higher than zero and close to unity or higher than unity.
- The effects of population age structure and unemployment rate are usually insignificant.
- The use of primary care "gatekeepers" seems to result in lower health expenditure.
- Significantly lower levels of health expenditure appear to occur in systems where the patient first pays the provider and then seeks reimbursement, compared to other systems.
- Capitation systems tend to lead to lower expenditure on average than fee-for-service systems.

Table 6.1. **Health expenditure and GDP in OECD countries, 1998**

	Total health expenditure per capita (US$ PPP)	GDP per capita (US$ PPP)	Public/total health expenditure (%)	Population > 65 (%)	Beds/ 1 000 inhabitants	Gatekeeper (1 = yes, 0 = no)
Australia	2 085	24 181	70.0	12.2	8.5	1
Austria	1 894	23 574	71.8	15.4	8.9	0
Belgium	2 050	23 805	71.2	16.5	7.2	0
Canada	2 360	25 293	70.1	12.3	4.1	1
Czech Republic	937	13 164	91.9	13.7	8.9	0
Denmark	2 132	25 702	81.9	14.9	4.5	1
Finland	1 510	21 793	76.3	14.7	7.8	1
France	2 043	21 785	77.7	15.8	8.5	0
Germany	2 361	22 953	75.8	16.6	9.3	0
Greece	1 198	14 327	56.3	16.6	5.0	0
Hungary	717	10 477	76.5	14.5	8.2	0
Iceland	2 113	25 277	83.9	11.5	9.1	0
Ireland	1 534	22 710	76.8	11.4	3.7	1
Italy	1 824	22 271	67.3	17.6	5.5	1
Japan	1 795	24 102	78.5	16.2	16.5	0
Korea	740	14 384	46.2	6.6	5.1	0
Luxembourg	2 246	37 567	92.4	14.3	8.0	0
Mexico	419	7 864	48.0	5.1	1.1	0
Netherlands	2 150	24 714	68.6	13.5	11.3	1
New Zealand	1 440	17 745	77.0	11.6	6.2	1
Norway	2 452	26 161	75.8	15.6	4.0	1
Poland	524	8 181	65.4	11.8	5.3	0
Portugal	1 203	15 696	66.9	15.1	4.0	1
Spain	1 194	17 027	76.4	16.3	3.9	1
Sweden	1 732	21 855	83.8	17.4	3.8	0
Switzerland	2 853	27 336	73.2	15.1	18.1	0
United Kingdom	1 510	22 119	83.3	15.7	4.2	1
Turkey	316	6 544	71.9	5.2	2.5	0
United States	4 165	32 299	44.8	12.4	3.7	0
OECD average	1 707	20 721	72.4	13.6	6.8	–

Source: *OECD Health Data 2001* and European Observatory on Health Care Systems.

- The ratio of in-patient expenditure to total health expenditure is positively related to health expenditures.
- Public sector provision of health services is associated with lower health expenditure.
- The total supply of doctors may have a positive effect on health expenditure.

Musgrove *et al*. (2002) analysed national health accounts estimates for 191 WHO member states for 1997. They found that total health spending rises from around 2-3% of GDP at low incomes (< 1 000 US dollars per capita), to typically 8-9% at high incomes (> 7 000 US dollars per capita). They found as much relative variation in the share for poor countries as for rich ones, and even more relative variation in amounts of US dollars.

Further, at low incomes, out-of-pocket spending is high on average and varies from 20-80% of total health expenditure. At high incomes that share drops sharply and the variation narrows. Absolute out-of-pocket expenditure nonetheless increases with income. Public financing increases faster, and as a share of GDP, and converges at high incomes. Health takes an increasing share of total public expenditure as income rises, from 5-6% to around 10%.

1.3. OECD 1998 – An up-date and replicate

Most studies of the determinants of health care expenditures use data from the 1970s and the 1980s. The latest major study, Gerdtham *et al.* (1998) used data up until 1991. It is thus interesting to see if the findings are still valid. Using cross-sectional data for 1998 from *OECD Health Data 2001*, we run a multiple regression analysis with some of the earlier defined determinants. The following log-linear (the continuous variables transformed in natural logarithms) model was specified:

$$HE_i = b_0 + b_1\, GDP_i + b_2\, PHE_i + b_3\, Age65_i + b_4\, Beds_i + b_5\, Gatekeeper_i + e_i,$$

where *i* denotes the i'th country, $i = 1, 2, \ldots, 29$; *HE* is the total health expenditure per capita and *GDP* is the gross domestic product per capita, both in purchasing power parity US dollars. *PHE* is the share of total health expenditure that is publicly financed. *Age65* is the percentage of the population aged over 65. Beds is the number of in-patient beds per 1 000 inhabitants. *Gatekeeper*, finally, is a dummy variable indicating whether the primary care has a gatekeeper function.

The selection of explanatory variables was based on the results presented by Gerdtham and Jönsson (2000). Some other variables were considered on the supply side (number of physicians, admission rate). None of these were included in the model, mainly due to data problems, *i.e.,* difficulties to find valid and comparable data from all countries.

The estimation process started from an unrestricted equation including all five independent variables in the above model, which was then reduced by successive elimination of variables not significantly correlated (on the basis of individual t-statistics) with the dependent variable.

The regression results are summarised in Table 6.2.

Table 6.2. **Regression results**

Dependent variable: health expenditure per capita

Variable	General model		Reduced model	
	Coefficient	t-value	Coefficient	t-value
Constant	–3.643[1]	–3.388	–3 750[1]	–4.074
GDP	1.217[1]	13 631	1 222[1]	15 069
PHE	–0.463[2]	–2 471	–0.448[2]	–2 596
Age 65	0.341[2]	2 698	0.356[1]	3 051
Beds	2.742E-02	0.405		
Gatekeeper	–1.209E-02	–0.189		
df	23		25	
R^2 (R^2 adj.)	0.947 (0.936)		0.947 (0.940)	

1 and 2. Represent 1% and 5% levels of significance, respectively.
Source: OECD (2001) and Gerdtham and Jönsson (2000).

Health expenditure increases with aggregate income (GDP) and with the share of the population over 65, while a high share of public financing seems to be correlated to lower health expenditure. There is no significant correlation with the supply-related variable number of hospital beds or with the presence of a gatekeeper function. The results are as expected, with two exceptions; the age structure of the population and the presence of primary care gatekeepers. However, the results are relatively sensitive to which countries are included in the analysis. For example, if United States is excluded the significant

correlation between share of public financing and health expenditure disappears. Likewise, the significance of the age variable is due to the inclusion in the OECD database of some countries with very young populations and low expenditures (Korea and Mexico).

2. What can we learn from these comparisons?

What do these studies tell us about the various health care systems? Are some of them more efficient? Are some more equitable?

Obviously, these kind of studies give no direct answers to these questions. Without information on prices per unit of service provided they tell us nothing about the quantity of health services provided in the various countries. The fact that health expenditure share of income increases with income per capita in most countries does not necessarily imply that health care consumption is higher in rich countries. Firstly, maybe they just pay more per unit of service provided. However, studies using health care specific PPPs as deflators or explicitly including the relative price for health care in the regression equation produce the same income elasticity, see Gerdtham and Jönsson (1991b and c). These studies also show that the relative price of health care has a strong rationing effect on quantity, *i.e.* a price elasticity of –0.84 indicate that decision-makers will adjust the quantity of care according to price changes. Secondly, data on health spending during the 1990s show that the expenditure share does not necessarily increase with income per capita (*OECD Health Data 2001*).

The fact the United States is above the regression line, *i.e.* has higher than expected health expenditures, does not depend on a higher average consumption, but is mainly a reflection of an expensive health care. Standardised for the high price level, the US will end up close to the regression line. A closer look at the high expenditures in the US, over 50% higher than the OECD average, show that relative prices account for the major part of the higher costs (Reinhardt *et al.*, 2002). Physician salaries are three times higher than the OECD average and the ratio of the average income of a US physician to the average employee compensation for the United States as a whole is about 5.5 as compared to about 1.5 in Great Britain and Sweden. At least one study of inpatient care has shown that US patients receive much more intensive treatment than, for example, patients in Canada, without significantly better outcomes (Newhouse *et al.*, 1988).

The health expenditure share of GDP is a ratio, by definition the product of the relative price of health care and quantity, divided by GDP. This is important in comparisons over time and in interpreting the positions of various countries relative to the regression line in Figure 6.1. The ratio may decrease even if health expenditures increase, if GDP increases at a higher rate. On the other hand, an increasing ratio may be a consequence of unchanged or decreasing health expenditures in combination with a decreasing GDP. An example is Finland, where the health expenditure share of GDP increased from 7.4% in 1989 to 9.3% three years later, mainly as a consequence of a 16% decrease in GDP, which in turn was a result of the lost export to the Soviet Union. Luxembourg's position below the line does not mean that Luxembourg has very low health expenditures but is merely a consequence of the high GDP per capita in that country. The position of Sweden is also a consequence of relatively slow economic growth. Fifteen years ago the Swedish GDP per capita was about 25% higher than the OECD average. Today Sweden is close to the average. So, with regard to the general economic wealth – in terms of GDP per capita – Sweden seems to have the health care cost expected. However, it should be noted that the Swedish level of health expenditures underestimates the real size of the health care services consumed (the volume) since the relative price is low.

Comparative studies of this kind have also been criticised because they focus on expenditure instead of the concept of opportunity cost. Consequently, "staff density and structure" has been launched as a complementary measure of health care resources. That may give a somewhat different picture of health care system capacity in various countries. In recent decades, the number of physicians and nurses have increased considerably faster in Sweden than in the rest of Europe and in the United States, while at the same time their relative salaries have been reduced (Anell and Willis, 2000). It may be an interesting observation, but it does not add very much to the understanding of the determinants of health care costs and expenditures.

The share of GDP spent on health care says nothing about the quality of care, health outcomes, effectiveness, or about the distribution of health care consumption. Neither do international comparisons give such information. Nevertheless, comparisons like these can be of interest from a health economics perspective. Analyses of the influence of different factors on health expenditures may, for example, contribute to identifying factors responsible for an inefficient resource utilisation, and thereby indirectly to more efficient resource utilisation. For example, the study by Leu attempted to identify inefficiencies derived from public choice theory (Leu, 1986). Gerdtham and Jönsson (1991a) focused on the potential effect on expenditures of open-ended financing systems. In both these cases, identification of such correlation would indicate that spending at the margin might be of low value compared to the opportunity cost. However, we must recognise the debate about the value of welfare economics for deriving hypothesis about inefficiencies in health care systems (Evans and Barer, 1995).

To sum up, there is every reason to be careful when interpreting international comparisons of the kind presented in Figure 6.1. It is not possible to draw directly any conclusions about the quality or efficiency of a health care system from international comparisons of health expenditures and their share of GDP. Alternative measures need to be developed, that describe the resources used for health care, as well as the correlation with performance, quality and outcome.

3. Impact of population age structure – Sweden as an example

In Figure 6.1, Sweden is close to the average among the OECD countries – regarding health expenditure per capita as well as GDP per capita and health expenditure share of GDP. In the 1980s, Sweden had a position farther to the right and higher in the diagram, even above the regression line. The change in Sweden's relative position is partly due to the Ädel-reform. Since 1992, elderly care is a responsibility for the municipalities and thus not included in the official health expenditure statistics.

The problem to separate medical and social services for the elderly is not only a problem in time series analysis but also in international comparisons, particularly when it comes to identification of the impact of an increasing number of elderly on health care expenditure.

Table 6.3 shows the costs for health care and elderly care in different age groups. Elderly care includes nursing home care, other residential care and services provided to the elderly in their home. Part of elderly care is medical services, and health care can include elements of social services. However, after the Ädel reform, when the "bed-blockers" were discharged from hospital (the number of hospital days decreased about 45% in Sweden during the 1990s) that part is very small. However, the medical care component in elderly

Table 6.3. **Age-specific health and elderly care costs and age-specific mortality are strongly correlated**

	Age 00-19	Age 20-34	Age 35-49	Age 50-64	Age 65-74	Age 75-84	Age 85+
Cost of care (SEK	5 914	7 529	9 652	13 623	27 581	71 422	174 111
Health care	5 914	7 529	9 652	13 623	20 395	26 732	27 601
Elderly care	0	0	0	0	7 186	44 690	146 510
Mortality rate per 1 000	0.356	0.578	1.627	6.012	20.982	57.268	153.670

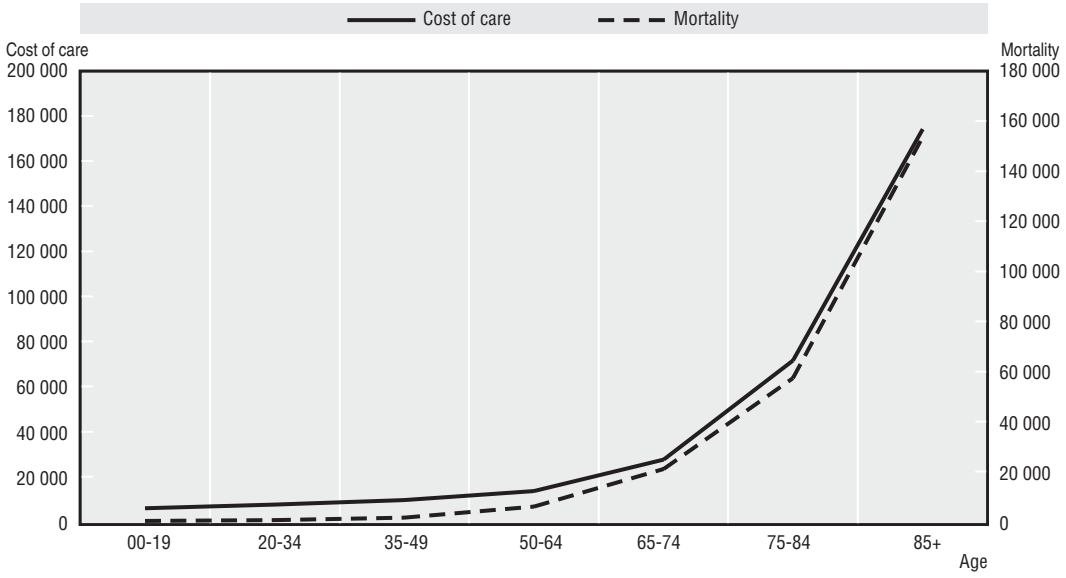
Source: Ekman (2002), *Statistical Yearbook of Sweden* (1999).

care is significant. A study by the National Board of Health and Welfare (NBHW) in Sweden revealed that the share is on average about 15% (NBHW, 2001a). The calculation of this share is a technical issue, since medical care and elderly care is produced as a joint production, where only specific elements can be separated.

This is not only a problem for international comparisons between countries and over time, but also for assessing the impact of an increasing share of elderly on costs. As is shown in Table 6.3, the cost for elderly care is higher than health care from 75 years and increasing at a steeper rate. The arrangements for care of the elderly varies greatly between countries, in some countries a major part is absorbed through informal care. It is thus difficult to collect comparable data.

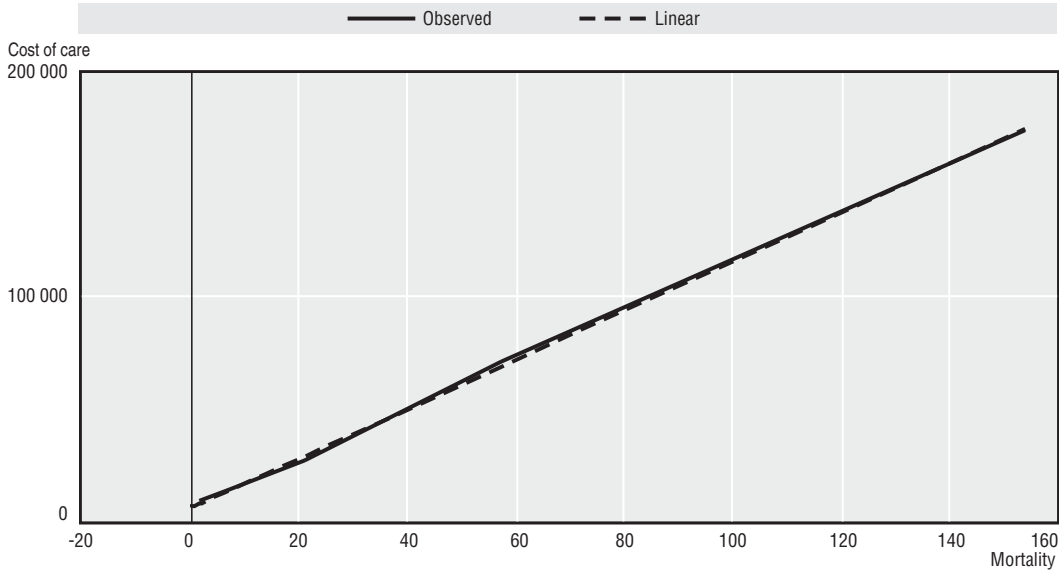
The age factor is also influenced by the strong correlation between age and mortality. As the data in Table 6.3 suggest, and the curves in Figure 6.2 illustrate, there is a strong correlation between the health and elderly care costs and mortality rates in Sweden in 1997. If the two curves in Figure 6.2 are instead plotted against each other, the close relationship becomes even more apparent, as can be seen in Figure 6.3. Linear curve fitting with age specific mortality as the independent variable gives an adjusted R^2-value of 0.999.

Figure 6.2. **The age-specific cost of care (SEK) and the age specific mortality (per 1 000) plotted in the same figure**



Source: Ekman (2002), *Statistical Yearbook of Sweden* (1999).

Figure 6.3. **The age specific cost of care and the age specific mortality plotted against each other**



Source: Ekman (2002), *Statistical Yearbook of Sweden* (1999).

The strong correlation between costs (in different age groups) and mortality, in combination with the observation that the last years of life account for a large share of life time health care costs, have produced the hypothesis that it is time to death rather than age that is the driver for health care costs (Zweifel *et al.*, 1999). It has still not been tested if differences in mortality rates between countries can explain differences in costs. It is unlikely at a macro level, since mortality rates differ much less between countries than the age structure.

4. The output of health care

Health care is not only a cost to society but it also contributes in various ways to economic growth. This fact is highlighted in a report of the World Health Organisation's Commission on Macroeconomics and Health (WHO, 2001). The report, which focuses mainly on low-income countries and the poor in middle-income countries, states that the linkages of health to poverty reduction and long-term economic growth are powerful, much stronger than is generally understood.

A central recommendation of the Commission is that both donor countries and developing countries should greatly increase their investments in the health sector. According to the Commission a scaling up of donor funding by 0.1% of the incomes of rich countries will translate into about eight million lives saved by the end of this decade. The poor countries are called upon to establish national commissions and to chart out a strategy for scaling-up efforts to implement the recommendations.

To be sure, the link between health care and health improvements has been questioned. It has been argued that, at least in rich countries, health care contributes relatively little to improved health. During the twentieth century life expectancy at birth increased by 20-25 years in Sweden. According to a rough estimation based on Bunker *et al.* (1994), about five of these years could be assigned to health care (NBHW, 2001b).

Nixon (2000) found for the EU countries that as per capita health expenditure increases, infant mortality decreases, and vice-versa. For life expectancy the results were less convincing with a positive correlation for female life expectancy but a negative sign for male life expectancy. He concluded that statistical tests of significance for a causal link will require more detailed analyses.

Bhargava *et al.* (2001) modelled the proximate determinants of economic growth at five-year intervals using panel data on GDP series. The models showed significant effects of adult survival rates (ASR) on economic growth rates for low income countries. For example, for the poorest countries, a 1% change in ASR was associated with an approximate 0.05% increase in economic growth. A similar increase of 1% in investment/GDP ratio was associated with a 0.014% increase. For highly developed countries such as United States, France and Switzerland, the estimated effect of ASR on economic growth was negative.

Since the health care production function certainly is subject to the law of diminishing returns, the benefits of health care can be expected to be higher in poor countries than in rich ones. This is confirmed by the findings made by *e.g.* Barro and Sala-i-Martin (1995), that the positive linkage between per capita GDP and life-expectancy diminishes as per capita GDP increases, and also that the inverse relation between infant mortality and per capita GDP attenuates as per capita GDP rises.

Another aspect of the output of health care concerns the way health care is measured in national accounts. Nations generally measure their economic performance using the yardstick of national output and income. This approach, however, does not fully capture improvements in the health of the population.

Nordhaus (2002) examined some of the shortcomings of traditional concepts, and proposed a new concept – health income – that can be used to incorporate improvements in health status. He also discussed how the proposed measure fits into existing theories of consumption and valuation, and applied the concepts to the United States over the twentieth century. It was concluded that accounting for improvements in the health status of the population would make a substantial difference to the measures of economic welfare. Nordhaus concludes that, over the last half-century, health care expenditure appears to have contributed as much to economic welfare as the rest of consumption expenditure.

5. Concluding remarks

Three decades of international comparative studies of the macroeconomic determinants of health care expenditures have produced a number of insights. Where are we going from here? Gerdtham and Jönsson (2000) demanded more theory of the macroeconomic analysis of health expenditure. Without a theoretical framework, it is difficult to make progress in this type of analysis, since data seldom speak for themselves. Most of the hypotheses tested so far, such as income, relative prices, public financing and open-endedness of systems, have been derived from microeconomic theory. As our understanding of the development of health care systems increases, and more data are available to describe them, it should be possible to develop other testable hypothesis. Kanavos and Mossialos (1999) also demand a theoretical framework for international comparisons of health care expenditures, but fail to come up with any concrete options.

An interesting approach is that of Nordhaus (2002), aimed at incorporating improvements in health status into the measurement of national income. Nixon (2000)

tried to find evidence for convergence in health outcomes. Mapelli and Cassetti (1997) use an input-output model in order to find out more about the role of the health care sector in the total economy, and about the interdependency between the health care sector and other sectors. These attempts to include health outcome are mainly looking at the consequences of spending but may also produce some insights to the determinants of expenditures.

This leads us into a different set of policy issues, related to the optimal level of expenditures. There is often a misunderstanding that the fact that expenditures are related to GDP, has the normative significance that any deviations from the regression line is a sign of inefficient allocation of resources. This is obviously not the case, even if we can see that such arguments have an influence on policy in some countries.

The issue about efficient allocation of resources is usually studied in a partial framework using economic evaluations of alternative allocations of resources; for example different treatment strategies. However, we can also see that international comparisons are used for the study of cots and quality for specific diagnosis (see Gandjour *et al.,* 2002). Their study focus on cost-per-patient but could be developed into an analysis of expenditures as well. For some earlier attempts in this direction see Jönsson (1983) and Jönsson and Carlsson (1991).

It is easier to integrate expenditure and efficiency analysis at subsector levels, but a new set of problems of interaction between different subsectors arises. However, with the increasing interest in the contributions of new medical technology to both costs and outcome of health service, we will probably see more studies in the future along these lines. The OECD Ageing-Related Diseases project on disease and treatment specific costing is one example of this.

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PART II

Chapter 7

A Framework for Evaluating Medical Care Systems

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Abstract. *In this paper, I frame existing knowledge about international comparisons of medical systems. I argue that medical systems can be characterized in three ways: a low marginal product of medical care; a high average product of care; and underprovision of care to many people. These features likely result from the importance of technical change in medical care with a system ill-equipped to allocate resources well. Understanding how different systems work in this allocation is a key issue remaining for research.*

* I am grateful to the National Institutes on Aging for research support.

Introduction

It has been notoriously difficult for researchers to compare medical care systems across countries. Some data are available about how medical inputs differ across countries (physicians, nurses, high-tech equipment, and the like), but little information on differences in treatments or in health outcomes. This lack of information has stymied policymakers in many OECD countries. All countries want to do what is best (leaving aside how to define that, for the moment), but no one really knows which model that is.

Partly to shed light on these issues, the OECD has recently led a major research project comparing the medical care systems of different countries. The OECD looked at how common medical conditions are treated across countries, and how health outcomes for people with those conditions compare. There is an enormous amount to be learned from the OECD project. The project itself is extremely well done, and extraordinarily useful. There is much to be learned from it. Some countries that have prided themselves on doing well are not shown in the data to be that good. Other countries whose medical systems are not seen as very compelling in fact do quite well.

In this paper, I summarize what can be learned from the new set of international comparisons, and how to frame our knowledge of international comparisons more generally. My aims are several: to highlight what we know already about medical systems, and what is still to be learned; and to integrate the results from the OECD analysis into the existing literature.

1. Preliminaries

I start with some basics about how to compare medical care systems. There are many goals for medical care systems. *Access* is the ability of people to use the system when needed. It is closely related to *equity*. Medical care is a good that people are not happy allocating through the free market alone. Having the poor get squeezed out of medical care because their income is too low is simply not acceptable. Thus, governments take it upon themselves to guarantee that everyone has at least basic use of the medical system. The value of access depends on the *quality* of the system. All else equal, systems that are higher quality are preferred to those that are lower quality.

Access and quality come at a price, however. Since medical care is often publicly guaranteed, the *costs* of medical care run through the public sector. In the typical OECD country, three-quarters of medical care is paid for by the public sector (OECD, 2002). The debate about how much to spend on medical care is a constant theme in all the OECD countries, and is reflected in the country reports for this project.

In addition, countries have other, non-economic goals in medical care. We would like medical systems to be *responsive* to what people want – used without undue burden or hassle. We would also like the medical system to conform to basic notions of *fairness*. For example, racial and ethnic minorities should not be discriminated against in the medical system.

From an economic perspective, the question is how to trade off these different goals. It is a truism that one cannot have all of everything. To understand this tradeoff, we need a little theory.

There are three potential benefits to spending more on medical care. The first is the value of improved health to the individual affected and his family. This is the primary benefit in most of the situations the OECD studies consider. Treatments for heart disease, stroke, and breast cancer all have benefits largely in the health of those who are sick.

The second potential benefit is the impact of these health changes on the finances of others. Monetary externalities can be either positive or negative. In the case of Ageing-Related Diseases, they are usually negative. Prolonging the life of older people increases the number of years of dependency relative to years of contribution. For younger people, the financial consequences can be positive, as when treatment of a condition such as chronic depression allows more people to go to work.

The third possible benefit is a health externality. When one person receives antibiotics for a bacterial infection, all people are less likely to contract the disease. These health externalities can be negative as well, as when treating viral infections with antibiotics leads to antibiotic resistant strains of disease. These health externalities are an extremely important issue in developing countries, but are less important in the developed world. Most of the money spent on medical care in developed countries goes to care for chronic, non-contagious diseases. I thus ignore this part of the calculation.

These benefits must be weighed against the current and future costs of providing medical care. Treating someone who is sick involves costs up front, and potentially down the road as well. Both the short-term and long-term costs of interventions must be considered in deciding whether additional care is worth it.

2. Characterizing medical systems

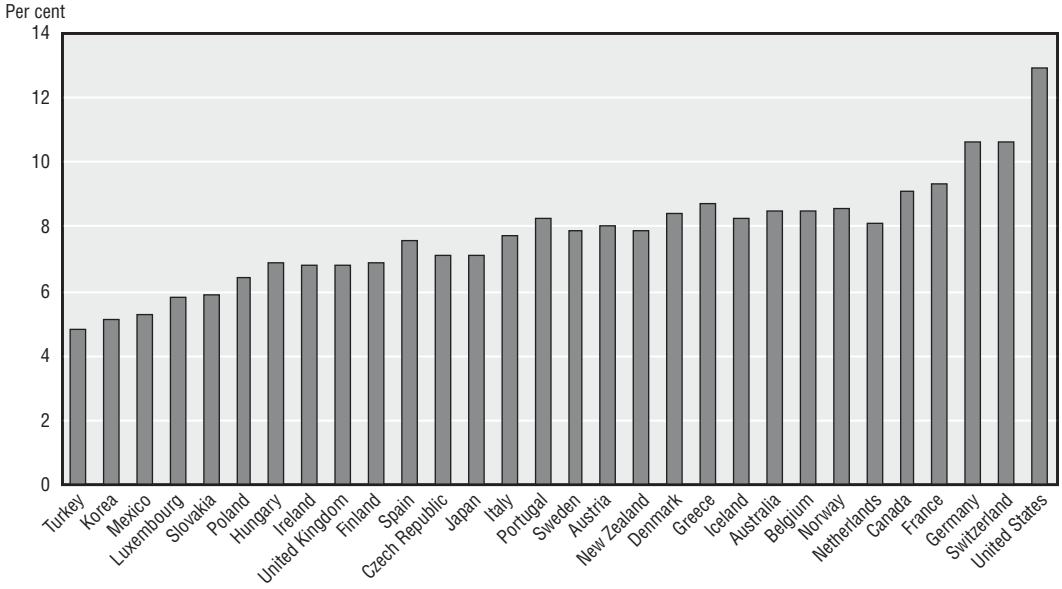
With this framework in mind, I seek to systematize what we know about medical care systems in the developed world. I group the findings into three sets of facts.

Fact 1: At the margin, more spending does not seem like it is worth it. The first fact is a statement about the marginal product of medical care. There is ample evidence for this conclusion. The cross-country data presented in the new OECD studies demonstrate this well. Spending differs greatly across OECD countries. Figure 7.1 shows this graphically. Medical spending ranges from a low of about 5% of GDP (Turkey and Mexico) to nearly 14% of GDP (United States).

And yet, health outcomes differ far less. In the OECD results, there are some countries that are health outliers, but they are rare. The UK does very poorly, and Japan does very well. But these are exceptions. The vast bulk of countries have relatively similar outcomes, despite very large differences in spending. Spending more at the margin is not necessarily associated with better health.

Of course, one needs to know why some countries spend more than others to know how to evaluate this. The OECD studies show that one important source of medical spending differences is differential use of intensive technologies. Countries with higher spending use intensive technologies more. That is not surprising; one would be shocked to discover less use of technology in countries with overall greater budgets. But it is important to rule out pure price differences as the sole source of spending differences (they are one source). And it illustrates a further part to this stylized fact: a lot of the provision of medical

Figure 7.1. **Medical spending as a share of GDP, 1998**



Source: *OECD Health Data* (2002).

services is provided in situations where the marginal product is low. To take just one example, the United State performs intensive surgery on heart attack patients five to ten times more commonly than does Canada, and yet mortality after a heart attack is similar in the two countries (Cutler, 2002).

Of course, quality of life varies too, and some studies estimate that improved quality of life is associated with more intensive procedure use (Rouleau *et al.*, 1993; Mark, 1994; Pilote *et al.*, 1994; Tu *et al.*, 1998). No one has done a full analysis of whether this is true, however. Nor has anyone calculated whether increased provision of intensive care is worth it, if there are quality of life effects. But it is hard to escape the conclusion that at least some of the use of intensive technologies is in situations where it is inappropriate or of only marginal value.

Fact 2: On average, medical spending is worth it. The second fact is somewhat more novel, but I believe the evidence for it is strong: over time, medical technology changes are worth the expense. To understand this result, we need to use the economic framework developed above. I use data from the US, although I suspect data from other countries would yield similar conclusions.

Consider the treatment of cardiovascular disease. Since 1950, cardiovascular disease mortality in the United States has declined by nearly two-thirds. Cardiovascular disease was, and is, the leading cause of death in the United States, but it has been falling in a wave of remarkable progress. Translated into years of life, the average American aged 45 can expect to live another 4½ years today over that in 1950 solely because of reduced cardiovascular disease mortality.

Cardiovascular disease mortality has declined for many reasons. Medical care has improved, leading to better treatment for those who are sick and fewer people having acute events. Similarly, lifestyles have improved, with less smoking and lower fat diets. Cutler and Kadiyala (2002) decompose cardiovascular disease mortality reductions into medical and non-medical components. We find that about two-thirds of lower mortality is a result of

medical advance, and one-third is a result of behavioral changes.* The medical advances include surgical care such as bypass surgery and angioplasty, medications for acute emergencies such as thrombolytics, and preventive medications such as antihypertensives and cholesterol-lowering drugs. The ⅔–⅓ split is not exact, but they are close enough for what I want to do with them. Taking that two-thirds due to better medical care suggests that the average 45-year-old lives an additional three years because medical care has improved.

To value those additional years, we need to know the worth of a year of life. This is a venerable topic in economics. Viscusi (1993) and Murphy and Topel (2002) provide reviews. Most of the studies to date estimate the value of life use a compensating differential framework: people faced with different health risks are analyzed to determine how much they are willing to pay or need to be compensated to avoid a higher level of risk. The answers are not the same in all studies, but the range is relatively tight. A general consensus is that life for a middle-aged person is worth about US$3 million to US$7 million. On an annual basis, this is a value of about US$100 000. I use this as an estimate of the value of a year in good health.

This value is to the person and his family. There are also external costs and benefits that need to be considered. In the case of cardiovascular disease, the external effects are largely costs. People suffering cardiovascular disease are generally older, and older people collect more in benefits than they contribute in taxes. A high-end estimate is that an older person uses US$25 000 more in resources than he contributes on an annual basis. Thus, the net value of reducing cardiovascular disease to society is US$75 000 per year of life.

Finally, the three years of additional life occur several years in the future and need to be discounted to a common year. I discount them to age 45 using a 3% real discount rate. With this assumption, the value of medical care improvements for cardiovascular disease since 1950 is about US$120 000 per person aged 45.

These benefits must be compared to the costs of prolonging life. Spending on cardiovascular disease has increased immensely since 1950. In 1950, little could be done for a person with any serious cardiovascular disease. Today, the set of available technologies includes sophisticated medications, surgical procedures, and monitoring technologies. I estimate that the average 45-year-old will spend US$30 000 more in present value on medical care for cardiovascular disease than his counterparts did in 1950.

The US$30 000 increase in spending is large, but it is much smaller than the value of improved health. Indeed, the health improvement is worth four times what it cost. The rate of return – 300% in this case – is enormous. Medical care costs more over time, but it is worth it.

Cardiovascular disease is only one example, but other examples suggest the same result. I have found similar conclusions in analysis of low birth weight infants, and the treatment of depression and cataracts (Cutler and McClellan, 2001). I have not looked at everything, but at enough to feel relatively confident of the results.

Fact 3: Some care is underprovided. The third fact is the opposite of the first one: many services that are worth providing are not received. The United States provides several examples of this. Perhaps the clearest is the treatment of people who have just had a heart attack. Most such patients should take beta-blockers on an ongoing basis. These drugs, developed in the 1970s, reduce the workload of the heart and cut the risk of a repeat heart attack by about one-quarter.

* The Monica studies of the World Health Organization reach a similar conclusion for the period of the mid-1980s to the mid-1990s (Tunstall-Pedoe *et al.*, 2000).

Beta-blockers are cheap, costing about US$1 per day. Cost-effectiveness analyses uniformly show the benefits of this therapy (Phillips *et al.*, 2000). But despite these favorable attributes, only half of patients who are discharged after a heart attack receive a prescription for a beta-blocker. Further, not all of these receiving a prescription for beta-blockers follow through. As few as one-quarter of heart attack survivors actually receive appropriate levels of therapy (Soumerai *et al.*, 1997). This is in a country that has long prided itself on being technologically sophisticated.

The beta-blocker example is not unique to the United States. In Canada, virtually the same share of people with a heart attack receive beta-blockers as in the United States (Rochon *et al.*, 1999). Canada is similarly poor on diagnosis of other chronic conditions such as depression, which are underdiagnosed in the US as well. Underdiagnosis and undertreatement are pervasive parts of health systems wherever they have been measured.

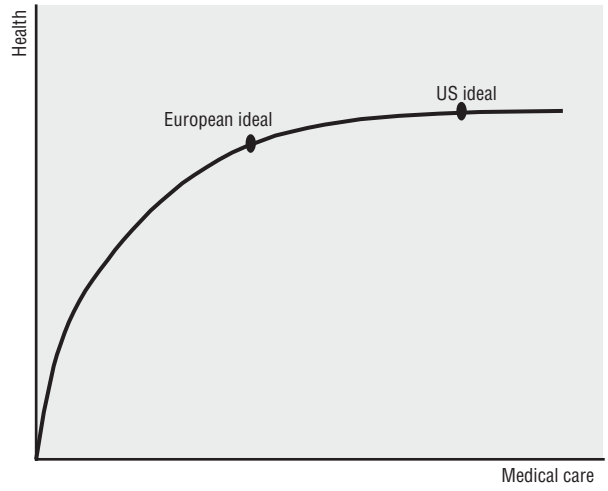
The reason for this is somewhat involved, but has a simple theme: the incentives generated by the reimbursement system. Almost all countries reimburse physicians on a fee-for-service basis. These systems pay well for intensive procedures, moderately well for office visits, but little or nothing for follow-up, monitoring, or error checking. Thus, anything that needs to occur outside of an intensive setting – including learning the literature about appropriate medications and seeing if patients have followed up on those prescriptions – happens relatively poorly. This is the case with much chronic disease care, throughout the world.

3. Explaining the facts

The key question for research is how these disparate facts can co-exist. What theory of the medical system puts them all together? I do not have complete answers to these questions, but I sketch a theory that provides a start.

Start with the relation between medical care and health, shown in Figure 7.2. Medical care is represented here as the number of people treated a particular way. For example, it might be bypass surgery operations after a heart attack, or intensive chemotherapy for women with breast cancer. Associated with each treatment is some health improvement.

Figure 7.2. **Production possibility frontier for health**



Source: Author.

People are ranked so that those benefiting most are at the left end of the chart, nearer the origin. These people should ideally be treated first, with others treated later.

The relation between the number of people treated and total health improvement is given by the production possibility frontier (PPF). It represents the maximum health improvement given the number of people treated. The PPF is concave to the origin because of diminishing marginal productivity.

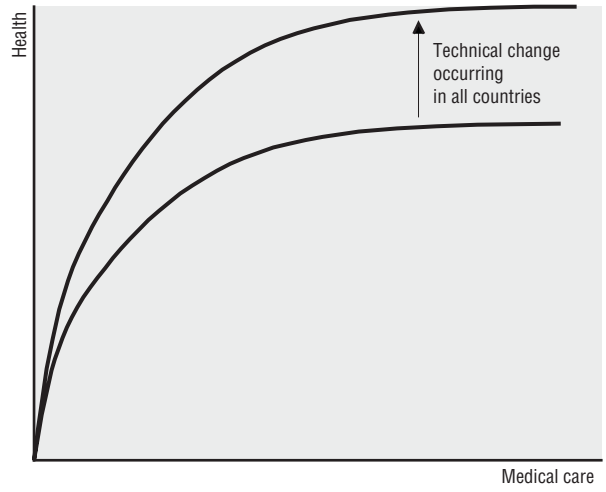
If medical care systems were efficient, countries would locate at different points along the PPF, reflecting their differing tastes for medical care and other goods consumption. The United States, for example, might choose a high level of medical care, reflecting a taste for very intensive treatment, while the European ideal might be somewhere to the left, with lower spending and marginally lower outcomes. Some countries with abnormally low spending – perhaps the UK given the OECD data – would be even further below.

Figure 7.2 shows the low marginal product of medical care. Relative to the European ideal, spending increases substantially in the US without major improvement in health. This is consistent with the first fact noted above.

Technological change can be represented as an upward shift of the production possibility frontier: for the same number of people treated, we can get more health improvement. This is shown in Figure 7.3. Technological change would affect all countries – those initially providing more care as well as those providing less. Thus, all countries are affected by it. The value of this technological change depends on how much it costs. If the cost is smaller than the benefits, the return to technology will be large. This is true even if the marginal product of medical care is low. There is no necessary contradiction between a low marginal product of medical care and a high average product of care, the second fact noted above.

But the assumption that countries are on the production possibility frontier need not be right. In competitive markets, we typically think that outcomes will be efficient, since people get what they are willing to pay for. But medical care is not a classic economic market. The information and pricing problems familiar to all medical care observers mean that there is potential for great inefficiency. The beta-blocker example illustrates this

Figure 7.3. **The impact of technical change**

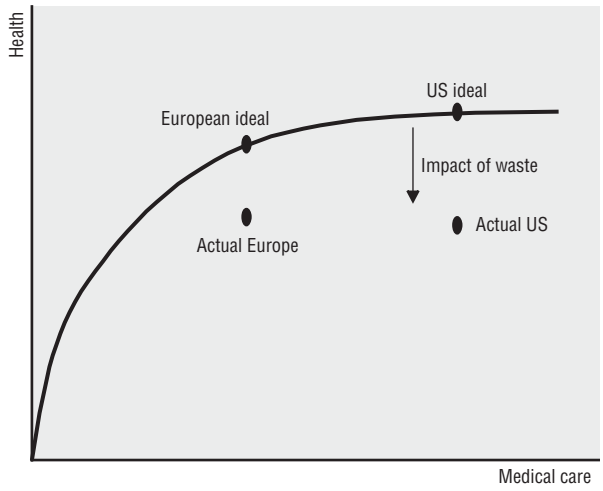


Source: Author.

inefficiency. A technology with low cost and high benefits may not be commonly utilized, because the markets don't work well.

This inefficiency is shown in Figure 7.4. Countries will likely be inside the production possibility frontier, perhaps by differing amounts.

Figure 7.4. **The impact of waste**



Source: Author.

The comparison between the actual US and the actual Europe is not at all clear. European countries will certainly spend less than the US, but outcomes could be better or worse. In fact, outcomes likely vary across Europe, in addition to between Europe and the US. Countries with relatively good allocation schemes would be closer to the PPF, while countries with poor schemes would be farther away.

4. Implications

This economic framework of a production possibility frontier with technical change and allocative inefficiency can potentially explain all of the facts noted above. A low marginal product of medical care results from some countries being on the flat of the curve and (potentially) more inefficiency in high-spending countries. A high average product results from welfare-enhancing technical change. And there is clear evidence for inefficiency.

Beyond reconciling the different facts, this framework also suggests a direction for the OECD studies to pursue. In particular, two questions follow from this model that it would be very fruitful to explore. First, to what extent is the resource allocation more or less efficient in different countries? Developing a way to characterize the efficiency of resource allocation is a clear need in answering this question. Second, has technical change been welfare enhancing in the OECD countries as a whole, or is valuable technological change primarily limited to the US? Answering this question would indicate how much countries should worry about the growth of medical costs, as opposed to the level of waste in the system at a point in time.

These questions seem like a natural avenue for the OECD to pursue, and other organisations to follow. Cross-country medical care comparisons are beginning to make headway on a difficult task. They should continue that momentum and teach us even more.

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PART II

Chapter 8

Integrating Cost-of-disease Studies into Purchasing Power Parities

by
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Abstract. *This paper examines cost data used in the OECD Ageing-Related Diseases study with the objective of assessing whether these data are appropriate for improving Purchasing Power Parity measures for medical care. In principle, the type of data collected are appropriate but the information will need refinement*

* An anonymous referee contributed valuable suggestions for improving the exposition of this paper.

The OECD Ageing-Related Diseases (ARD) study contains information on the cost of specific treatments for heart disease, stroke, and breast cancer. I have been asked to review whether such data on cost of disease treatments are appropriate for improving Purchasing Power Parity (PPP) measures for medical care. The short answer is: cost-of-treatment information is exactly the information that is needed, in principle. However, the information in the ARD studies might need a little refinement. The rest of this paper explains.

1. Health care expenditures and health

I begin by considering a contention that frequently arises in discussions of the relation between medical expenditures and health. One frequently hears statements such as: US spending on health care, which amounts to around 13% of GDP, must not be productive (says the speaker), because life expectancy in the US is lower than it is in some other countries that spend a smaller amount on health care. What is the relationship between medical care expenditures and health?

There is little disagreement that health is produced by many factors, and not solely by the activities of the medical sector. Diet, lifestyles, environmental factors, genetic endowments, and other influences determine an individual's, or a society's, level of health. It is sometimes asserted that nonmedical influences on health are more important than the medical ones (McKeown, 1976; Mokyr, 1997), and for the major, long-run changes in health, there is much to be said for that position.

Medical and nonmedical influences on the "production" of health can be represented in a very general way as:

health (t) = H (medical (t – n), diet (t – n), lifestyle (t – n),environmental (t – n), genetic, etc.) [1]

"Health" is thus the ultimate output of a "production process" in which medical interventions are one of a number of contributing inputs. Moreover, the present level of health is a consequence, at least in part, of actions in the past – of past expenditures for health care and of past diet, past environmental, and past lifestyle influences. The production of health status is an intertemporal production process, indicated by the (t – n) subscripts in Equation [1], where the right-hand side variables are to be understood as vectors that incorporate information for all past periods in the individual's life.[1]

Some of the variables in Equation [1] are goods whose consumption makes a positive contribution to present utility, but which have an adverse effect on future health. A rich and fatty diet is an example. Grossman (1972) emphasized that abstaining from consumption of such goods is like an investment, in the sense that current consumption (utility) is reduced in order to have greater utility in the future.

The future periods may be a long way off, so the adverse consequences of current unhealthy behavior will be discounted by a rational consumer. For example, Garber and Phelps (1997) remark that a drastic reduction in fatty diets will only increase the (discounted value) of life expectancy by four days for men and 2 days for women. The future health

consequences are normally changes in probabilities, rather than deterministic. Discount rates, assessments of probability changes, and – because of genetic factors, for example – the actual risks of adverse effects may differ greatly across individuals. Thus, their willingness to undertake "investments" in future health – to reduce current unhealthy, but utility-generating, consumption activities – may differ greatly.

As incomes rise and as consumers as a group become more wealthy, consumption of rich diets and more sedentary lifestyles may increase because these are luxury goods.[2] Because expensive medical procedures are also more readily available in a wealthier society, income affects health in two ways. It may encourage less healthy behavior, leading to lower health (Grossman, 1972, presents empirical evidence of this). But income also permits more resources to be devoted to medical care, which increases health.

One might contend that the relation between income and consumption of unhealthy diets is U-shaped: It has long been known that in very poor societies, only the rich are fat, because the poor cannot afford to eat so well. But in wealthier societies, individuals in the lower-income part of the population are more likely to be obese, because with their society's higher income they can afford to eat abundantly (American fast food is cheap, compared with incomes of even the poor), while the rich or the better educated may eat more healthy diets.[3]

Whatever the shape of the relation between income and healthy behaviors, the effects of fatty diets, sedentary behavior, and smoking on heart disease in a society might merely be offset by the development of expensive treatments, such as heart bypass surgery. If so, the overall death rate from heart disease might be the same as the rate in a society with healthier living and a smaller amount of expensive surgery. Cross-country comparisons of heart attack death rates are suggestive in this respect, although (as indicated in the following) not conclusive.

Thus, the incidence of heart disease in two countries tells us nothing about the value of the output of the medical sector. Equation [1] does not imply that a society's *level* of health is determined by its health expenditures or by the level of medical interventions it supports. Neither does it imply that a society with a higher level of health expenditures necessarily has better health than another society with lower health expenditures. Some aggregate-level studies have regressed variables such as countries' levels of pharmaceutical consumption or other measures of medical expenditures on some measure of their health status. Equation [1] suggests how many behavioral and environmental variables must be held constant for such studies to be meaningful. Standard econometric "omitted variable" problems contaminate almost any conceivable cross-country regression specification of Equation [1] – there is little way of determining whether it is the level of health expenditures, or some other collinear but omitted variable that determines cross-country differences in health.

In Triplett (2001) I suggested measuring the contribution of the health care sector to the production of health by the incremental contribution to health caused by medical interventions. That is, using Equation [1]:

$$\text{effectiveness of the health sector } (= N) = \partial(\text{health})/\partial(\text{medical}), \text{other influences constant} \quad [2]$$

where ∂ (health) is the change in health that is attributable to ∂ (medical), the incremental resources put into medical care interventions.

Equation [2] describes a relation between medical procedures and health, *all other influences on health constant*. In principle, since N is derived from Equation [1], one could estimate N from a well-specified form of Equation [1]. However, as noted earlier, it is unlikely that any aggregate regression exercise can ever hold other influences on health constant. For this reason, we need an alternative estimate of N that does hold other influences constant. Scientific evidence on the effectiveness of medical treatments is designed to do just that, with a clinical trial.

Scientific studies of effectiveness are invariably tied to particular interventions. Interventions are, by their nature, specific, and they relate to specific diseases. Measuring the health implications of medical interventions inevitably implies a strategy of examining these interventions on an intervention-by-intervention basis. Economists need, not aggregative information on health expenditures and health status, but information that can be linked to specific medical conditions.

To do this right, ∂ (medical) should include the increments of all the resources required by a medical intervention, which may include direct and indirect costs (unpaid caregiving by the patient's family, for example). And ∂ (health) should be a comprehensive measure that incorporates all of the effects on health of a medical intervention, including unwanted side effects, if any. In the cost-effectiveness literature (Gold *et al.*, 1996), such an impact is called a "health outcome." Gold *et al.* (1996, p. 83) define a health outcome as the end result of a medical intervention, the change in health status associated with the intervention over some evaluation period, or over the patient's lifetime. Equation [2] implies that the *health outcomes associated with medical interventions define the output of the health care sector*.

For measuring prices or costs of medical care, or for estimating medical care services in national accounts, or the productivity of the medical care industry, or for making international comparisons of health care systems, none of this would matter very much if the treatments did not change. Each treatment, z, is associated with one value of N, say, N_z, so we can just count treatments and aggregate them in some way. But treatments do change and they also differ across countries. When change occurs, it is necessary to evaluate the changes in treatment – to use the usual price and output measurement language, one needs to "quality adjust" medical expenditure data for changes in the treatments. It is at this "quality adjustment" point that effectiveness measures are required, because the quality adjustment requires comparing the effectiveness of the new treatment with the old, or the treatment carried out in country A with the one usually used in country B.

Equation [2] thus implies that the information that economists need for measuring health care output is the same as the information needed to determine whether a medical intervention is an effective treatment. This medical data is addressed in cost-effectiveness studies.

It is commonly observed that actual treatments do not always correspond to medical best practice, and that results in practice do not always match the results of clinical trials. In principle, N would be adjusted to take account of these problems (excess surgery, for example). We are a long way from having such adjusted empirical measures, but economic measurement of health expenditures according to the human repair model is just beginning.

2. The human repair model

In Triplett (2001) I considered an approach to measuring the output of medical care that is based on Equations [1] and [2]. I called it the "human repair model," to make the

point that in the human repair model, measuring health care output proceeds in ways that are similar to methods used for nonmedical services (for example, car repair).

In the human repair model, we assemble data on expenditures on treating groups of diseases, such as, for example, expenditures on treating mental conditions, or circulatory diseases, or, if more detailed data are available, on treating heart attacks or treating depression. Such expenditures by disease data are produced in cost-of-disease accounts, including Hodgson and Cohen (1999), Moore *et al.* (1997), Mathers *et al.* (1998), and United Kingdom Department of Health (1996).[4] Regrettably, time series consistency has not been a past priority in constructing cost-of-disease accounts, which creates a substantial data problem.

If we can construct price indexes by disease, then these disease-specific measures of medical inflation can be used as deflators to obtain measures of the real quantity of medical services by disease. For countries that have publicly-provided health care systems, it is more natural to estimate the quantity side: quantity indexes of numbers of treatments, weighted with costs, give the real changes in the quantities of medical care services, and the price indexes are estimated implicitly (see Section 4). The essence of the human repair model is the same in either case: One begins from an accounting for the costs of treating diseases, then the quantity and price information necessary to understand changes or differences in medical care expenditures is constructed on a disease-by-disease basis.

The human repair model obviously contrasts with the "total health/total medical expenditures" approach that I discussed (and rejected) in the previous section. It also contrasts with the approach to medical care price and output measures that have traditionally been pursued in national accounts and in national health accounts (NHA), almost all of which have measured inputs to health care treatments, not the outputs of the medical care process, which are treatments for disease.[5]

In countries where health care is provided by the public sector, health care output is usually measured as is other government output – by combining the inputs that the sector purchases. Because productivity is the ratio of outputs to inputs, measuring output by inputs explicitly eliminates productivity change in the medical care sector, by setting it to zero.

The US has a predominantly privately-produced health care system. Prices are thus relevant, and price indexes are used to create constant price output measures for medical care. Historically in the US, the Consumer Price Index (CPI) component for medical care has been used for deflating medical expenditures in national accounts and national health accounts. This CPI medical care index was until recently constructed from a sample of medical care transactions: a hospital room rate, the price for administering a frequently-prescribed medicine, or the charge for a visit to a doctor's office (see Berndt *et al.*, 2000). Such transactions are effectively medical inputs, but they are sufficiently standardized that the same transaction can be observed repeatedly, which is required for a monthly price index.

The historical US CPI approach also tends to eliminate productivity change, because it sets the unobserved output price equal to the aggregation of the input prices collected for the CPI. Productivity can also be expressed as the ratio of output price to input prices. Actually, for much of the period in which this CPI approach was used in the US, measured health care productivity growth was negative (Triplett, 1999a). Negative measured productivity growth in the medical care sector is also evident in data for Canada (Sharpe *et al.*, 2002).

As suggested by Berndt *et al.* (2000) and in Triplett (2001), the input pricing methodology has never been regarded as satisfactory for measuring health care inflation, output, and productivity, and for the national accounts. Recently, the US Bureau of Labor

Statistics, in its Producer Price Index (PPI) program, shifted to gathering prices for specified medical treatments. The BLS selects a sample of treatments from within a *Diagnostic-Related Group* (DRG) category;[6] it then follow costs of treating the disease sample through time – see Berndt *et al.* (2000). As a direct result, measured medical care productivity growth in the US is no longer negative, it is positive (Triplett and Bosworth, 2002).

A substantial amount of research on improved price indexes by diseases is contained in Cutler and Berndt (2001). These studies go beyond the BLS indexes in explicitly introducing, to the extent possible, medical care outcome measures. Diseases for which price indexes have been constructed by researchers include heart attacks, stroke, breast cancer, premature births, arthritis, cataract surgery, and some others.

Although this research so far does not cover a sufficiently wide set of conditions across the full ICD-9, the human repair/cost-of-disease framework clearly has great promise for improving measures of health care in national accounts. Eurostat (2001) endorses the cost of disease approach for future improvements in national accounts. At this writing, there appears to be substantially less interest in the human repair/cost-of-disease approach among compilers of national health accounts, including those of the US.

For international comparisons, a Purchasing Power Parity (PPP) shows "the ratio of the prices in national currencies of the same good or service in different countries" (Schreyer and Koechlin, 2002). PPPs are like price indexes, except that comparisons are made across countries or areas, at the same point in time. Schreyer and Koechlin (2002) present a good introduction to the topic; see also OECD (2002).

Like most medical care price indexes, PPPs for health care are constructed from a list of inputs to the medical care process. Eurostat-OECD (2002) includes a list of 462 prescription pharmaceuticals, starting with Almax and ending with Xalatan. A set of medical appliances are also included, such as eyeglasses, and medical supplies, such as bandages. Lab tests and general practitioner and other medical consultations (office visits) are other input measures. Prices are obtained for a small number of medical procedures, such as tooth extraction. Indexes of wage rates or earnings for a list of medical occupations complete the Eurostat-OECD PPP health care calculation. Nearly all of the components are input price measures, not output prices.

Results of the latest round (1999) of PPPs for medical care for a selected list of OECD countries are presented in Table 8.1. The US has costs that are substantially higher than other

Table 8.1. **Price levels for health expenditures on GDP at international prices, 1999**

US = 100

Australia	51.5
Belgium	63.2
Canada	50.7
Denmark	78.7
Finland	74.3
Greece	39.0
Italy	61.0
Japan	75.0
United Kingdom	62.5
United States	100.0

Source: OECD (2002), Table 11, p. 152.

OECD countries. The reason usually given is that the US has substantially higher earnings for medical care occupations, and earnings have a large weight in the PPP for medical care.

Because PPP compilations are similar to price indexes, a similar cost-of-disease approach to constructing PPPs is a natural extension of the time series work that is emerging in the national accounts arena. Moreover, one use for PPPs is to compare national accounts aggregates internationally. It is thus reasonable to think about replacing the current PPP procedures, which amount to pricing inputs into the treatment of disease, with explicit measures of the cost-of-disease treatments across countries. Indeed, OECD (1997) contains a proposal for PPP research along these lines.

Pricing the cos- of-disease treatments is not a simple matter. The problems are discussed extensively in the various contributions in the volumes edited by Cutler and Berndt (2001) and Triplett (1999b). But the data in the ARD study provide exactly a step in the desired direction.

3. Assessing the ARD cost-by-procedure data

For the ARD study, researchers gathered unit costs from a variety of sources for specific treatments. For example, in the heart disease study, unit costs of an elective angioplasty were obtained from studies in nine countries.

The three ARD reports themselves express these unit costs data as a proportion of each country's per capita GDP. The reasoning behind this presentation decision is unclear. Apparently, the researchers desired to abstract from elements of medical care that reflected income differences among the countries and that presumably did not have anything to do with treatments. An example might be provision of private telephone lines in hospitals: In higher income countries such amenities might come to be prevalent, essentially because there is a lodging element in a hospital stay with standards that go beyond medical necessity. At one place the report even considers dividing the unit cost data by the existing PPP for medical care.[7]

For calculating a PPP, the unit costs themselves are desired, not the unit costs divided by per capita GDP or by some other number. The underlying unit cost data for the ARD heart disease study are displayed in Table 8.2.

Data in Table 8.2 are calculated in national currency units. If the medical procedures in Table 8.2 are really identical across countries, the data suggest that an elective angioplasty procedure costs about Can$3 000 in Canada in 1996, £3 000 in Great Britain, and US$21 000 in the United States (the Great Britain and United States costs actually refer to earlier years, so they must have risen by 1996).

A PPP unit expresses the costs or prices of a product or common set of products across countries. Typically, for the OECD the common unit is either the unit of the largest country (the United States) or of the OECD average. A PPP for each of the product categories in Table 8.2 can be obtained simply by dividing through by a common currency unit. Table 8.2 is converted into a PPP table using the United States as the numéraire, with the results displayed in Table 8.3A. To take the entry for "elective PTCA" as an example, the PPP can be interpreted as the exchange rate between the US and Australian dollars that reflects cost differences in elective PTCA, which as the table shows is about 25 to 1. In an actual PPP program, some index number formula would be used to combine the individual PPP entries of Table 8.3A (and those for the other disease treatments in the study), but I have not done this for present purposes.

Table 8.2. **Costs by procedure in national currency units**

	Australia	Belgium	Canada	Denmark	Finland	Greece	Italy	Japan	Great Britain	United States
	National currency units									
	AUD	BEF	CAD	DKK	FIM	GDR	EUR	JPY	GBP	USD
	1998-99	1998	1996	1997	1999	1999	1998	1999	1993	1991
1. Uncomplicated AMI	4 803	118 844	4 325	44 717	14 650	430 000	3 889	–	–	–
a) Disch. dead	5 105	–	–	–	–	–	–	–	–	–
b) Disch. alive	–	–	–	–	–	–	–	–	–	–
2. Complicated AMI, with PTCA, alive	9 575	329 262	7 240	58 667	23 090	1 121 638	–	–	–	27 653
3. Complicated AMI, w/o PTCA, alive	6 684	161 060	5 841	58 667	23 090	430 000	4 884	–	–	30 226
4. AMI, deceased	5 857	83 657	–	21 785	10 070	–	3 511	2 651 009	–	–
5. Elective PTCA excl. AMI	5 419	162 351	3 112	31 211	29 610	2 206 391	6 197	1 942 915	3 024	21 113
a) No compl. (incl. AMI)	–	–	–	–	–	–	–	–	–	–
b) PTCA (IHD and compl.)	–	–	–	–	–	–	–	–	–	–
6. CABG	17 596	518 520	8 887	95 357	52 190	2 840 000	12 911	4 324 965	5 722	31 600
a) w/o cath.	–	–	–	–	–	–	–	–	–	–
b) With cath.	–	–	–	150 584	102 860	–	15 600	–	–	–

Source: Moïse and Jacobzone (2003).

Table 8.3A. **PPP for medical procedures, expressed in national currency units relative to US costs**

	Australia	Belgium	Canada	Denmark	Finland	Greece	Italy	Japan	Great Britain	United States
	AUD	BEF	CAD	DKK	FIM	GDR	EUR	JPY	GBP	USD
	1998-99	1998	1996	1997	1999	1999	1998	1999	1993	1991
1. Uncomplicated AMI	Not calculated									
2. Complicated AMI, with PTCA, alive	34.6	1 190.7	26.2	212.2	83.5	4 056.1	–	–	–	100
3. Complicated AMI, w/o PTCA, alive	22.1	532.9	19.3	194.1	76.4	1 422.6	16.2	–	–	100
5. Elective PTCA excl. AMI	25.7	769.0	14.7	147.8	140.2	10 450.4	29.4	9 202.5	14.3	100
6. CABG	55.7	1 640.9	28.1	301.8	165.2	8 987.3	40.9	13 686.6	18.1	100

Note: Unit costs for each country for each line of Table 8.2, divided by US unit cost for the same line.
Source: OECD.

The PPP definition calculated in Table 8.3A is not such an intuitive one. In Table 8.3B, the PPPs are expressed in units of a common currency, in this case the US dollar.[8] In standard PPP terminology, the numbers in Table 8.3B are called "comparative price levels".[9]

Taking as an example the entry for elective PTCA for Canada, Table 8.3B indicates that this procedure costs 11% in Canada of what it costs in the US, expressed in US. dollars. The procedure costs 19% of the US costs in Australia, and around 24% of US costs in Great Britain. For bypass surgery (CABG), Canadian costs are around 20% of the costs for this surgery in the US, Australian, Belgian, Danish and Italian costs are around 40-45%, while in Japan the surgery costs 13% more than in the US.

Table 8.3B. **Comparative price levels**

US = 100

	AUS	BEL	CAN	DNK	FIN	GRC	ITA	JPN	GBR	USA
	1998-99	1998	1996	1997	1999	1999	1998	1999	1993	1991
1. Uncomplicated AMI	Not calculated									
2. Complicated AMI, with PTCA, alive	25.6	33.3	19.0	32.1	16.1	14.9	–	–	–	100
3. Complicated AMI, w/o PTCA, alive	16.4	14.9	14.0	29.4	14.7	5.2	17.2	–	–	100
5. Elective PTCA excl. AMI	19.0	21.5	10.7	22.4	27.0	38.3	31.2	76.1	23.5	100
6. CABG	41.2	45.9	20.4	45.7	31.8	32.9	43.5	113.1	29.7	100

Note: PPPs from Table 8.3A, divided by each country's exchange rate (national currency per US dollar) in 1997.
Source: OECD.

From almost everything that has been written about international comparisons of medical care costs, one expects higher costs in the US. For one thing, it is well established that earnings of medical professionals are higher in the US than in most other countries (an old result, see Aaron and Schwartz, 1983). However, the ratios in Table 8.3B seem too large to be believable. They are substantially greater than the differences recorded in the standard PPP program (see Table 8.1), which records mainly input prices to medical care. If output price spreads among countries were really greater than the spreads in their input prices, this implies that multifactor productivity differences among countries are inversely proportional to their price levels. That is a startling hypothesis.

Moïse and Jacobzone (2003) express a number of qualifications about the cost data (see express Section 6.3.1, paragraphs 19 and 21). I suppose I am saying that the tabulation in Table 8.3B make me more uncomfortable with the data than are the authors.

The ARD cost data were obtained from a variety of studies that were conducted for other purposes. No doubt few of the original researchers were concerned about international comparability. An extension of the ARD work will probably need to collect the prices directly to assure comparability, rather than relying on secondary sources. It is well worth the effort.

4. Conclusions

Although I have reservations about the data that were collected in the ARD study, these are exactly the kind of data that are required to make international comparisons. It is well known that expenditures on health care differ tremendously across countries. One suspects that variations in the costs of medical procedures, variations in the utilizations of different procedures, and perhaps other factors explain these international differences. Decomposing the changes in medical care expenditures into prices and quantities is the first step in understanding international differences in health care expenditures. However, the cost data will no doubt have to be collected with as careful attention to international comparability as are any other PPP collections.

4.1. *A supplementary note on direct quantity measures*

Most of the cost data in the ARD study appear to be costs, or charges, which are not always the same thing as prices. In many OECD countries, prices for medical procedures do

not exist because they are not charged directly, or else the prices that are charged are not realistic prices in the sense that car repair prices express the cost of repairing one's car.

However, one ultimately wants quantity comparisons across countries. How does the real volume of health care services differ internationally? Getting a PPP is only an intermediate step. The same thing is true for national accounts. We want to know changes in, for example, real consumption. Mostly, we measure prices of consumption commodities in order to deflate expenditures data in national accounts – we want quantity measures of consumption (the national accounts term is "volume"), in other words, we want to know about international differences in standards of living. PPPs are only a step toward the ultimate objective.

For non-market commodities, it may make no sense to compute the quantity measures by deflating by a price index because there is no applicable price index. However, a straightforward alternative exists: One can compute a quantity index directly. In the health context, the costs of medical procedures provide the weights for computing a quantity index in national accounts. This is discussed briefly in Triplett (2001).

The same point can be made about PPP comparisons. One wants a PPP in the usual case in order to make comparisons of real consumption levels across countries. In the case of health, one wants a PPP for health services in order to make comparisons of the real consumption of health services across countries. Where health care is not a market commodity, price indexes or PPPs are not really relevant. Instead, one can get at the underlying question – measuring differences in real health services internationally – by computing a quantity index of medical treatments.

For constructing international quantity studies, the costs of medical treatments provide the weights. The PPP (if it is wanted for its own sake) can be computed implicitly. Accordingly, the cost data collected in the ARD study can be used to get at the underlying question, just in a somewhat different form from the usual PPP analysis. Discussion of this point takes us too far afield.

Notes

1. This specification is not intended to deny that current levels of health care expenditure and current diet or lifestyle affect current health, but rather to emphasize the time paths of the effects and the fact that individuals' decisions have intertemporal effects.
2. Smoking apparently has a low income elasticity, but automobile transportation has a high income elasticity almost everywhere, leading to the observation that automobiles kill more people through reduced exercise than they do in accidents.
3. Healthy diets have actually become more expensive: in American grocery stores and inexpensive restaurants, fresh fruits and vegetables no longer provide economical portions of diet. In the analysis of healthy or unhealthy diets, relative prices intrude, as they do in most aspects of consumption behavior.
4. This UK Health Department study, which is not the same UK study that was cited in the OECD reports, followed the same methodology as the US, Canadian and Australian studies, but is somewhat less refined. The OECD reports also cite a newer study from the Netherlands.
5. It is true that much medical care expenditure is for prevention and maintenance; for economy of language, I include these expenditures in "treatments", though allocating them among diseases is difficult.
6. US DRGs are identical to DRGs in Australia and similar to those in other countries. They are based on or can be linked to the international classification of diseases (ICD-9). However, the referee points out that implementations of DRGs differ across countries, creating international noncomparabilities in data derived from DRGs.

7. To the extent that the ARD unit cost data measure output prices, dividing them by the existing PPP input price indexes would actually produce a measure of medical sector productivity. As noted above, existing PPPs for medical care are input cost indexes. One method for calculating multifactor productivity is precisely to divide an output price index by an input price index. See Schreyer's (2001) manual on productivity for the OECD. A qualification is that the PPP does not include all inputs (services of medical capital goods are generally excluded).
8. We used exchange rates for 1997, taken from International Monetary Fund (2002).
9. Comparative price levels "provide a measure of the differences in price levels between countries (…) the number of units of a common currency needed to buy the same [commodity or group of commodities] in each country" (OECD, 2002, p. 12).

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PART III

Measuring Ageing and Health Expenditure Today and Tomorrow

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PART III

Chapter 9

Projecting Future Needs

Long-term Projections of Public Expenditure on Health and Long-term Care for EU Member States*

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Abstract. *The aim of this paper is to present long-term projections of public expenditure on health and long-term care produced by EU member States which try to quantify the future impact of ageing populations on public budgets. This work constitutes the first serious attempt to establish broadly comparable long-term expenditure projections for health and long-term care for the EU member States.*

* This paper essentially summarises the health and long-term care chapter of the EU Economic Policy Committee report "Budgetary Challenges Posed by Ageing Populations" of November 2001, which presents long-term projections on old-age pensions and health and long-term care for EU member States. The work on the projections for health and long-term care were greatly assisted by colleagues in the OECD secretariat (Stéphane Jacobzone and Howard Oxley), colleagues associated with the European Observatory on Health Care Systems (Reinhard Busse, Raphael Wittenberg and Adelina Comas-Herrera) and Daniel Franco of the Bank of Italy. The views expressed in this paper are those of the author alone and do not reflect in any way the policies or views of the European Commission.

1. Summary and background

1.1. *Context and background to the projections*

In late 1999, the Economic Policy Committee of the European Union established a working group to examine the economic and budgetary implications of ageing populations (Working Group on Ageing – WGA).[1] As a first step, the WGA decided to examine the impact of future demographic changes on age-related public expenditures. Having completed projections on pensions, the group started work on public expenditure on health and long-term care in 2001.[2] These projections were run in parallel to, and in close collaboration with, a similar projections exercise in the OECD.

1.2. *The projections*

The WGA projections cover fourteen of the fifteen EU member States, and project expenditure for the period 2000-2050. The expenditure projections were produced by national correspondents of the WGA using a common methodology, a common demographic projection and commonly agreed macroeconomic assumptions.

The projections undertaken "match" current age- and sex-specific estimates of per capita public expenditures to the projected future demographic structure of the population in order to generate projections of total public expenditure on health and long-term care. Using this (relatively simplistic) method allowed the WGA to produce broadly comparable projections for the widest group of countries. However, the results of projections using this methodology should not be treated as likely future levels of expenditure. On the one hand, they do not model the role of non-demographic factors in driving health and long-term care expenditure. On the other, they assume a simple relationship between age and expenditure, when in fact there is a great deal of uncertainty about which demographic features will drive expenditures. In summary, the projections are best thought of as a "snapshot" of the impact of demographic forces on future expenditure levels.

1.3. *Results of the projections*

The projections suggest that the impact of demographic changes on health and long-term care systems could lead to significant pressure for public finances over the long-term. Where member States have presented results for both health care and long-term care, demographic changes would result in an increase in public spending in the range of 1.7 to 3.9 percentage points of GDP between 2000 and 2050. Among these member States, the countries that would experience the highest overall increases in public expenditure tend to see the largest part of this increase in long-term care. These numbers compare with an average increase for 14 OECD countries of 3 to 3.5 percentage points over the same period (Dang *et al.,* 2001). For *health care,* demographic changes could lead to increased public spending in the range of 0.7 to 2.3 percentage points of GDP over the next fifty years. For l*ong-term care*, ageing could lead to increases in expenditure ranging from 0.2 to

2.5 percentage points of GDP – the increase is highest in member States with strong traditions of formally provided long-term care, and thus high initial spending levels.

In summary, the increased fiscal burden implied by demographic changes for health and long-term care systems could be significant, thus having serious repercussions for fiscal sustainability and debt dynamics.

The rest of this paper will be structured as follows. Section 2 will give a short overview of the demographic assumptions underlying the projections. Section 3 will briefly review the relationship between age and health and long-term care expenditures. The methodology for the projections is outlined in Section 4 and Section 5 presents the results.

2. The demographic outlook for the EU – the common projection

The common demographic projection was produced by Eurostat in 2000.

2.1. Underlying assumptions

In the baseline scenario of Eurostat, the following assumptions were made (these are summarised in Table 9.1).

Fertility rates

In 2000, the average fertility rate in the EU was 1.5, with fertility rates ranging from 1.2 in Spain and Italy to 1.8 and 1.9 in Denmark and Ireland respectively. The demographic assumptions assume that fertility rates across member States converge towards an average of 1.7 for the EU by 2050, with most of the increase occurring in the coming two decades. However, even this increase in fertility is too low to ensure a natural replacement of the population or to stabilise its age structure over the projection period.

Migration flows

The baseline scenario of Eurostat assumes average net inward migration to EU member States of around 640 000 persons annually over the projection period, constituting just under 0.2% of the total population.[3] All member States are projected to have net inward migration throughout the projection period, including countries such as Ireland which have experienced substantial inward migration in the recent past.

Life expectancy

This is projected to increase steadily over the projection period. Having risen from 67 in 1960 to 75 in 2000, average life expectancy at birth for men is projected to rise to 80 by 2050. It is also projected to rise for women, from 81 in 2000 to 85 by 2050.

2.2. Main trends

The main trends emerging from the demographic projections undertaken by Eurostat, are summarised in Table 9.2. The total size of the EU population is projected to continue to grow slowly from 376 million in 2000 to 386 million in 2020. Thereafter, it starts to fall reaching 364 million in 2050 – a reduction of some 12 million compared with 2000. This aggregate picture for the EU masks large differences in the timing and scale of the changes among member States. Whereas large falls are projected in the size of the total population in Italy, Spain and Germany over the projection period (17%, 11% and 8% respectively), the total population is projected to grow in a number of countries, including France and the UK

Table 9.1. **Fertility rates, life expectancy and migration flows**

	Fertility rate (number of live births per woman in her lifetime)				Male life expectancy (life expectancy at birth in years)			
	2000	2025	2050	Change	2000	2025	2050	Change
Belgium	1.5	1.8	1.8	0.3	75.3	79.7	80.5	5.2
Denmark	1.8	1.8	1.8	0.0	75.2	78.6	79.4	4.2
Germany	1.4	1.5	1.5	0.1	74.7	78.7	80.0	5.3
Greece	1.3	1.6	1.6	0.3	75.9	80.0	81.0	5.1
Spain	1.2	1.5	1.5	0.3	74.9	77.5	79.0	4.1
France	1.7	1.8	1.8	0.1	74.8	78.8	80.0	5.2
Ireland	1.9	1.8	1.8	–0.1	74.0	77.7	79.0	5.0
Italy	1.2	1.5	1.5	0.3	75.5	79.6	81.0	5.5
Luxembourg	1.7	1.8	1.8	0.1	74.4	79.3	80.0	5.6
Netherlands	1.7	1.8	1.8	0.1	75.5	78.7	80.0	4.5
Austria	1.3	1.5	1.5	0.2	75.0	77.9	81.0	6.0
Portugal	1.5	1.7	1.7	0.2	72.0	76.1	78.0	6.0
Finland	1.7	1.7	1.7	0.0	73.9	78.2	80.0	6.1
Sweden	1.5	1.7	1.8	0.3	77.3	79.5	82.0	4.7
United Kingdom	1.7	1.8	1.8	0.1	75.2	78.9	80.0	4.8
European Union	1.5	1.6	1.7	0.2	75.0	78.7	80.0	5.0

	Female life expectancy (life expectancy at birth in years)				Migration			
					2000		2050	
	2000	2025	2050	Change	Volume[1]	% of pop.	Volume[1]	% of pop.
Belgium	81.4	84.9	85.5	4.0	10	0.10	15	0.15
Denmark	79.6	82.1	83.1	3.5	11	0.20	10	0.18
Germany	80.8	83.9	85.0	4.2	300	0.36	200	0.26
Greece	81.0	83.9	85.0	4.0	22	0.21	25	0.24
Spain	82.1	84.5	85.0	2.9	31	0.08	60	0.17
France	82.8	85.9	87.0	4.2	50	0.08	50	0.08
Ireland	79.4	82.8	84.0	4.6	18	0.46	5	0.11
Italy	82.0	85.0	86.0	4.1	50	0.09	80	0.16
Luxembourg	80.8	84.1	85.0	4.2	3	0.71	2	0.36
Netherlands	80.9	83.6	85.0	4.1	33	0.21	35	0.20
Austria	81.2	83.5	86.0	4.8	10	0.12	20	0.26
Portugal	79.2	82.6	84.0	4.8	12	0.12	25	0.23
Finland	81.1	84.0	85.0	3.9	6	0.11	5	0.10
Sweden	82.0	83.9	86.0	4.0	15	0.17	20	0.23
United Kingdom	80.0	83.6	85.0	5.0	90	0.15	70	0.11
European Union	81.3	84.3	85.5	4.2	661	0.17	622	0.17

1. Net inflow (thousands of persons per year)
Source: Eurostat – central demographic scenario.

(by 5% and 4%) with the largest increases projected for Luxembourg and Ireland (29% and 26%). Moreover, while the total populations of France and the UK are projected to keep growing until 2040, the population level has already started to fall in Italy and is projected to start falling in 2010 in Spain and 2015 in Germany.

The EU working age population (persons aged between 15 and 64) will stay broadly stable at some 246 million until 2015, after which it will decline to 203 million by 2050 – a drop of some 18%. In percentage terms, the largest declines are projected for Spain (29%) and Italy (33%), with only Ireland projected to see an increase (5%). As well as declining in

Table 9.2. **Total population and evolution of demographic dependency ratios**

	Total population (millions)				Share of older workers in working age population (population aged 55-64 as % of population aged 15-64)			
	2000	2050	Change		2000	2050	Change	
			Absolute	%			Absolute	%
Belgium	10.2	10.1	–0.1	–1.4	16	22	6	38
Denmark	5.4	5.5	0.1	2.7	19	21	2	10
Germany	82.3	75.6	–6.8	–8.2	19	22	3	18
Greece	10.5	10.2	–0.3	–3.0	17	21	4	26
Spain	39.4	35.1	–4.3	–10.9	15	22	7	48
France	59.2	62.2	3.0	5.0	14	21	7	46
Ireland	3.8	4.8	1.0	26.0	13	20	7	50
Italy	57.6	48.1	–9.5	–16.5	17	23	5	29
Luxembourg	0.4	0.6	0.1	28.8	15	20	4	29
Netherlands	15.9	17.7	1.8	11.5	15	20	5	36
Austria	8.1	7.6	–0.5	–6.1	17	23	6	38
Portugal	10.0	10.9	0.9	9.1	16	19	4	23
Finland	5.2	5.0	–0.2	–4.3	16	22	6	40
Sweden	8.9	9.2	0.3	3.7	18	23	5	28
United Kingdom	59.5	61.8	2.3	3.8	16	21	6	38
European Union	376.4	364.2	–12.2	–3.2	16	22	6	34
	Very old as a % of elderly (population aged 80+ as a percentage of population aged 65+.)				Old age dependency ratio (population aged 65+ as a percentage of population aged 15-64)			
	2000	2050	Change		2000	2050	Change	
			Absolute	%			Absolute	%
Belgium	21	37	16	73.8	26	45	20	76
Denmark	26	35	8	31.2	22	36	14	65
Germany	22	39	18	80.7	24	49	25	101
Greece	20	33	13	62.4	26	54	28	110
Spain	22	33	11	51.0	25	60	36	146
France	22	38	15	67.3	24	46	30	89
Ireland	23	27	4	18.3	17	40	23	139
Italy	22	39	17	79.3	27	61	35	131
Luxembourg	21	38	16	76.2	21	38	16	76
Netherlands	23	37	14	59.6	20	41	21	103
Austria	23	42	18	77.2	23	54	31	133
Portugal	19	31	12	62.9	23	46	24	104
Finland	22	36	13	59.9	22	44	22	98
Sweden	29	36	6	21.6	27	42	16	58
United Kingdom	25	37	12	45.8	24	42	18	76
European Union	23	37	14	63.7	24	49	26	100

Source: Eurostat.

size, the labour force will be greying, with workers aged between 55 and 64 accounting for an increased share of the total workforce.

At the same time, the numbers of elderly persons aged 65 and above will rise from 61 million in 2000 to 103 million in 2050 – an increase of some 70%. All member States would register increases of over 50% with the largest rates of increase in countries with a low starting position (*e.g.* Ireland, Luxembourg and the Netherlands). Notably, there will be a striking increase in the number of very old persons (*i.e.* aged 80 and above) from 14 million in 2000 to 38 million in 2050. Of course, projections of health and long-term care

expenditure are rather sensitive to the numbers of the very elderly given the high levels of spending for the very old.

As shown in Table 9.2, the old-age dependency ratio (defined as persons aged over 65 as a percentage of working age population) is projected to more than double from 24% in 2000 to 49% in 2050 for the EU, with dependency ratios reaching a new plateau around 2040. Again, there are important differences between member States, with the highest ratios of some 60% in 2050 projected for Spain and Italy.

2.3. The reliability of long-term demographic projections

The WGA explicitly recognised that caution must be exercised in interpreting and using long-term population projections as they become more and more uncertain the longer the projection period. However, it was also noted that many of the changes taking place in demographic structure over the projection period are predicted with a degree of confidence as they rely on past changes in fertility rates and on the increased life expectancy of the population currently alive.[4]

With specific reference to the Eurostat demographic projection, the WGA highlighted two issues. Firstly, a number of member States have pointed out that the common demographic projections differ considerably from projections made by national statistical institutes, and that the assumptions employed by Eurostat do not fully match with their own experiences.[5] Secondly, the baseline scenario assumes a substantial increase in the fertility rate in the coming two decades, and assumes a certain level of inward migration. The accuracy of these assumptions will need to be checked when updated population data becomes available.

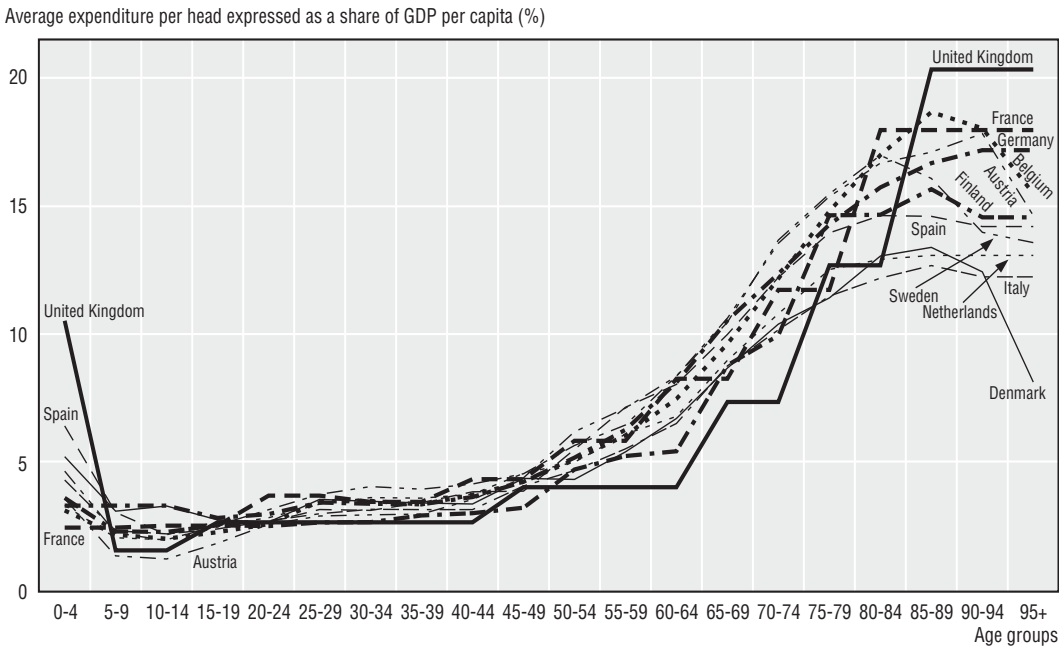
3. Ageing and health and long-term care expenditure

The projections run by the WGA rely upon current age- and sex-specific estimates of per capita public expenditure on health and long-term care. While the methodology for the projections is discussed below, it might be useful to first briefly examine the relationship between ageing and health and long-term care expenditure.

3.1. Patterns of age-related expenditure on health care

Figure 9.1 presents age-specific estimates for public expenditure on health care for some member States. Average expenditures per head on health care for different age groups (expressed as a share of GDP per capita in the figure) are quite similar across member States for prime-age individuals – the largest differences between member States are at the tail-end of the age-distribution. Nevertheless, in all member States, after childhood, the age-related expenditure profiles reveal increasing per capita expenditure levels with age. However, in those member States where expenditure levels for the highest age groups have been estimated separately (notably Austria, Belgium, Denmark and Sweden) expenditure on health care appears to decline somewhat for the highest age groups.[6] In some member States, health expenditure for the youngest age groups is also high.[7] Data broken down by sex reveals that average levels of expenditure on women tend to be higher than those for men in middle-age groups, due to pregnancy. Thus, as at a given point in time, older persons tend to consume more health care than other groups, and so it might seem that health expenditure and ageing are highly related.

Figure 9.1. **Age profiles for public expenditure on health care for males and females**



1. The age-related profiles expressed as a share of GDP per capita, were those used for running the projections of health care expenditure. The base year used for the projections varies slightly across member States and so the profiles in the graph above refer to different years for different member States: 1997 for France, 1998 for Belgium, Denmark, Spain and the United Kingdom; 1999 for Italy; and 2000 for Germany, Finland, Netherlands, Austria, and Sweden. (Profiles for Portugal are not presented here as a different age classification is used.)
2. The expenditure profiles here relate to public expenditure on health care only. Notably, they exclude private expenditures and public expenditure on long-term care.
3. Where the age-profile is flat at the tail-end of the age-distribution, this is generally because a breakdown across age-groups was not available at the highest ages in those member States.

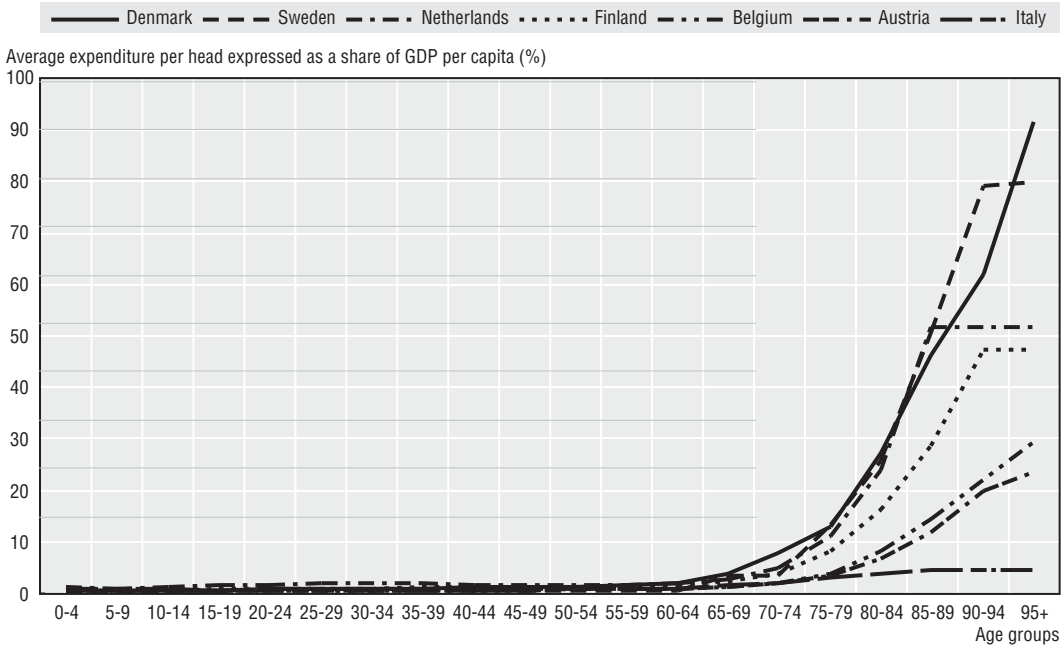
Source: Economic Policy Committee (2001).

However, the age-profiles displayed above for each member State give average expenditure levels per head for different age groups in a single year only. Analysing age-profiles for individual countries over time can illustrate important dynamics in the patterns of health care spending. Notably, some countries, although not all, have experienced greater increases in average expenditure levels for older age groups than for other groups in the past – *i.e.* the steepness of the age distribution has increased over time.[8]

3.2. Patterns of age-related expenditure on long-term care

Long-term care, as distinct from traditional health care intervention, is often required to help persons complete the essential tasks of daily living, which they may be prevented from completing themselves either due to chronic illness, disability or frailty. However, it should be noted that the boundary between health care and long-term care is difficult to draw, and it is thus difficult to disentangle the two elements in expenditure data. Moreover, this boundary is likely to have been drawn differently in different member States in accordance with the differing traditions in organising care across countries. It is nevertheless important to try to separate the two elements in expenditure data, as health and long-term care expenditures have different determinants, and thus different trends over time.

Figure 9.2. **Age profiles for public expenditure on long-term care**



1. The age-related profiles expressed as a share of GDP per capita, were those used for running the projections of long-term care expenditure. The base year used varies across member States, and hence the profiles in the graph above refer to different years for different member States: 1998 for Belgium, Denmark; 1999 for Italy; and 2000 for Austria, Finland, Netherlands, and Sweden.
2. The expenditure profiles here relate to public expenditure on long-term care only.
3. Where the age-profile is flat at the high-end of the age-distribution, this is generally because a breakdown across age-groups was not available at the highest ages in those member States.

Source: Economic Policy Committee (2001).

Figure 9.2 shows expenditure profiles for a number of member States. Age profiles for long-term care expenditure in member States, show very little or no expenditure for young and prime-age individuals,[9] and then rapidly increasing levels of per capita expenditure for elderly persons. Where expenditure profiles for long-term care were broken down by sex, they generally revealed higher per capita expenditure on long-term care for women than men. It is worth noting that whilst average expenditures per head on health care peak for almost all member States at somewhere between 15 and 20% of GDP per capita, the average expenditures per head on long-term care peak at much higher levels. In Figure 9.2, the highest peak of average expenditures is for the age-group 95 years and over in Denmark, where expenditures are around 90% of GDP per capita.

One other striking feature of Figure 9.2 is that long-term care expenditure levels per head differ considerably between countries – this reflects radically different traditions in the provision of care for the elderly. In some member States, care for the elderly is in large part formal, with a large share of formal care provided in an institutional setting,[10] thus leading to high levels of public spending. In other countries the tradition is for informal provision by family members. However, in those countries where there is limited public provision of formal care, some long-term care is likely to be provided through the health system, and thus will be included in data on health expenditure. Thus Figure 9.2 might somewhat exaggerate the extent of the differences in the levels of publicly funded long-term care across countries.

3.3. Ageing and public expenditure on health and long-term care

The age-related pattern of health care expenditure per head discussed above initially fuelled concerns about the future fiscal impact of ageing populations. This is because there will be dramatic increases in the numbers of persons reaching old age and very old age in the coming decades. Firstly, dramatic increases in the numbers of elderly persons are due to the entry into old age of the baby-boomer generation. This generation is larger than those preceding it and larger than those generations following it, representing an imbalance in the age structure. Secondly, there is a long-term trend of increases in life expectancy, which also mean greater numbers of people surviving to old and very old age.

However, the relationship between age and health and long-term care expenditure levels per head is far more complex than these static age-related expenditure profiles suggest. In fact, contrary to the impression created by age-specific profiles of average expenditure, empirical research reveals that population ageing has not been an important driver of aggregate levels of expenditure on health care – Jacobzone (2001) notes that at the aggregate level, no link exists between levels of spending and the relative demographic situation of countries.[11]

For example, in Europe, total expenditure on health roughly doubled as a share of GDP over the period 1960-90. Public expenditure grew even more rapidly as a result of increased coverage by public insurance. However, empirical evidence suggests that ageing was not a significant driving force in the increase in health expenditure, and that other factors were more important (OECD, 1994). These included: increased coverage of public provision of health care or health insurance; increased demand/consumption of health care in line with increased prosperity; and supply-side factors such as the increased use of new and more expensive technology; and high medical price inflation.

One reason for the limited effect of population ageing on health care expenditure, is that health care expenditure over the lifetime of an individual tends to be concentrated at the end of life, irrespective of the age of death (these expenditures at the end of life are sometimes called "death costs"). Because mortality rates are higher at older age groups, the concentration of expenditure at the end of life leads to an upwards bias in the distribution of health expenditure by age for these groups. Thus, to the extent that future population ageing reflects increases in life expectancy as well as increases in the volume of the elderly, projections based on static age-related expenditure profiles are likely to overestimate the impact of ageing on future aggregate expenditure levels.

Life expectancy has increased significantly in Europe in the second half of the last century, and increases are also expected in the future. Increases in life expectancy have gone hand-in-hand with improvements in the average health status of the elderly, particularly for the young elderly (that is persons aged less than 80). On the other hand, very old age (over 80 or 85) continues to be characterised by illness, disability and/or frailty.

For long-term care, Jacobzone (2001) notes that changes in expenditure tend to be driven by trends in disability, institutionalisation, changes in social models (which determine the extent of provision of care in an informal setting), and changes in policy on the provision of care. Results for OECD countries (Jacobzone *et al.*, 2000) reveal reductions in disability, and some reduction in institutionalisation of elderly persons, which may have some (limited) impact on public finances.

In summary, therefore, whilst at any given point in time a large share of the overall resources of health and long-term care systems is devoted to elderly people, this does not

necessarily mean that ageing is or will be a key driver of expenditure increases. A simple combination of age-related expenditure profiles with future demographic projections, as is done in the expenditure projections reported here, gives a somewhat simplistic view of the impact of ageing on health and long-term care expenditures. It best captures the increased pressure on health and long-term care systems emanating from the expected increases in the numbers of persons reaching old and very old age. However, this pressure will be mitigated somewhat by improvements in the health status of the elderly – *i.e.* to the extent that health expenditures are concentrated at the end of life, and that life expectancy is increasing, these simple projections are even likely to overestimate the importance of ageing on expenditure. On the other hand, these projections ignore a number of other underlying causes of increases in health care expenditure, which might lead to increases in costs beyond those assumed here. Jacobzone (2001) notes that projections carried out in this fashion cannot be considered to be "real numbers" for the future, but more a snapshot of the simple effects of demography.

4. Description of the projection exercise

4.1. *Aim and scope of the projections exercise*

The specific aim of the WGA exercise was to run projections of public expenditure on health and long-term care in order to facilitate an assessment of the impact of ageing populations on public finances. In particular, the projections set out to measure *only* the impact of demographic changes – no attempt was made to quantify or project trends in other likely cost drivers. Moreover, the aim of the projection exercise was to produce broadly comparable projections for the largest number of EU member States. Given the varying range of existing data and expertise across member States, it was necessary to choose a methodology which would be relatively simple to apply. Hence the use of age-related expenditure estimates as the basis for the projections, despite their shortcomings.

The projections for *health expenditure* and *long-term care expenditure* were carried out separately in order to isolate the implications of demographic changes for the two different expenditure items. Moreover, the projections include *only public expenditure* on health and long-term care – in some member States private expenditures can be significant. Projections were run for each year from *2000 to 2050*, although the WGA recognised that projections beyond a certain timeframe are likely to be very uncertain. Fourteen member States were able to carry out projections for health expenditure, and ten for long-term care.[12]

4.2. *The methodology for the core projections*

While projections of health care expenditure and long-term care expenditure were run separately, the approach used was exactly the same.

The basic approach

Age- and sex-specific expenditure estimates for a base year were matched to the population structure in that year.[13] That is, the estimates of average expenditure for each age- and sex-specific group were multiplied by the number of people in each group, and the products were summed. Where the sum did not match the measured public expenditure from macroeconomic sources, the expenditure estimates were scaled to give the right macro number for the base year.[14] The scaled age- and sex-specific expenditure estimates were then deflated by GDP per capita (in the base case, see below). For each of the projection years, the deflated expenditure estimates for each age- and sex-group were

matched to the projected number of people in that group, and the products were summed to give the overall estimate of public expenditure for the given projection year as a share of GDP per capita. Finally, the sum was divided by the population level in order to give estimates of public expenditure as a share of future GDP levels.

In this way projections are generated whereby the relative magnitudes of expenditures per head across age- and sex-groups are constant and are defined by the expenditure estimates of the base year. Similarly, the projections assume that average age- and sex-specific expenditure levels remain fixed as a share of GDP per capita throughout the projection period. In other words, the growth rate of average age- and sex-specific expenditures per head in absolute terms, is the same as the growth rate of GDP per capita.

The cost assumptions

Projections were actually carried out using two different *cost assumptions*. The first cost assumption employed, as described above, was that average expenditures per head (across all age- and sex-groups) grow at exactly the same rate as *GDP per capita*. The evolution of expenditure as a share of GDP under this cost assumption can be considered to be neutral in macroeconomic terms – this is because if there were no change in the age composition of the population, then the share of the health/long-term care expenditures in GDP would remain the same over the projection period (even if the population level changes).

The second cost assumption employed was that expenditures per head grow at the same rate as *GDP per worker* (*i.e.* at the same rate as productivity[15]).[16] The logic for this second cost assumption is that wages are a key determinant of costs in the health and long-term care sectors, as these two sectors are labour intensive. It is further assumed that wages in the health sector grow at the same rate as wages in the whole economy, and that wages in the whole economy generally follow the trend of economy-wide productivity.[17]

The main difference between the two cost assumptions relates to whether a change in the rate of labour market participation would have an impact on health/long-term care expenditure expressed in absolute terms (*e.g.* in euros). Using the cost assumption of GDP per capita, higher participation and thus employment, leading to a higher GDP per capita is accompanied with a higher absolute level of expenditure, as the results expressed as a percentage of GDP are projected to be constant. Using the GDP per worker cost assumption, higher participation does not have an impact on the absolute level of health expenditure, thus leading to a decrease of expenditure when expressed as a share a GDP. That is, higher participation would not help in cushioning the budgetary costs of ageing under the GDP per capita cost assumption, but does under the GDP per worker cost assumption.

4.3. *Advantages and disadvantages of the methodology employed*

One of the primary *advantages of the basic approach* used for the projections is that it generates projections which essentially focus on the impact of demographic changes on expenditure levels. Another advantage is its relative simplicity (if age-related expenditure profiles are available).

However, in terms of measuring the future burden for public finances, this approach has a number of *drawbacks*. Firstly, the approach assumes a simple relationship between age and health and long-term care expenditure levels per capita. As discussed in Section 3, the actual future relationship is likely to be far more complex. Notably, the approach taken in these projections ignores the concentration of health expenditures at the end of

life, and is thus likely to overestimate the impact of future demographic changes on overall expenditure levels.

Secondly, the projections do not attempt to explicitly model the impact of non-demographic/microeconomic factors which are likely to be important in driving health and long-term care expenditures in the future. These include the diffusion of medical technology (particularly in health care), relative prices for medical inputs, the intensity of care at older ages, the extent to which long-term care is provided in a formal setting, and the organisational set-up of both health and long-term care systems.

Ideally the likely effects of these microeconomic factors on future possible trends in health expenditure per head would be explicitly modelled, and would be used to determine the cost assumptions for the expenditure projections. However, this would be an exercise which is extremely complex and uncertain, and far beyond the scope of the current projections. Instead, as discussed above, the cost assumptions used in the projections exercise are based on macroeconomic considerations and are moreover relatively neutral in this regard. As a result, the increases in costs-per-head assumed over the projection period are relatively moderate.[18] If the cost assumptions had instead been based on the likely evolution of microeconomic cost drivers, the assumed growth in expenditures per head may well have been significantly higher.

5. The results of the projections

In this section, the main results[19] of the WGA's projections for public expenditure on health and long-term care are presented. As discussed above, projections were carried out using two different cost assumptions. However, as the results are not greatly different under the two different cost assumptions over the long-term, they will be presented together here.

5.1. *Results of baseline projections for public expenditure on both health and long-term care*

Table 9.3 reveals that for those member States that conducted projections of total public expenditure for *both health care and long-term care*, the pure consequences of demographic changes on expenditure would lead to increases ranging from 1.7 to 3.9% of GDP over the projection period. For these member States, overall levels of public expenditure would range between 7.5% of GDP (for Italy) to 12.1% of GDP in 2050 (in Sweden). On average, expenditure would increase by between 2.2 and 2.7 percentage points of GDP by 2050 from 6.6% in 2000 – this compares with an increase of 3.3 percentage points by 2050 from a starting level of 6.6% in 2000 for fourteen OECD countries.

With the exception of Austria, all of the member States that would experience the highest overall increases in total public expenditure on health and long-term care (over 3 percentage points of GDP), would experience the largest part of this increase through increased public expenditure on long-term care rather than health care. These are the member States that have a strong tradition of formal provision of long-term care for the elderly (Denmark, the Netherlands, Sweden and Finland).[20]

In almost all member States projection results under the GDP per worker cost assumption are higher than under the GDP per capita cost assumption, although the difference is generally not very great as the projected evolution of GDP per capita and GDP per worker is quite similar in the long-term. Where the results under the GDP per worker

Table 9.3. **Total public expenditure on health care and long-term care**

Central demographic variant expressed as a share of GDP

	Total health and long-term care			Health care			Long-term care		
	Expenditure as a share of GDP in 2000 (%)	Increase in expenditure in per cent of GDP between 2000 and 2050		Expenditure as a share of GDP in 2000 (%)	Increase in expenditure in per cent of GDP between 2000 and 2050		Expenditure as a share of GDP in 2000 (%)	Increase in expenditure in per cent of GDP between 2000 and 2050	
		Per capita	Per worker		Per capita	Per worker		Per capita	Per worker
Belgium	6.1	+2.1	+2.4	5.3	+1.3	+1.5	0.8	+0.8	+0.8
Denmark	8.0	+2.7	+3.5	5.1	+0.7	+1.1	3.0	+2.1	+2.5
Germany[1]				5.7	+1.4	+2.1			
Greece[1]				4.8	+1.7	+1.6			
Spain[1]				5.0	+1.7	+1.5			
France	6.9	+1.7	+2.5	6.2	+1.2	+1.9	0.7	+0.5	+0.6
Ireland[2]	6.6		+2.5	5.9		+2.3	0.7		+0.2
Italy	5.5	+1.9	+2.1	4.9	+1.5	+1.7	0.6	+0.4	+0.4
Nehterlands	7.2	+3.2	+3.8	4.7	+1.0	+1.3	2.5	+2.2	+2.5
Austria	5.8	+2.8	+3.1	5.1	+1.7	+2.0	0.7	+1.0	+1.1
Portugal[1]				5.4	+0.8	+1.3			
Finland	6.2	+2.8	+3.9	4.6	+1.2	+1.8	1.6	+1.7	+2.1
Sweden	8.8	+3.0	+3.3	6.0	+1.0	+1.2	2.8	+2.0	+2.1
United Kingdom	6.3	+1.8	+2.5	4.6	+1.0	+1.4	1.7	+0.8	+1.0
European Union (weighted average)[3]	6.6	+2.2	+2.7	5.3	+1.3	+1.7	1.3	+0.9	+1.0

1. Results for public expenditure on long-term care are not yet available for a number of member States.
2. Results for Ireland are expressed as a share of GNP.
3. Weights are calculated according to the member States for which results are available. Therefore for health care it is a weight for the EU-14, and for long-term care, and total expenditure on health and long-term care, the average is for 10 member States.

Source: Economic Policy Committee (2001).

Table 9.4. **Average employment and population growth over the projection period**

	Average growth in employment per annum between 2000 and 2050 (%)	Average growth in population per annum between 2000 and 2050 (%)
Belgium	–0.11	–0.03
Denmark	–0.09	0.05
Germany	–0.32	–0.16
Greece	–0.02	–0.22
Spain	–0.20	–0.22
France	–0.03	0.10
Italy	0.51	0.52
Ireland	–0.34	–0.33
Netherlands	0.09	0.23
Austria	–0.19	–0.12
Portugal	0.03	0.18
Finland	–0.29	–0.09
Sweden	0.01	0.07
United Kingdom	–0.08	0.08

Source: Economic Policy Committee (2001).

cost assumption are greater than under the GDP per capita cost assumption (*i.e.* for all countries except Greece and Spain), this is because employment growth over the projection period will be lower than population growth[21] (see Table 9.4). In these countries, the

differing trends in overall population and employment are due largely to the changing age composition of the population, including notably a greying of the population.[22]

The mechanical impact of ageing on levels of public expenditure on *health care* would lead to increases in expenditure of between 0.7 and 2.3 percentage points of GDP by 2050. Most member States experience increases in the range of 1 to 2 percentage points of GDP, with only three projecting increases above two percentage points of GDP (Germany, Ireland and Austria). Detailed results reveal that the impact of demographic changes on health expenditure is likely to stabilise around 2040 for most member States, in line with a stabilisation in the demographic structure around this time.

The impact of demographic changes on levels of public expenditure on *long-term care* would lead to increases in expenditure ranging from 0.2 to 2.5 percentage points of GDP by 2050. On average this is an increase of around 70%. In 2050, expenditure levels would range from 0.9% of GDP (in Ireland) to 5.5% of GDP (for Denmark). Unlike in the case of health care, expenditure on long-term care across the ten member States does not tend to stabilise but continues to grow throughout the projection period, in line with the continued growth of the share of the population aged 80 and over.[23]

It is possible to distinguish two groups from the ten member States for which projections for long-term care are available: six member States would experience increases in expenditure of up to and around 1 percentage point of GDP and the other four (Denmark, Netherlands, Finland and Sweden) would experience increases of between 1.7 and 2.5 percentage points of GDP. The second group are all countries with strong traditions of formal care for the elderly. However, low projected increases in expenditure in other member States, which are the result of lower initial levels of public expenditure on long-term care, may not necessarily mean that these countries avoid sharp increases in expenditure. This is because marked increases in the numbers of the very old combined with projected increases in labour market participation, particularly for women, might force policy changes which lead to increased formal provision of long-term care in those countries.[24]

Notes

1. This group is made up of experts from national administrations, the European Commission, the European Central Bank and the OECD.
2. For more information on the Economic Policy Committee, please go to *http://europa.eu.int/comm/economy_finance/epc_en.htm* To download the full Committee report on the "Budgetary Challenges posed by Ageing Populations" follow the link for Ageing.
3. Migration flows are difficult to project as they are driven by economic developments both inside and outside the EU and because they can be more directly influenced by policy choices.
4. While higher levels of inward migration than those projected could potentially offset the projected declines in the total and working-age populations, they would have to reach levels far in excess of those experienced in the past (United Nations, 1999).
5. On the other hand, some have queried the accuracy of official national population projections, arguing in particular that they may underestimate the demographic changes underway, see Schieber and Hewitt (2000), Lee and Skinner (1999), and Anderson *et al.* (2001).
6. To some extent this might reflect the fact that long-term care systems bear an increased burden *vis-à-vis* health care systems for caring for the very old, and thus some health expenses might be included in reported expenditures for long-term care. It should be recalled that in analysing data it is often difficult to distinguish between health and long-term care expenditures. However, some caution should be exercised in assessing these results, as estimates of expenditure for the highest parts of the age distribution are not likely to be very robust.
7. The coverage of expenditures for the youngest groups are not strictly comparable. In some member States, costs of birth are explicitly included in the health expenditure attributed to

persons in the first year of life, notably in the UK (and Portugal). In other member States, these costs are attributed to the mother.

8. See Jacobzone (2001) for a summary of the results for some OECD countries. Data for Germany, France and the United States show steepening profiles at high age groups over time. Jacobzone notes that detailed studies for the US reveal that this is due to the increasingly intensive use of technology at older ages. Other countries however, *e.g.* Canada and Finland, see relatively homogeneous developments in expenditure levels per head across age groups.

9. There are differences in the coverage of long-term care expenditure across member States, and thus profiles are not strictly comparable. These differences are due, *inter alia*, to different institutional structures for the provision of long-term care *e.g.* long-term care systems in some countries by definition only provide care for the elderly.

10. Trends in OECD countries in recent years have been to reduce the share of formal care provided in an institutional setting, especially for the younger elderly. Care is instead provided in elderly persons' homes, which is usually in line with their wishes, as well as implying much lower levels of expenditure. See OECD (2000b).

11. However, it should be understood that the demographic changes which will be seen in the coming decades are much greater than those experienced in recent years.

12. Only Luxembourg was not able to submit projections of public expenditure on health care. Projections of public expenditure on long-term care are available for Belgium, Denmark, France, Ireland, Italy, Netherlands, Luxembourg, Austria, Finland, Sweden and United Kingdom – for the other member States age-/sex-specific expenditure estimates were not available for long-term care. The projections for Ireland do not follow the common methodology precisely, but are broadly consistent with projections for other member States, but Ireland only submitted results under the GDP per worker cost assumption (see below). Moreover, average expenditure per head for Ireland is expressed as a share of GNP per capita rather than GDP per capita.

13. In all countries, separate profiles were available for men and women for health care, and for almost all for long-term care.

14. This exercise is of particular relevance where the expenditure estimates were generated in studies covering only sub-sections of the overall population.

15. Where productivity is measured by person employed.

16. In order to project the per capita cost assumption case, projections of employment levels were required – these were generated in the context of the pensions projections carried out by the WGA, and are consistent with the demographic scenario.

17. This also implies that either: the health and long-term care sectors do not benefit from productivity gains, and that the volume of care services provided does not increase; or alternatively that both productivity in the health and long-term care sectors, and the volume of services provided grow in line with the rate of economy-wide productivity growth.

18. A unitary elasticity of expenditures to GDP per capita/worker has been assumed here, when historically the long-term elasticity of expenditures to income has been higher than one.

19. In the report EPC (2001), the projection results are discussed in more detail – this includes sensitivity tests on some assumptions. In addition, results are presented for some member States using alternative methodologies.

20. In general, due to the methodology employed, although with some marked exceptions, those member States that have high initial levels of expenditure also tend to be those that have the highest final levels of expenditure in 2050.

21. Or equally that the decline in the population is smaller than the decline in the numbers of persons employed.

22. The results of the projections using the per worker cost assumption, expressed as a share of GDP, show slightly more variability over the projection period than those using the per capita cost assumption. In some periods, expenditure declines as a share of GDP as the impact of ageing is more than offset by the contribution of employment to GDP growth. However, this is not to say that expenditure levels (in absolute terms) decline in those periods.

23. In contrast, the share of the population aged over 65 tends to stabilise in a number of member States around 2040.

24. Moreover, it should once again be stressed that the data for long-term care, on which the projection results are based, are highly uncertain.

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PART III

Chapter 10

Population Ageing, Health Expenditure and Treatment:
An ARD Perspective

by
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Abstract. *There is an increasing body of evidence which shows that the expected increase in health expenditure due to ageing populations may not be as large as the general impression. This paper examines the relationship between ageing and health expenditure by first summarizing some of the literature. The paper goes on to examine the results of the OECD's Ageing-Related Diseases study in the light of a specific issue discussed in the literature, the less aggressive treatment of the elderly. It then goes beyond the cited studies to examine outcome trends. This study provides a unique opportunity to examine ageing within a multi-country study. The paper shows that the elderly are less likely to receive aggressive treatment and are more likely to have worse health outcomes.*

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Introduction

Population ageing is a sign of economic and social progress. But ageing is also viewed by many as the most important factor determining the magnitude of health expenditures today, but more importantly, in the future as the population age distribution shifts to older ages. The potential unsustainability of rising expenditures on health is a major policy concern, but the reality may prove to be less dire than many suspect as studies increasingly find the impact of demographics to be less than what is commonly believed.

This paper will explore the issue by first looking at the apparently contradictory relationship between ageing and health expenditure, followed by a discussion on two of the main issues underlying this relationship: proximity to death and the aggressiveness of health care treatments for the very old. Following this, results from the Ageing-Related Diseases (ARD) study will be presented to help understand the issues that underlie this relationship, within an international comparative context. The presentation of ARD results will include information on health outcomes, which can shed some light on what health spending buys for the elderly (in this paper the elderly will refer to the population aged 65 and over).

1. The ageing-health expenditure relationship

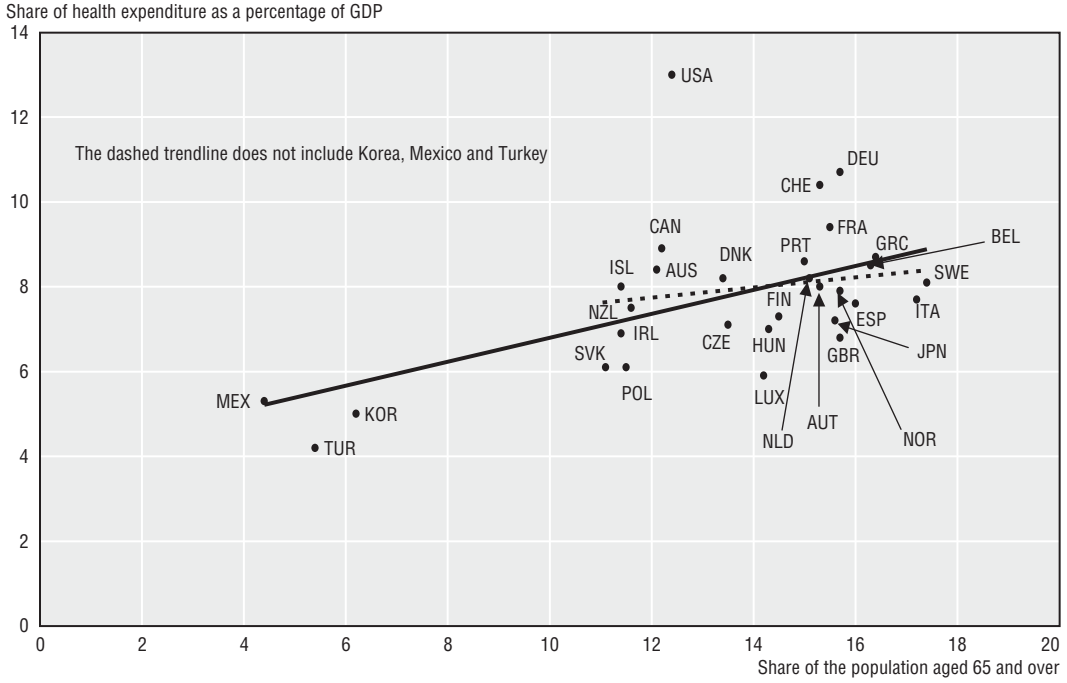
Across OECD countries, an apparently contradictory relationship exists between ageing and health expenditure. On the one hand, across OECD countries there appears to be little or no association at the aggregate level between the age of the population and the level of health expenditures. On the other hand, when health expenditures are disaggregated by age within countries, there is a strong and positive association between increased age and health expenditures.

No link between the age of the population and the level of aggregate health expenditure…

Figure 10.1 depicts the relationship between health spending and the share of the population aged 65 and over across OECD member countries. The vertical axis represents the share of health expenditure as a percentage of GDP, while the horizontal axis is the share of the population aged 65 and over. The trendline shows there to be a slightly positive relationship between the two variables, however this relationship is heavily influenced by the presence of three countries, Mexico, Korea and Turkey, whose populations are much younger than other OECD countries. Removing these three countries from the graph allows for a comparison of countries with much more homogenous population age structures. The dashed trendline that excludes these three countries is almost flat, showing that at best there is a weak relationship between older populations and the amount of money they spend on health.

The absence of a relationship between health expenditure and ageing is counter-intuitive. Everyday observations show the elderly to be sicker than younger persons. The

Figure 10.1. **Health expenditure and the share of the population aged 65 and over, 1997**



Note: Linear regression lines using least squares were fitted to the data. The equation for the trendline that included all countries shown in the chart is y = 0.28x + 3.97; standard error for the coefficient of x = 0.084. The equation for the trendline that excluded Korea, Mexico and Turkey is y = 0.15x + 6.46; standard error for the coefficient of x = 0.15.
Source: OECD (2002).

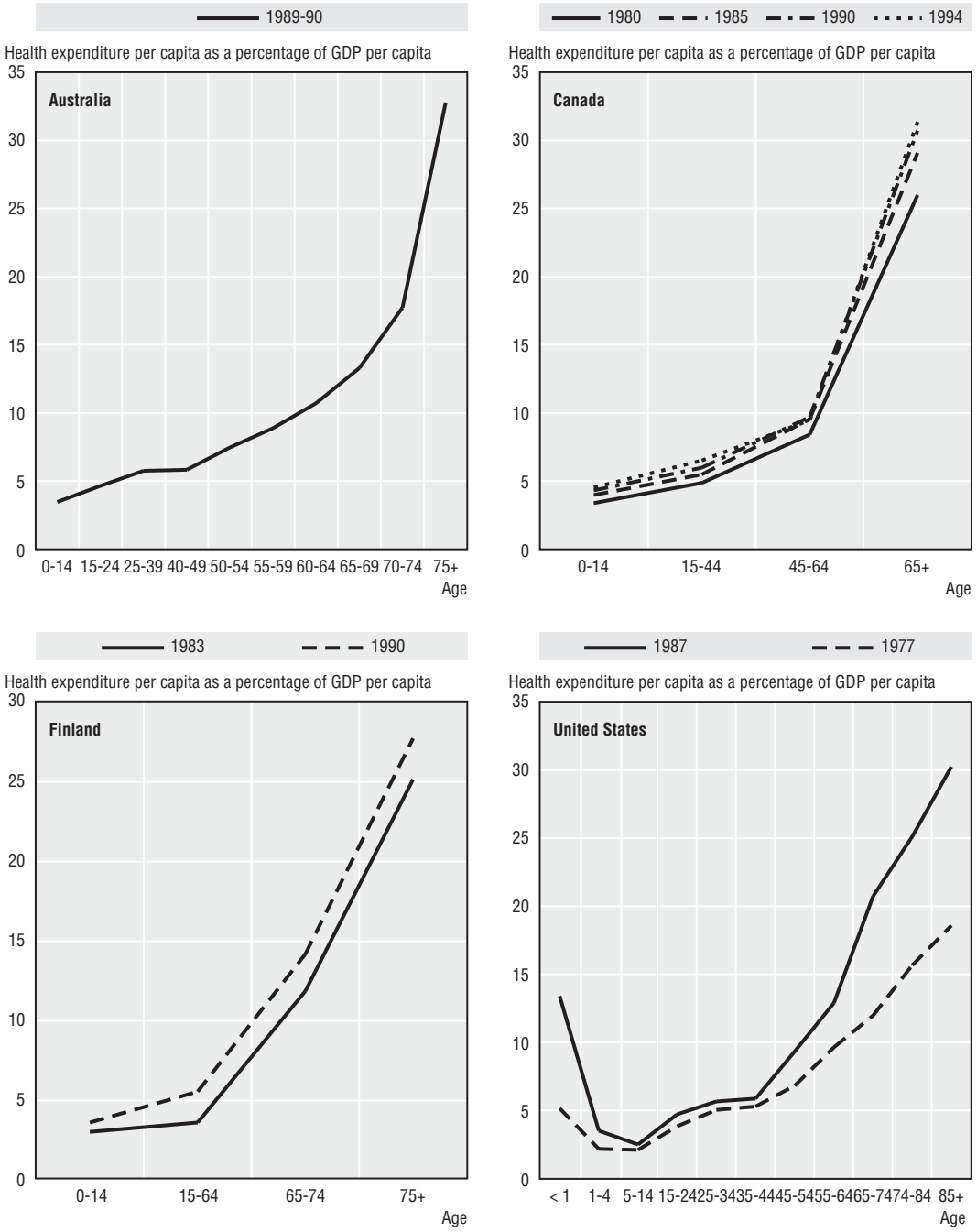
weight of statistics showing a positive correlation between age and morbidity would tend to confirm such a casual observation. Thus, it is plausible to expect that older populations would have more sick persons, thus would consume a greater volume of health care services, and therefore, would spend more money on health care, assuming the costs of health care are similar regardless of age. Yet Figure 10.1 suggests that this is not the case, although other drivers which are affecting the level of health expenditure, such as income and technology, need to be taken into account.

… yet health spending increases with age for micro data

However, when health expenditure data are disaggregated by age within countries, the relationship between age and health spending conforms to the expected relationship. Figure 10.2 provides health expenditure profiles by age for four countries: Australia, Canada, Finland and the United States. These figures show average health expenditure per capita as a percentage of GDP per capita, by age group (GDP per capita is used as a denominator to make the scale of the vertical axis more comparable across countries and over time).

In all four countries, health expenditure increases with age.[1] For Canada and Finland, there is a sharp increase in health expenditure between the age group immediately below 65 years, 45-64 and 15-64 respectively, and the age group starting at 65. For Australia and the US, the increase is not as sharp, owing to the use of more narrowly defined age groups. Age 65 is usually chosen as a convenient threshold for defining the elderly because it is the age at which many individuals become eligible for public health insurance coverage, such

Figure 10.2. **Age profiles for health expenditure over time**



Source: Hakkinen (1996).

as prescription drug coverage in Canada and Medicare in the US. Thus, part of the increase in health expenditure past the age of 65 may be accounted for by patients consuming health services to which they did not have access prior to reaching the age of 65. However, the fundamental pattern, health expenditure increasing with age, especially for the elderly, is the same in most countries regardless of public health insurance eligibility conditions for the elderly.[2]

Indeed, for the countries in Figure 10.2, health spending on the elderly ranged from 40.3% of total health spending in Canada in 1994-95 to 35.3% in the United States in 1987. This relationship appears to be consistent both over time and across countries (Bains, Part III in this volume; Health Canada, 2001; Richardson and Robertson, 1999).

What are the reasons for this apparently contradictory relationship between age and expenditure on health?

A significant body of work exists on trying to determine the main forces driving health expenditure. What is clear from this body of work is that factors other than age are important determinants of health expenditure and that some may be stronger than age. The seemingly contradictory relationship between age and health expenditure which Figure 10.1 and Figure 10.2 evince, in fact reflects a more complicated relationship where age is but one of several variables that exert an influence on health expenditure.

Studies of the relationship between age and health expenditures at a micro-level can help to clarify some of the contradictions of the relationship as shown above. Two issues emerge from these studies: proximity to death and the utilisation of health care services by the very old.

Proximity to death

One reason postulated for the positive relationship between health spending and increased age is that it is spurious, a result of the elderly being at higher risk of death. Over the course of an individual's lifetime, the greatest amount of spending on health care services will occur near death, usually measured as within the last year of life. Thus, the positive age gradient associated with health care spending is not due to increased age *per se*, but is a consequence of the greater concentration of persons living the last year of their life being concentrated among the elderly. Several studies have shown that spending on health care is concentrated near death (Brockman, 2002; Levinsky *et al*., 2001; Mcgrail *et al*., 2000; Roos *et al*., 1987). In fact, there is evidence that spending on health during the last year of life is even more compressed, with half of all spending in the last year of life occurring during the last two months (Garber *et al*., 1998; Lubitz and Riley, 1993).

The reason for this explosion of health care spending associated with dying should be fairly obvious; individuals near death are likely to be sicker than those that are not.[3] This closely follows Fries' hypothesis of the "compression of morbidity" (1980), in which future populations will increasingly experience only a few years of major illness in very old age, rather than living a significant number of years with chronic illnesses and disability. While Fries' morbidity compression hypothesis applies to older people, its significance regarding health expenditure near death is that the compression of morbidity occurs at the end of life, hence the time during individuals' lives when the greatest amount of health care is required, and consequently when most spending over the lifetime takes place, is near death. Therefore, since the greatest concentration of persons near death is found in the older age groups, health expenditure will exhibit a positive age gradient.

Health care utilisation by the very old…

Grouping together the elderly as one large homogenous group, such as the age/expenditure profiles from Figure 10.2 or the ratio of health expenditure for persons aged 65

and over to those aged less than 65, fails to detect differences in health expenditure between the oldest elderly and the younger elderly. For example, Figure 10.2 shows very steady increased expenditure with age profiles for health expenditure as a percentage of GDP per capita for the elderly in Canada, and for the elderly aged 65-74 and 75 and over in Finland. Even for the United States where data are shown by 10-year age groups, the profile shows health expenditure to be increasing with age. In all three situations, the very old are included as part of a broader age group.

If the very old are separated out from these broader age groups, a slightly different pattern emerges: the positive age gradient with respect to health expenditure remains, except that for the very oldest, the curve drops because per capita spending on the very old elderly is lower than spending on the younger elderly. For example, Bains (see Part III in this volume) shows that per capita *public* expenditure on health care in Finland is greatest for persons aged 85-89, after which it declines. This is a different pattern from Figure 10.2 where health expenditure peaks for the population aged 75 and greater. Austria, Belgium, Denmark, Spain and Sweden all show similar profiles. To the extent that the profile for public expenditure on health care reflects total expenditure in these countries (public expenditure on health averages about 75% of total health expenditure for European Union countries), this shows that lumping together the very old with younger elderly age groups hides a more complex relationship.

For long-term care expenditure, the differences between the oldest elderly and the younger elderly are even more pronounced. This creates a greater problem if the elderly are treated as one large homogenous age group, since the age gradient for expenditure on long-term care is considerably steeper than the age gradient for health expenditure (Bains, Part III). A proper account of health-related expenditure would group health expenditure and long-term care expenditure together, but this would not obviate the need to treat the elderly as a heterogeneous group.

How do we reconcile the following factors? Health care spending is greatest near death, the proportion of the very old near death will be greater than younger age groups and health care spending per capita decreases for the very old? One possible explanation would be if the very old near death were treated differently, more to the point less expensively, than younger persons near death.

… is less aggressive than health care for the younger elderly

Several studies support the notion that per capita spending on health care for the very old is less than it is for younger age groups because, on average, the very old receive less expensive treatment. Scitovsky (1988) found that very old decedents (people near death, which in their case was within one year of death), aged 80 and over, received less intensive hospital and physician services than younger elderly decedents, aged 65 to 79. Using US Medicare data, Lubitz and Riley (1993) find Medicare payments per person-year for decedents declined with age. They find a similar decline for the use of acute care services. Since acute care services, measured as inpatient hospital care, acount for by far the largest portion of payments per person-year for decedents, 70.3% in 1988, they suggest that less aggressive, and therefore less expensive care for the very old is the cause of the decline by age in Medicare payments per person-year.

In fact, several studies have shown that the very old receive less aggressive treatment than younger persons (Yu *et al.*, 2000; Levinsky *et al.*, 1999; Hamel *et al.*, 2000). Levinsky *et al.*

(2001) provide three pieces of evidence to support this view. First, they note that decreased expenditure on hospital services for decedents aged 85 or greater compared to decedents aged 65-74 accounts for 80% of the decrease in total health expenditures between these two age groups. Of the various types of services they examined, use of hospital services was the most expensive. Second, there is a greater decrease in the costs of hospitalising decedents aged 85 or greater compared to those aged 65-74 than the decrease in the number of admissions for the same two age groups. If costs decrease more rapidly than admissions across age groups then the oldest patients must be receiving less expensive, which usually means less aggressive, care than younger patients. Finally, among hospitalised decedents, use of selected expensive services was far less for the group of patients 85 and older then those of younger age groups.

The fact that the costs of treating the oldest patients during their last year of life are less than younger patients is not a uniquely American phenomenon. Using data from hospital claims files for Germany's largest public health insurer, Brockman (2002) found that, for the same diseases, older patients during the last year of life were treated less aggressively and at lower cost than younger patients. Unlike Levinsky *et al*. (2001), Brockman also compared decedents with survivors. While finding similar results concerning the less costly treatment of very old decedents, she found almost no difference in costs between decedents and survivors for the oldest old. In part, this was because the oldest old died from less expensive diseases [Levinsky *et al*. (2001) concluded differential costs for different diseases was not a factor]. Interestingly, for decedents it was found that cancer was the costliest disease for both men and women, while cardiovascular disease was the least expensive for women and one of the least expensive for men. However, the main reason why it was less costly to treat the oldest old was that they received less costly care for the same disease, especially in the case of cardiovascular disease and cancer, a result also found by Levinsky *et al.* (2001).

The preceding examples show that the oldest elderly receive less expensive hospital care. Are there similar results for other health care services, such as physician services? Levinsky *et al*. (2001) find that Medicare expenditures for physician services are greatest for the elderly aged 65-74 and lowest for those aged 85 and over. Age/cost profiles for physician services in Ontario, Canada, show that the cost of physician services declines for the oldest old (Denton *et al*., 2002), with the exception of general practice for which costs continue to increase up to the oldest age group, those aged 90 and over.

One area of health care services likely to have a significant impact on health expenditure for the elderly, especially the very old, is long-term care. In Canada for example, per capita expenditure on institutional care for person 85 and older in 2000/2001 was 20 times greater than expenditure per capita on persons aged 65-74 (Health Canada, 2001). Even for persons during the last year of life, expenditure on nursing home care for the oldest elderly can be more expensive, despite the non-acute nature of care. Levinsky *et al.* (2001) show that for very old persons during the last year of life, expenditures for the use of skilled nursing facilities was greater for individuals aged 85 and over than for those aged 65-74.

Is there a decrease in per capita expenditure on health care for the very old if expenditure on long-term care is included, that is, does increased spending on long-term care make-up for the decline in health spending for the very old? There is no clear answer to that question. There is evidence that shows the bulk of expenditure for the oldest age

groups is for long-term care (Lagregren and Batljan, 2000), but evidence also exists that shows the bulk of expenditure is related to non-long-term care expenditure (Health Canada, 2001).

The ageing health expenditure relationship revisited

The above exposition can be summarised as follows:

1. Over the course of an individual's lifetime, health care costs are greatest during the last year of life. It is proximity to death, not age itself, that is largely responsible for the positive association between health care expenditure and age.
2. The oldest elderly receive less aggressive, and therefore less expensive, care than younger persons. This leads to a decrease in the age/expenditure profile for the very oldest age group if the elderly as a group are sufficiently disaggregated. However, there may not be a decrease in the age/expenditure profile if expenditure on long-term care is taken into account.

The data collected for the ARD study cannot address the first issue. Information on individuals' proximity to death was not collected. Furthermore, the cost data are not directly linked to the utilisation data collected and they cannot be dissagregated by age. To the second issue, while the issue of expenditure on the very old cannot be addressed directly, information has been collected on several indicators of aggressive treatments to shed some light on the differences in aggressive treatments across countries. Specifically, information was collected on the number of admissions to hospitals, as well as the use of several high technology procedures, such as percutaneous transluminal coronary angioplasty (PTCA), coronary artery bypass graft (CABG), mastectomy and computed tomography.

On the issue of aggressiveness of treatment for the oldest old, the ARD study can complement work in this area by comparing outcomes across countries. For example, outcomes in countries that treat the elderly more aggressively can be compared to other countries. Since severity or case-mix were not controlled for, the comparisons of health outcomes across age and sex should be treated with caution, even though the number of comorbidities may not be a significant factor in differences in health expenditures between the very old and younger age groups (Brockman, 2002; Levinsky *et al.*, 2001).

2. The age dimension of disease

As mentioned previously, there is a strong, positive relationship between age and morbidity.[4] The Ageing-Related Diseases study examined three common diseases of the elderly, ischaemic heart disease (IHD), breast cancer and ischaemic stroke. To examine the age dimension of these diseases we present data on their incidence. The first disease, IHD has the expected age profile of an Ageing-Related Diseases, increased incidence with age. The second disease, breast cancer, has a more complicated age profile, while the profile for the third disease, stroke, is easily the most age-related of the three diseases.[5]

The incidence ratios calculated in Table 10.1 show, for each disease, the ratio of the incidence for the oldest age group (varies by disease) to the youngest age group (40-64) for which data was collected.[6] For AMI and stroke, Table 10.1 shows the ratio of the incidence of both diseases for men aged 75 and older to the incidence of the disease for men aged 40-64. For breast cancer, the ratio is calculated as the incidence of breast cancer for women aged 80 and over to the incidence of women aged 40-64.

Table 10.1. **Incidence ratio of oldest to youngest**

AMI – males (75+/40-64)		Breast cancer (80+/40-64)		Stroke – males (75+/40-64)	
AUS (96-97)	6.8	AUS	1.4	AUS (Pe)	14.0
DNK	6.3	BEL	1.0	AUS (Me) 96-97	11.5
GBR (Ox)	9.3	CAN	1.8	DNK	6.9
SWE	8.3	FRA	1.1	DNK (Ju)	6.9
		ITA	3.8	NOR	13.3
		JPN	0.8	SWE	16.8
		NOR	1.4		
		SWE	1.5		
		USA	1.8		

Note: For AMI, there is an upper bound of 99 years for Sweden. For ischaemic stroke there is an upper bound of 84 years for Australia (Perth); for Australia (Melbourne) the data refer to first ever stroke. The data for AMI refer to 1996; breast cancer is 1995; stroke is 1997 unless otherwise stated.
Source: These data were collected by the experts in the countries participating in the ARD study.

Table 10.1 shows that for both AMI and stroke, incidence is greater for the oldest age groups than for the youngest. Stroke is generally considered to afflict the elderly more than AMI and this is reflected in the data. The ratios range from 6.9 (Denmark) to 16.8 for stroke and 6.8 (Australia) to 9.3 (Great Britain, Oxford) for AMI. For breast cancer, whether incidence is greater for the oldest age group is not as clear. The range of values for the ratio of the incidence of breast cancer for persons aged 80+ to those aged 40-64 is between 1 and 2, with the exception of Japan (0.8) and Italy (3.8). These ratios are not nearly as large as those for AMI and stroke. This reflects a much flatter age profile for breast cancer incidence than for the two other diseases. A further contributing factor may be the age groups for which breast cancer screening programs are defined (Hughes and Jacobzone, 2002).

The ARD data show that even for "Ageing-Related Diseases", the age dimension of diseases varies considerably. The ratios from Table 10.1 for AMI and stroke demonstrate that ageing is a significant factor in determining morbidity for these two diseases. To a much lesser extent, the same can be said for breast cancer. While the age profiles of incidence for these diseases should not be considered indicative of all diseases, the usefulness of these data lie in clarifying the link between incidence and consumption of health care services.

Higher incidence of disease in the elderly should translate into higher rates of admission…

Ceteris paribus, higher incidence rates for AMI, stroke and breast cancer should lead to higher rates of admissions for these diseases. If the costs of treating the elderly in hospitals are lower, especially since the elderly tend to be sicker, thus requiring more interventions and/or longer stays, this should translate into higher per capita hospital expenditures.[7] This issue can be studied by examining the data on admissions collected for the ARD study.

In Table 10.2 the ratios of admissions of the oldest persons to the youngest persons are calculated in the same manner as was done for incidence. For AMI and stroke, the calculated ratios are the number of admissions per 100 000 persons aged 75 or older to the number of admissions per 100 000 persons aged 40 to 64 years. For breast cancer, the ratio is calculated as the number of admissions for breast cancer per 100 000 women aged 80 and over to the number of admissions of breast cancer per 100 000 women aged 40-64 (see endnote 5).

Table 10.2. **Admissions ratio of oldest to youngest**

AMI – males (older males/40-64)			Breast cancer (80+/40-64)		Stroke – males (75+/40-64)	
	75+	85-90				
AUS (96-97)	4.2	4.3	BEL	0.7	AUS 97-98	16.5
BEL	2.8		CAN	1.5	CAN (AB)	16.7
CAN	4.3	5.0	FRA (97)	0.6	CAN (ON) 96	14.0
DNK	4.6	3.5	HUN	0.7	ESP	10.8
DEU	3.2		ITA (96)	0.8	GRC (95)	13.5
GBR (Ox)	4.6		NOR	1.2	ITA	12.6
ITA (98)	3.2	3.4	SWE	1.1	NOR	13.3
JPN	3.2	3.3			SWE	14.8
SWE	6.3	6.1			USA	11.1
USA	3.1					

Note: For AMI, there is an upper bound of 89 years for Canada, Denmark, Italy and Sweden; for Germany, Japan and the United States, there is a lower bound of 45 years for the youngest age group. For ischaemic stroke, there is an upper bound of 99 years for Greece. The data for AMI refer to 1996 unless otherwise indicated; breast cancer is 1995 unless otherwise indicated; stroke is 1997 unless otherwise indicated.
Source: These data were collected by the experts in the countries participating in the ARD study.

Similarly to the incidence ratios, the admissions ratios in Table 10.2 reveal that older persons are admitted for AMI and stroke more often. For AMI, the admissions ratios range from 6.3 for Sweden to 2.8 for Belgium, showing that older persons are hospitalised more often for AMI. For stroke the positive association between age and admissions is even more striking. The ratios range from 16.7 in Alberta, Canada, to the lowest of 10.8 in Spain. For breast cancer it is not as clear. In only three countries, Canada, Norway and Sweden, is the ratio of admissions of older women to younger women for breast cancer greater than one. Again, this reflects a much flatter age profile for breast cancer admissions, similar to the age profile for breast cancer incidence.[8]

If admissions decisions are made irrespective of age, hospital admissions ratios could be expected to roughly reflect incidence ratios. For AMI, all four countries for which comparisons between incidence and admissions ratios could be made had lower hospital admissions ratios than incidence ratios. For stroke, the admissions ratio for Sweden was slightly lower. In the case of breast cancer, the differences between admissions ratios and incidence were negligible, with the exception of Italy, but this would be more expected than for either AMI or stroke. Treatment for breast cancer takes place far less often as an inpatient than for AMI or stroke, therefore differences in the type of aggressive care given to older breast cancer patients against younger patients is not as likely to show up in admissions data.

There are two possible factors that may help to explain the lower admissions ratios for AMI and stroke. The first reason why admissions ratios are lower than incidence ratios is that they reflect a less aggressive approach to treating the older persons. The second reason is that many persons with severe cases of AMI or stroke die before ever being admitted to hospital, thus they would be included in the calculation of incidence ratios, but not included in the calculation of admissions ratios. Since older persons are more likely to have more severe cases of these two diseases, and therefore are more likely to die before reaching hospital, this can account for some of the difference in lower admissions ratios. This is likely to be much less a factor for breast cancer owing to the more chronic nature of the disease as compared to AMI and stroke.

As discussed earlier, the pattern of less aggressive treatment of disease in older persons is most apparent in the treatment of the very old. To examine this in more detail, admissions ratios for AMI for persons aged 85-90 to those aged 40-64 were calculated and are shown in Table 10.2. However, when compared to the ratio of hospital admissions for persons aged 75 and older, there appears to be no evidence of less aggressive treatment for the very old. Based on hospital admissions data alone we cannot duplicate the finding that utilisation of aggressive medical care decreases for the very old.

... unless the elderly are treated less aggressively than younger persons

The ARD study has collected data on the use of several expensive procedures to compare treatment of the elderly *vis-à-vis* younger persons. The use of these procedures provides a more accurate picture of aggressive treatments than hospital admissions. For AMI information was collected on percutaneous transluminal coronary angioplasty (PTCA) and coronary artery bypass graft (CABG) use. For breast cancer information was collected on the use of mastectomy and breast conserving surgery (BCS), the latter with and without adjuvant radiation therapy (RT). Finally, for stroke information was collected on the use of diagnostic computed tomography (CT) scans. The ratio of utilisation of these treatments between older persons and the young are shown in Table 10.3.

Table 10.3. **Treatment ratios of oldest to youngest**

AMI – males			Breast cancer		Stroke – males	
PTCA (older persons/40-64)			(80+/40-64)		(75+/40-64)	
	75+	85-90	Mastectomy		CT Scan	
AUS (96-97)	0.10		BEL	1.3	AUS	0.87
CAN(ON)[2]	0.29	0.08	CAN (MB)	0.8	AUS (PE)	0.74
ESP (97-98)	0.30		CAN (ON)	0.9	CAN (AB)	1.03
ITA (98)		0.10	GBR (ENG)	0.5	CAN (ON)	0.88
JPN		0.44	FRA (97)	1.7	ITA	0.91
SWE[2]	0.17	0.02	NOR	1.0	ESP	0.88
			SWE (94)	1.2	SWE	0.94
					USA	0.92

CABG (elderly/40-64)			BCS (80+/40-64)		
				No RT	RT
AUS (96-97)	0.13		BEL (97)	0.6	0.4
CAN(ON)[2]	0.48	0.04	CAN (MB)	0.7	0.2
ESP (97-98)	0.39		CAN (ON)	0.8	0.2
ITA (98)		0.00[1]	GBR (ENG)	0.3	0.1
SWE[2]	0.38	0.00[1]	FRA (97)	0.6	0.4
			NOR	0.9	
			SWE (94)	0.3	0.02

AMI: Acute myocardial infarction.
BCS: Breast conserving surgery.
CABG: Coronary artery bypass graft.
PTCA: Percutaneous transluminal coronary angioplasty.
Note: For AMI, there is an upper bound of 89 years for Canada, Denmark, Italy and Sweden; for Germany, Japan and the United States, there is a lower bound of 45 years for the youngest age group.
1. There were no CABG performed on persons 85-90 in the reference year.
2. These data represent utilisation of PTCA or CABG 90 days from the initial admission. For ischaemic stroke, there is an upper bound of 99 years for Greece. For breast cancer, the youngest age group is 40-69. The data for AMI refer to 1996 unless otherwise indicated; breast cancer is 1995 unless otherwise indicated; stroke is 1997 unless otherwise indicated.

Source: These data were collected by the experts in the countries participating in the ARD study.

The calculated ratios show the percentage of men aged 75 and older admitted for AMI who received PTCA(CABG) to the percentage of men aged 40-64 admitted for AMI who received PTCA(CABG). The data on breast cancer are based on women with breast cancer admitted for either mastectomy or breast conserving surgery. They show the percentage of these women aged 80 and older who underwent surgery divided by the percentage of these women aged 40-64 who underwent surgery. For stroke, we chose the use of CT scan showing the percentage of patients aged 75 or older admitted for stroke who underwent a CT scan divided by the percentage of patients aged 40-64 admitted for stroke who underwent a CT scan.

Table 10.4 shows that older AMI patients receive intensive treatments less frequently than younger patients, despite higher incidences of AMI and higher admissions rates to hospitals. For stroke, differences in utilisation between older stroke patients and younger patients are less clear. According to these data, there is little difference in the utilisation of CT scan between elderly stroke patients and younger patients, the ratios are close to 1, the lowest being 0.74 for Perth, Australia.

Table 10.4. **Health outcomes ratios of the elderly *versus* the young**

AMI – males (older persons/40-64)			Breast cancer (80+/40-64)		Stroke – males (75+/40-64)	
1-year case fatality	75+	85-90	5-year survival		1-year case fatality	
AUS (96-97)		8.0	CAN (MB	1.02	CAN (AB)	2.8
CAN(ON)	5.7	8.5	CAN (ON)	0.89	CAN (ON)	3.6
DEN	3.8	4.9	GBR (91-93) (ENG)	0.61	DNK (95-99)	3.6
ESP	4.5		FRA (90)	0.95	GBR (OX)	2.0
NOR		5.8	JPN (92)	0.84	SWE	3.7
SWE	2.9	3.9	NOR	0.89		
			SWE (94)	1.07		

Note: For AMI, there is an upper bound of 89 years for Canada, Denmark, Italy and Sweden; for Germany, Japan and the United States, there is a lower bound of 45 years for the youngest age group.

1. These data represent AMI patients who died one year from the initial admission. For ischaemic stroke, there is an upper bound of 99 years for Greece. The data for AMI refer to 1996 unless otherwise indicated; breast cancer is 1990-94 unless otherwise indicated; stroke is 1997 unless otherwise indicated.

Source: These data were collected by the experts in the countries participating in the ARD study.

For breast cancer the results are more ambiguous. On the one hand, Table 10.4 shows elderly breast cancer patients receive mastectomy less than younger patients in the United Kingdom (GBR 0.5), but are more likely to receive mastectomy in France (1.7). For the other countries the ratios are fairly close to 1. On the other hand, elderly breast cancer patients are less likely to receive BCS, especially with radiation therapy, than their younger counterparts.

Quality of life plays a greater role in the decision to opt for surgery to treat breast cancer than it does for AMI or stroke. The general consensus in the literature is that for early stage breast cancer, BCS with radiation therapy and mastectomy have similar recurrent-free and overall survival rates (Fisher *et al.*, 1985; Veronesi *et al.*, 1981). However, as the data have demonstrated, the elderly are far more likely to undergo mastectomy than BCS without radiation therapy. There is some debate that patient preferences may play a role; the elderly would be more likely to opt for BCS because they wish to avoid radiation therapy or they are less concerned with the diminution in quality of life resulting from mastectomy. However, other factors, including availability of RT, have been found to influence the choice of BCS relative to mastectomy, making it difficult to disentangle the determining factors in the decision of which surgical option to use (Hughes and Jacobzone, 2002).

Utilisation figures demonstrate that the elderly appear to receive fewer treatments than the non-elderly for AMI and stroke. For AMI, data were available for the very old, those aged 85-90. The data in Table 10.4 show that the very old were even less likely to receive PTCA and CABG. Compared to the admissions and incidence ratios, the very old did indeed receive far fewer intensive treatments than expected. Furthermore, for Ontario, Canada and Sweden, the very old were much less likely to receive PTCA or CABG than patients 75 and over as a whole.

3. Outcomes

Examination of two dimensions of medical care for the elderly, the treatment and expenditure dimensions, does not present the full story. The health outcomes resulting from medical care are of at least equal importance from a health policy perspective, yet the studies on health expenditures and ageing cited in this paper did not study health outcomes. Their focus was on expenditure. In fact, these studies used an outcome, death, to define their cohorts. Studying other outcomes relevant to the dying, such as quality of life, was beyond the scope of these studies.

An objective of the ARD study was to examine not only the spending associated with the delivery of medical care to the elderly, but also the health outcomes associated with this care with a view to determining what treatment levels provide the best value. Information on health outcomes is presented in Table 10.4. For AMI and stroke we show case fatality one year following the initial admission, measured as the proportion of AMI or stroke patients who died within a year following admission to hospital for AMI or stroke. The data are presented as the ratio of patients aged 75 and greater who died within one year following their initial admission for AMI(stroke) against patients aged 40-64 who died within one year following their initial admission for AMI(stroke). For breast cancer, Table 10.4 shows the ratio of women aged 80 and over who were still alive five years after their initial diagnosis for breast cancer against those women aged 40-64 who were alive five years following initial diagnosis. The breast cancer data were calculated for surviving women for the period 1990 to 1994, so will include women who have been alive for longer than five years following the initial diagnosis.[9]

As expected, AMI patients aged 75 and older were more likely to die within a year from admission than those aged 40-64. The ratios range from 2.9 in Sweden to 5.7 in Ontario, Canada. It would be a mistake to conclude from this that the elderly appear to have the best outcomes in Sweden and the worse in Ontario. In fact, one-year case fatality rates among the elderly in Ontario and Sweden are quite similar. However, AMI patients aged 40-64 have lower case fatality rates in Ontario than in Sweden, so it is the lower denominator in Ontario that is responsible for the higher ratio (Moïse and Jacobzone, 2002). Table 10.4 also presents health outcomes ratios for AMI patients aged 85-90 against those aged 40-64. Unsurprisingly, the ratios are higher than for the 75+/40-64 ratios.

For stroke, the range of ratios is much smaller than for AMI and is generally lower. One interesting thing to note is that the ratios for health outcomes for stroke are much lower than the corresponding ratios for admissions for stroke. For example, the ratio in 1997 of the rate of admissions for persons aged 75 and over to those aged 40-64 in Sweden is 14.8, significantly higher than the ratio of 3.7 for health outcomes. For AMI these two sets of ratios were much closer. While it is likely a large part of the difference between the ratios for admissions and those for outcomes for stroke stems from the much larger numbers

used to calculate the admissions ratios, whether these lower ratios have any significant meaning is unclear. Although data on disability of patients following admission for stroke were not available for the ARD study, it is likely the ratios calculated from these data would be greater than the 1-year case fatality ratios from Table 10.4.

For health outcomes for breast cancer, the story is much the same as in Table 10.1, Table 10.2 and Table 10.3, the difference between the elderly and younger persons is not as significant as for the other two diseases. However, differences between the elderly and younger persons are greater for health outcomes than they are for incidence, admissions or treatment. This is particularly true for England (ENG) where the ratio of survival for women aged 80 and over to women aged 40-64 is 0.61.

The ratios for breast cancer need to be treated with greater caution than those for IHD or stroke. The stage at which breast cancer is first detected is the most important factor that can affect the interpretation of the ratios calculated for breast cancer survival in Table 10.4. If older women are diagnosed at a later stage of the disease, when it is more advanced, then they will experience a worse prognosis than younger women. The most likely cause would be the defined age targets for organised screening programmes. Generally, these programs do not target women over 70 years, thus, older women would be diagnosed at a later stage of the disease, leading to worse survival outcomes (Hughes and Jacobzone, 2002).

4. Discussion

The clearest result from the ARD study regarding the elderly is that they appear to be treated less aggressively than younger persons, but the aggressiveness depends on the nature of the disease. The ARD study has shown that the elderly receive less aggressive care for AMI than younger persons (Table 10.2). But, this is a point of concern only if more aggressive care of AMI is shown to have better outcomes. The debate on this issue continues. Treatment for breast cancer may not be as intensive as PTCA or CABG, in the sense that breast conserving surgery and mastectomy are less invasive than these techniques. However, the ARD study shows the elderly are even less likely to undergo BCS with radiation therapy than BCS without, the former being the more aggressive. This should concern policy-makers since BCS with radiation therapy has proven to be as effective as mastectomy in treating early stage breast cancer (Fisher *et al.*, 1985; Veronesi *et al.*, 1981). As for stroke, aggressive treatment is usually not an option. Increasingly, studies are demonstrating that medical care for stroke should rely more on "stroke units", specialised inpatient care units that emphasise a multidisciplinary approach to stroke care (Moon, Part I in this volume), which may include access to CT scanners.

How should we consider the seeming implicit age rationing of health services for AMI, radiation therapy for breast cancer and CT scans for stroke? If it can be shown that health outcomes for the elderly in countries that tend to be less aggressive are no worse than in countries which are more aggressive in treating their patients then it may not be a problem. Indeed, given the higher costs associated with more aggressive treatments, it could be said that the less aggressive countries are more cost-efficient if their health outcomes are similar. However, the evidence from ARD is mixed. For example, the percentage of AMI patients aged 75 and older in the United States, the most aggressive country when it comes to treating AMI, who died within a year from admission was slightly lower than in the two closest countries, Canada (Ontario) and Sweden. This is in contrast

to AMI patients aged 40-64[10] for which outcomes were slightly better in Ontario then in the US and Sweden (Moïse, Part I in this volume).

If the age rationing on health services is explicit and has a direct impact on outcomes then the issue becomes problematic. For some of the newer medical treatments, age differences may also reflect the natural diffusion of health technologies whose utilisation will first evolve among a strictly defined patient base, usually with limited comorbidities, meaning younger patients (Moïse, Part IV in this volume). However, if the differences in treatment between the elderly and younger reflect an age bias, then the reasons for these biases need to be better understood. In some cases, it may be felt that treating the elderly less aggressively may be justified because their ability to benefit over the long-term is less. This type of bias could even be understood on the basis of constrained resources. A better understanding of the root causes of the differences in treatment between the elderly and younger persons would help governments better plan their uses of health care resources.

Comparing treatments, costs and outcomes across countries to assess the value of medical care is a challenging task. The ARD study has taken a significant step in meeting this challenge. The work of the ARD study points the way to the need for further work in this area, with a particular focus on older persons. It is not enough to say that one country treats its elderly patients more aggressively than another if we cannot say very much about the consequences of the treatment trends in each country in terms of health outcomes and costs for all age groups. We need to find those countries that spend less on health care yet achieve similar results as higher spending countries. This cannot be achieved without greater efforts at standardising the type of treatments and outcomes data collected by the ARD study. Furthermore, greater efforts in creating more comparable data on medical care costs and spending broken down by age are required if we are to realise this challenging task.

This paper has demonstrated the difficulty of including together the elderly as one large homogenous group. To date, most of the efforts in separating the oldest elderly from their younger counterparts have been done at a single country level. More international comparative work that separates the elderly into smaller age groups, such as the projection work of public expenditures undertaken by Bains and colleagues at the European Commission (see Part III in this volume), as well as international comparisons similar to those of the ARD study are a step in the right direction of a better understanding at the international level.

5. Conclusion

This paper, and the ARD study as a whole, demonstrate differences in treatments and outcomes between the elderly and younger persons. The ARD study has taken a step in the right direction by indirectly linking treatments with outcomes, *i.e.* by comparing treatment and outcome trends across countries using data linked by individual patients, without knowing the treatments received and resulting health outcome for each individual patient. To take the ARD study a step further in the right direction would be to study differences in treatments and outcomes by linking each treatment received by a patient with the resulting outcome.

In the ARD study, how differences in treatments translate into differences in expenditures is not entirely clear. In addition to direct linking between treatments and

outcomes, it would be desirable to have comparable information on the costs of treatments. The fragmentation of information due to the different points of contact with the health system along the continuum of care makes this a difficult task. Nevertheless, if more comparable information on health expenditures were to be identified then a significant step would have been taken in determining the relative cost-effectiveness of treatments for the elderly across countries.

Notes

1. Spending on newborns, shown in the figure for the US as "< 1", is typically higher than non-elderly age groups.
2. Data from various sources are available, but the four countries represented in Figure 10.2 were the most comparable. Bains (Part III in this volume) provides an example of age profiles of public spending on health in European countries. The profiles follow the same patterns as shown in Figure 10.2.
3. Both Brockman (2002) and Levinsky *et al.* (2001) found that a relatively small number of comorbidities, one or two, was not a significant determinant of expenditure. However, in the case of Levinsky *et al.*, expenditures increased significantly for patients with three or more comorbidities. Brockman found the same result for four or more comorbidities.
4. This is not necessarily true on a disease-by-disease basis since many diseases, such as cerebral palsy or mumps, affect persons much younger than the elderly.
5. For a more detailed depiction of these data, the reader may should refer to the ARD Technical reports (Moïse and Jacobzone, 2003; Moon, see Part I in this volume; Hughes and Jacobzone, 2003).
6. Acute myocardial infarction (AMI) is used instead of IHD because it is much easier defined than IHD and a significant portion of IHD incidence is due to AMI (Moïse and Jacobzone, 2002). Ischaemic stroke is used instead of all stroke because there is a much larger scope for treating ischaemic stroke than the other main category of stroke, haemorrhagic stroke for which physicians have little latitude in treating due to the severity of the disease (Moon, Part I in this volume).
7. Length of stay is strongly correlated with hospital expenditure, where the most significant expenditures on health would be expected.
8. Admissions data for breast cancer reflect treatment decisions more than AMI or stroke. First, they are likely influenced by admissions for chemotherapy and radiotherapy. Second, AMI and stroke admissions are much more likely to be emergency admissions where the discretion for treatment decisions is lower.
9. We did not control for case-mix or severity of the disease of the patients in any of the three diseases, so given older persons are more likely to be sicker we would expect *a priori* the ratios for AMI and stroke to be greater than one, less so for breast cancer.
10. The health outcomes data for persons aged 40-64 in the US are based on hospitalisations in California only, whereas data on persons aged 65 and over are national , which is why the US was not included in Table 10.3 or Table 10.4.

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PART III

Chapter 11

Data Needed for Research and Policy in Ageing Societies

Contribution of the Survey of Health, Ageing and Retirement in Europe (SHARE Project)

by

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Abstract. *Population ageing raises many issues of public policy at the cross roads of economics, sociology, psychology and medicine. While the OECD Ageing-Related Diseases project pointed to variations between countries in treatments and outcomes for common diseases, most European countries lack the necessary data to understand the reasons and the impact of such variations. The Survey of Health, Ageing and Retirement in Europe (SHARE) is designed to produce comparative, longitudinal, multidisciplinary data collected at an individual level and will further our understanding of the issues raised by population ageing.*

1. Issues about ageing

Due to declining mortality rates, especially at old age, and falling fertility rates, the demographic structure of industrialized countries is changing considerably (Disney, 1997). An unprecedented proportion of the adult population is professionally inactive, a reality with already visible economic consequences on public budgets. In addition, as a result of the well-known differential in longevity consistently observed between men and women, we are witness to a marked feminisation of old age and to increased risk of impoverishment of the social environment and support at an advanced age (Holden and Kuo, 1996; Tinker, 2002). Through the effects these changes will have on labour and capital markets, they raise unprecedented challenges on the long-term viability of welfare and health care systems (Jacobzone, 2000; Wiener and Tilly, 2002; Walker, 2002).

A better understanding of the effects of population ageing is needed to offer guidance on how public policies might be adjusted to take these changes into account.

Important research issues about ageing converge on the complex links between age, income, wealth, health and activity. They require an interdisciplinary collaboration as well as the availability of multidimensional data sources (Rice, 1992). Large statistical resources in the United States have been invested in order to provide such data, particularly the Health and Retirement Study (HRS) introduced in the early 1990s and sponsored by the National Institute on Aging. A similar survey, the English Longitudinal Study of Ageing (ELSA), is now conducted by academic institutions in England with the aim to gather data on health, economic position and quality of life in old age.

Other European countries face the same need for descriptive data concerning their ageing population. Their heterogeneity of culture, economic, political and social context provide the natural contrasts required for studies that will improve our knowledge through appropriate comparisons (Andersen and Hussey, 2001; Schoen *et al.*, 2000; Anderson and Poullier, 1999). Among the many research questions relevant for public policy issues, the following illustrate particular data needs:

- The **links between health state and socio-economic status:** longitudinal data from the Health and Retirement Study helped to understand better the causal relationships between illness, income, and wealth at older age (Smith, 1999). Even if a correlation is routinely found on cross-sectional data between wealth and good health, carefully crafted longitudinal data such as those obtained from the HRS were very useful to understand the direction of the causal relationship *(e.g.,* studies have shown that, in the US, wealth is affected by major illness episodes).
- The **dependency risk:** the increase in the number (both absolute and relative) of dependant elderly persons has led, across Europe and elsewhere, to various institutional and organisational responses (Norton, 2000). Yet it is difficult to evaluate the impact of these differences in terms of efficiency and equity. Such an evaluation would require internationally comparable data on health state, health care (including home care) services, income, intergenerational solidarity and family networks. In addition to cross

national comparability, data should be longitudinal, in particular to distinguish age effects from generation effects. In a long term perspective, if such data were available, it would be possible to estimate, *e.g.*, how the likelihood of dependency is influenced by elements such as health care purchasing power or informal help networks.

- The determinants of **retirement decisions:** there is strong evidence that financial incentives, health conditions, marital status and family structure play important roles in the decision to exit the labour force (Dwyer and Mitchell, 1999; Gruber and Wise, 2001). However, much of the available empirical evidence comes from US data, where institutional features of pension systems are radically different from the situation in European countries.
- **Savings and consumption behaviour** at retirement and at older age: what determines the evolution of wealth for the elderly, how do bequests and assets transfers interact with private (especially within the family) and public solidarity (Browning and Lusardi, 1996)?
- **Changes in health care coverage** at retirement time: international comparisons could illustrate the effect, on labour force participation, of various institutional features of health insurance systems (Lumsdaine *et al.*, 1997).

2. Data needed

Such questions, and many others, will be best studied if good data is available. Needless to say, the variability of institutional features of welfare systems, labour markets, family structure and health systems across Europe is a tremendous opportunity to analyse the effects of particular aspects of these systems on the issues mentioned above.

The Ageing-Related Diseases (ARD) project recently conducted by the OECD was an attempt to analyse the performance of health care systems for conditions that affect primarily older persons, taking advantage of the diversity of national health care systems. It compared investments in caring resources, utilization of specific medical treatments and outcomes in a variety of countries, and attempted to link them to differences in institutional structures (incentive features, mix of private and public provision and/or insurance, etc.). The OECD project on Ageing-Related Diseases produced very interesting comparisons between countries, resulting from major efforts to produce *a posteriori* similar data, using the same definitions and codes for all countries.

Although the ARD project used standard definitions for cases and treatments and pointed to substantial differences in treatments and outcomes across participating countries, it relied chiefly on retrospective and aggregate data. *A posteriori* standardization of disease definitions and treatments across countries is difficult and usually quite imperfect. Available data are scarce, and on many aspects they do not offer the necessary details needed to adjust for individual characteristics. To go further, there is a need for longitudinal data, collected at an individual level, based on a common questionnaire shared by a variety of countries. At this stage, the OECD ARD research evidences troubling disparities in Europe but we lack appropriate data to further document and understand the observed variations.

Further analyses of cross-country variations will only lead to reliable conclusions if many conditions are met. First of all, data should be comparable across countries. This requires a unified methodology and prospective data collection in all countries. Second, on all aspects such as health conditions and health behaviour, labour productivity or family structure, individual heterogeneity (both observable and unobservable) is important. To

take this into account, data should be collected at the individual and household level to control as much as possible for observed differences. Remaining unobservable differences (in particular attitudes towards risk and time) can be partially accounted for if repeated observations of identical individuals are available: on longitudinal data, changes in individual behaviour can be more easily attributed to changes in the environmental and incentive structure.

In summary, three elements are crucial:

- Data should be comparable across countries or systems.
- Data should be collected at the individual and household level, to account for observed and unobserved heterogeneity.
- Data should be based upon repeated observations on the same individuals.

Moreover, data should include variables concerning health, psychological variables, economic variables, environmental variables. By essence, collection of such data requires multidisciplinary cooperation.

3. The SHARE project

3.1. *Description*

The absence of appropriate data for the study of ageing-related issues in European countries has been recognised for a long time; the aim of the SHARE – a longitudinal **S**urvey of ***H***ealth, ***A***geing and **R**etirement in ***E***urope – project is to provide such data. The SHARE project does not start from zero. The model is the Health and Retirement Study conducted every two years in the USA by the University of Michigan with the support of the National Institute of Aging. HRS data now constitute a panel of 22 000 residents over the age of 50 and surveys variables on health, health services utilization, insurance coverage, financial status, family support, occupation and retirement. Experience from the English Longitudinal Study on Ageing is also integrated into the SHARE project. Data comparability is valued not only among countries, but also between SHARE and its model.

SHARE will collect interdisciplinary data on European citizens over the age of 50. Data to be collected will include *health variables* (*e.g.* self-reported health, physical functioning, cognitive functioning, health behaviour, bio-medical data, use of health care facilities), *psychological variables* (*e.g.* psychological health, well-being, life satisfaction, control beliefs), *economic variables* (*e.g.* current work activity, job characteristics, job flexibility, opportunities to work past retirement age, employment history, pension rights, sources and composition of current income, wealth and consumption, housing, education), *social support variables* (*e.g.* assistance within families, transfers of income and assets, social networks, volunteer activities, time use).

Although the long-term goal is to collect longitudinal data for citizens above 50 in all European countries, the current research aims at several preparatory surveys in a selected number of European countries.

The organisational structure of the SHARE Project consists of three elements:

- The co-ordinator, supported by the core management group, supervises the entire project.
- A matrix organisation of country and subject specialists. Each researcher belongs to both a country team and at least two working groups. Cross-national task-oriented working groups, which consist of those members in each country team who are interested in

specific subjects plus external experts, carry out the scientific substance of survey design and outcome analyses across countries.

- Advisory panels both on the national and the international level give advice and guidance to the project.

Participating countries and responsible institutions are listed in Table 11.1. They are a balanced representation of the various regions in Europe, ranging from Scandinavia (Denmark and Sweden) through Central Europe (France, Switzerland, Germany and the Netherlands) to the Mediterranean (Spain, Italy and Greece). Researchers of the concurring English Longitudinal Survey on Ageing (ELSA) and the US Health and Retirement Study (US HRS) give advice. Their experience is a key source of information for this project.

Table 11.1. **Management, countries and institutions participating in the SHARE project**

Project coordination:	Mannheim Research Center for the Economics of Aging, University of Mannheim, Germany
Core management group:	University of Mannheim, Germany
	University of Venice, Italy
	Tilburg University, Netherlands
Country teams leadership:	
Germany	University of Mannheim
Denmark	University of Copenhagen
France	EcoSanté (CREDES), Paris
Greece	Panteion University, Athens
Italy	University of Padua
Netherlands	Tilburg University
Spain	Centro de Estudios Monetarios y Financieros (CEMFI), Madrid
Sweden	University of Uppsala
Switzerland	University of Lausanne

Source: Author.

Eight countries are partially funded through research funds of the European Union. A ninth country, Switzerland, is participating as a non-EU country with matching funds from the Swiss government.

The project conducts experiments with a number of important design elements (*e.g.* sample design, questionnaire design, interview modes, comparison with administrative data), and culminates in a medium-scale survey of respondents over 50. This survey will follow a common set-up across all countries with the goal of collecting data that are strictly comparable to allow cross-country research. The surveys will be large enough to allow initial cross-country analyses in their own right, and, hopefully, also some within-country analyses.

Specifically, the SHARE Project tasks are to:

- Bring together a truly interdisciplinary team of first-rate researchers in demography, economics, epidemiology, medicine, psychology, public health, sociology, and statistics.
- Iteratively develop and administer common questionnaires in the various countries while taking into account differences in language, culture and institutions.
- Develop sample designs that are feasible in different countries, potentially making use of the sampling frames that are already available.

- Investigate response effects and feasibility of interviewing modes in experiments and pilots.
- After piloting and pre-testing, conduct a cross-national medium-scale survey (to be called the "main test survey") in all participating European countries with a strictly comparable questionnaire.
- Make the data available to researchers and public-policy analysts, conditional only on legal and confidentiality restrictions.
- Upon preliminary evaluation of the main test survey results, recommend a survey design and instrument for a ready-to-go pan-European longitudinal SHARE on a full scale.

3.2. Project workplan (cf. Figure 11.1)

At the beginning of the project, working groups and advisory panels have been formed which are responsible for the development of modules of the common questionnaire, for the sample design in the various countries, and for the selection and control of survey agencies.

Core of the workplan is the iteration between *questionnaire development* and *data collection*. Data will be collected in three stages. First *small-scale experiments* including trials with different interview modes, then *full-questionnaire pilots* will be run. Based on these experiences *a medium-scale test survey* will be held in all participating countries.

The substantive work of questionnaire development is performed by *eleven cross-national working groups* consisting of specialists in their fields. The specific fields of survey development assigned to these working groups are listed in Table 11.2. Their point of departure is the US HRS, the UK ELSA and other survey instruments (*e.g.,* in Germany, Italy and Sweden) which have addressed relevant questions in order to produce an English-language *draft questionnaire*. The entire team met in March 2002 in a plenary session to test

Figure 11.1. **Project timetable as in SHARE proposal**

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
	2002												2003											
Tasks	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D
Establish teams	x	x																						
Core questionnaire design	x	x	x																					
Economics modules' design		x	x	x	x	x																		
Health modules' design		x	x	x	x	x																		
Family/social network modules' design		x	x	x	x	x																		
Sample design		x	x	x	x	x																		
Tentative fieldwork agencies selection		x	x	x	x	x																		
Small-scale experiments			x	x	x	x	x																	
Evaluation of experiments				x	x	x	x	x	x															
Update of questionnaire design					x	x	x	x	x															
Update of sample design						x	x	x	x															
Field agencies selection							x	x	x															
Full questionnaire pilots										x	x	x												
Database design										x	x	x	x	x	x	x	x							
Evaluation of pilots													x	x	x	x	x							
Final questionnaire design														x	x	x	x	x	x					
Main translation															x	x	x	x	x					
Final sample design																x	x	x	x					
Field agencies selection																	x	x	x					
Main test survey																				x	x	x		
Data dissemination system																				x	x	x	x	x
Data pre-cleaning, weighting, anonymizing																						x	x	x
Preliminary response analysis																						x	x	x
Report on design of full SHARE																						x	x	x

Source: SHARE proposal to the EC 5th Framework Program, Börsch-Span, A., March 2001.

Table 11.2. **Modules of SHARE contents**

Physical health
Mental health and psychological status
Well-being
Savings and assets
Income and poverty
Consumption
Labour force participation, earnings and pension claims
Expectations and subjective probabilities
Family and social networks
Intergenerational transfers
Health system and health services utilisation
Working groups on methodological aspects:
Cross-national survey design
Data base management and data validation
Preliminary response analysis

Source: Author.

ideas and ensure that the proposed questions are likely to be viable in all participating countries. Three additional cross-national working groups will settle technical aspects such as sample design and data management.

Small-scale experiments (20-50 respondents) currently (as of October 2002) in progress purport to test critical aspects of this draft questionnaire. Such interviews aim at cognitive testing to ensure that the questions are understood and answered as intended in each country. Some of these aspects may be tested in only one country, others across many or all countries.

Results of these experiments will be used to design the full questionnaire which will be translated into the national languages. Efforts will be made to ensure functional equivalence both in relation to the concepts and wording. A second plenary session will ensure cross-national equivalence.

This *full questionnaire* will be piloted (100 primary respondents per country plus their spouses) to check for reliability and validity. The sample sizes need to be large enough to permit splitting the sample randomly to test alternative versions of certain questions and to test some substantive relationships between variables for plausibility.

The pilot results will be thoroughly analysed to maximise the reliability and validity of the questions. The results will suggest improvements to questions, assist in the design of the final source questionnaire, and help to select the various interview modes that are most suitable for each country and optimally adapted to the sample stratum (by age, household *vs.* institution). This process will culminate in a plenary session to ascertain cross-field consistency of a revised prototype questionnaire in English, which will then be translated into the languages of all participating nations.

A *medium-scale test survey* of this prototype questionnaire will then be conducted (1 500 primary respondents per country plus their spouses). This stage is essential in demonstrating the feasibility and the usefulness of SHARE, in that it permits substantive data analysis addressing the main questions of interest. This stage of the project will end in a final conference to which researchers, officers from the European Commission, and policy makers will be invited in order to disseminate results to a broad audience.

3.3. SHARE and the study of Ageing-Related Diseases

Health, in the SHARE project, is covered by two sets of questions relating to physical health and mental health, and by an additional set on health systems and health services utilization. The following reasons motivate the interest of integrating health questions in the survey:

- Health is a major determinant of well-being.
- Health at old age is a determinant of retirement decisions. As such, it has an impact on the active/non active ratio and on the productivity of societies, through the number of individuals who actively contribute to the production of economic wealth.
- Inversely, retirement decisions and more generally activity may also have effects on mental and physical health at older age. The causal relationships between health and activity (both paid and unpaid) are not yet fully understood.
- Poor health in old age is also a determinant of indirect loss of productivity when it is associated with a loss of autonomy. Women's working capacity, in particular, is diverted from the production of wealth by so-called "informal caregiving" activities.

The capacity of health systems to adapt to the needs of ageing populations is of central importance both for increasing the level of health-related quality of life, and for maintaining or increasing the level of contribution of all individuals to the productivity of their society (Lloyd-Sherlock, 2000).

European countries have distinct health policies (Ribbe *et al.*, 1997; Westert and Groenewegen, 1999). The exploration of individual behaviors in a variety of health care environments requires extensive data on health, wealth, insurance coverage and health services utilization, collected with a unified methodology in all countries (Cavelaars *et al.*, 1998). Health policy decisions concerning alternative ways to deliver and finance health services should be based on reliable empirical evidence, such as the extent to which European health systems succeed in meeting the needs of their older citizens.

For conditions that are age-independent, health systems have to deliver appropriate care to all age groups, including the oldest. Simultaneously, health systems are pushed by the demographic ageing phenomenon to develop appropriate responses for ageing-related conditions and for their consequences (Grimley Evans, 2000). According to published reports, there is probably room for more primary, secondary and tertiary prevention in old age, and many studies suggest that care in old age does not always conform to the recommendations for good practice (Institute of Medicine, 2001). Access to effective health care, including long term care, rehabilitation or palliative care, at an age where economic and social circumstances are the most heterogeneous can be improved or discouraged by specific aspects of health systems, such as the density of services supply or the coverage of services to older patients by social and private insurance.

Increasing costs of health care have prompted economic constraints, inducing rationing in health care delivery and financing, such as restrictions of access to specialist care or limited coverage of drugs costs. Increasing costs have also stimulated the growth of managed care, with potential benefits in terms of care coordination for older persons, but potential adverse effects on patients selection by health care providers. The way specific characteristics of health systems and health policies affect the older members of European societies, and whether all of them are equally affected, is not documented. The impact of these characteristics on older populations' health and wealth is not well-known.

The SHARE project will help to address the following general question, of utmost interest in all ageing societies facing pressures in their health and social budgets: *What are the respective effects of the health care environment and of individual characteristics on the level of health services utilization and, ultimately, on health in old age?*

The first wave of SHARE will provide the material for cross-sectional analyses of:

- the variability of health services utilization both within countries and between countries;
- the association of health services utilization with specific characteristics of health systems (for example, social and/or private insurance);
- the association of perceived barriers to health care with individual social and economic factors, as well as with specific characteristics of health systems.

By collecting, at an individual level, *the same data with the same methodology* in all participating European countries, each characterized by an independently conceived and organized health system, SHARE will provide a unique opportunity to compare health systems performance both in terms of effectiveness and of equity. Comparability of *individual* data collected in SHARE across a variety of health care systems is the necessary basis for a multilevel, cross-country analysis that combines individual and system effects on health (Hart *et al.*, 1997; Veugelers *et al.*, 2001). The *longitudinal design* of SHARE is the required basis for a valid analysis of the hypothetical causal sequence linking health system organisation and financing, access to care, health and wealth. And the *multidisciplinarity* of SHARE is the essential basis for a convincing integration of a large variety of determinants of health and wealth, properly measured, in such analyses.

The SHARE project will generate data to test for a very wide range of other hypotheses, related to the determinants of health and to the impact of a poor health on individual well-being and wealth.

3.4. *Dissemination activities*

SHARE is designed to be a fundamental scientific resource for understanding health, ageing and retirement in Europe. It will provide a knowledge base to improve the basis for policy and planning in an ageing society. Central to the philosophy of this project is therefore, to share the data collected by SHARE as soon as technically possible with the entire scientific and public policy communities. In accordance with data confidentiality regulations in various countries, only "factually anonymised" data will be made available to users. Initial comparative analyses of the SHARE database and of data sets from similar surveys will be performed with the financial support from the European Union.

A SHARE website (*www.share-project.org*) will contain full details of the data content, access arrangements, codebooks and other documentation. Similarly, all articles, books and papers based on the collected data, whether substantive or methodological, will be documented and catalogued on the SHARE website. The publicly-available and well-documented main test survey data are created to invite substantive data analyses by academia and policy research institutes.

Two large conferences will be organized, one after the pilot results have been released (mid-term review), and one at the end of the project (final conference). These conferences will be open to the scientific community at large, and some parts will be tailored specifically for EU policymakers in order to disseminate the results of this study to the public-policy community.

4. Conclusions

The SHARE Project will provide much needed data for all aspects of population ageing that lead to political decisions in European countries. It will also document interrelations of economic, social, environmental and health dimensions of ageing and offer European researchers the necessary material to study these relationship at an individual level. The much mentioned barrier of diversity in survey methods that characterizes cross-national comparisons of public policies will be overcome by the adoption of a common methodology in all participating countries. The collaboration between the SHARE Project and participants to the Health and Retirement Study will also facilitate comparisons between Europe and the USA. The current project will lead to the provision of comparative data for the second half of the 2010s and to further developments required by the longitudinal design of the survey.

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PART IV

Health Technology Diffusion, Assessment and Expenditure

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What is Best and at What Cost?
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PART IV

Chapter 12

The Technology-Health Expenditure Link
A Perspective from the Ageing-Related Diseases Study*

by
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Abstract. *Technology is generally accepted as the most significant force driving health expenditure growth. This paper explores that relationship by examining some basic facets of how health technology diffuses. Results from the OECD Ageing-Related Diseases study are used to show how countries differ with respect to the level of utilisation of technology. By focussing on the technology used for treating one disease in particular, heart disease, the paper also examines how technologies diffuse within countries. The question "Should we control technological change in order to control rising health expenditures?" is discussed, but the answer is left to future research.*

* This work has benefited from the collaborative work of a network of experts. The Ageing-Related Diseases study was supported by grants from the US National Institute of Aging (Y1-AG-9363-9364) and the Japanese Ministry of Health, Labour and Welfare.

Introduction

There is a large body of literature that explores the issue of the determinants of expenditures on health. The main driving forces identified are ageing populations, income growth and technology. While it has been generally accepted that technology is the most significant of these forces, relatively little research has focussed on determining the precise relationship. This paper sets out to explore the third, but most important of these factors that affects health expenditures, technology.

The paper begins with a short review of the literature, focussing particularly on that part of the literature that attributes the bulk of the growth in health expenditures to the advance of health technology. The review includes some previous work on how technology in health care spreads through the diffusion process. This provides the reader with some background for Section 2, where the results of the ARD study are used to examine the relationship between technology and health expenditure. The section begins with an analysis of the relationship between the level of health technology for the three diseases studied in the Ageing-Related Diseases (ARD) study: ischaemic heart disease, breast cancer and stroke, and overall health expenditures. Following this is an exploration of the longitudinal nature of the relationship focusing on utilisation of technologies over time, including some preliminary results of empirical analysis. Section 3 is a brief exploration of the following question: Should we control technological change in order to control rising health expenditures?

1. How does technological change affect health expenditures

Borrowing from the economic growth literature,[1] Newhouse (1992) uses a residual approach for accounting for health expenditure growth to show that the main driving force behind the growth in health expenditures is technological change in health care. He arrives at this conclusion by first examining known factors underlying health expenditures (demand – ageing populations, the spread of insurance, and the growth of income; supply – supplier-induced demand and differential productivity growth, *i.e.* productivity in medical care and other service industries have not grown as fast as the rest of the economy) and apportioning their contribution to the growth in health expenditures in the United States during the post-war period. Newhouse states that these factors taken together can explain, *at most*, 50% of the increase in health expenditure over the previous 50 years. He then provides a rationale to explain why technological growth accounts for the bulk of the residual, buttressing his argument with data that are in his view consistent with his rationale.

Newhouse was not the first economist to attribute such an important role to technology in determining health expenditure growth (Goddeeris, 1984a and 1984b; Aaron, 1991; Weisbrod, 1991), but his use of economic growth accounting methods facilitated the adoption of the idea among economists. Since then the idea has gained wide acceptance among economists (Fuchs, 1996; Cutler and McClellan, 2001; Okunade and Murthy, 2002).

While it is generally accepted that technological change is the largest contributor to the growth in health expenditures, little work has been devoted to exploring the mechanism of how this process works. An important first step is to understand exactly what economists mean when they describe technology in health. Most people have an intuitive grasp of what technology means to them, when they think of medical technology they think of "high-tech" equipment such as magnetic resonance imaging machines (MRIs) or complicated invasive procedures such as coronary artery bypass grafts (CABG). To an economist, technology is defined in terms of inputs, or "factors of production", the most common being labour, knowledge and capital. Firms use these factors of production to produce final goods or outputs. The set of all these processes constitute the technology, which can be defined in terms of a single firm, an industry or an entire economy.[2] The following paragraph provides an example within the context of the ARD study.

Consider a simplified example of how to treat acute myocardial infarction (AMI), or heart attack (blockage of the arteries that supply blood to the heart). In this case, technology would be defined for a single industry, the industry for treating AMI. The *capital* required will come in the form of surgical tools used, drugs administered, operating room time, number of days in hospital bed, etc. The *labour* will be the time required of physicians and nurses for the duration of the treatment. Finally, *knowledge* about the functioning of the cardiovascular system and how patients react to different treatments is required. These factors of production, or inputs, are then combined in various production processes, or *techniques*, which at their simplest form for AMI are CABG (grafting of an artery or vein to bypass an occluded artery(ies), angioplasty, or the more commonly performed procedure today, percutaneous transluminal coronary angioplasty (PTCA – use of a balloon catheter to dilate the blocked artery) and thrombolytic drug therapy (drugs – used to dissolve the blockage),[3] to produce a final *output*, in this case the health outcome resulting from each treatment. Finally, the set of all these processes is the *technology* for treating AMI. Thus, when people think of health technology in terms of the number of MRI machines available or the number of CABG that were performed in a given year, they are thinking of only that part of technology related to capital inputs, and only a fraction of that.

Continuing with the example from the previous paragraph, the invention of CABG in the 1960s and thrombolytic drug therapy and angioplasty in the 1970s were inventions, or new innovations, that added to the set of techniques that made up the technology for treating AMI. These technological changes improved the outcomes of patients with AMI and eventually became part of the standard set of treatments for AMI. The set of new techniques that contribute to technological change is not limited to new inventions. Improvements in the use of existing techniques, such as the introduction of intracoronary stents to prevent restonosis in PTCA, also contribute to technological change.

Since Newhouse's 1992 paper, the bulk of the research has focused on the relationship between the technological change and health expenditure growth. I use the term bulk somewhat loosely since the number of studies devoted to the subject has been small relative to the consensus that has come about among economists regarding the contribution of technological progress in health to growing health spending. Why then have there not been more studies that have tried to identify the mechanism of technological change that affects health care? After all, comparable, comprehensive data on health expenditure are available for as far back as 25 years for most OECD countries (OECD, 2002) and a plethora of studies have been coming out since the early 1990s that have examined health expenditure growth (Gerdtham, 1992; Gerdtham *et al.* 1998; Barrons,

1998; Cutler and McClellan, 2001; Okunade and Murthy, 2002). The problem likely arises from the difficulty in conceptualising technology, which makes it difficult to come up with an appropriate proxy measure for technological change (Ahern, 1993; Okunade and Murthy, 2002).

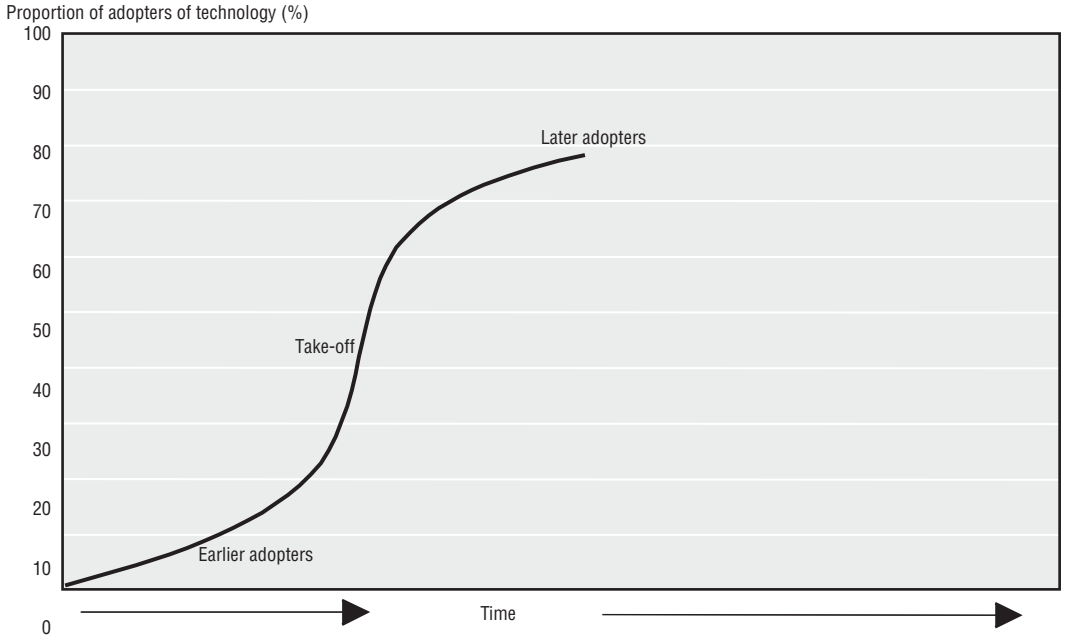
There have been several studies that have used proxies for technological change to examine the relationship between technological change and health expenditure. Cutler and McClellan (1996) use treatments for acute myocardial infarction (AMI) to shed light on the determinants of technological change. Their justification for using this particular disease is that technological change for treatment of AMI increased significantly over the previous decade, making it an excellent choice for studying the determinants of technological change, thus providing valuable insight into the largest contributing factor to health expenditure growth. Their findings suggest that technological change may in fact account for more of the growth in health expenditures than the generally accepted 50% postulated by Newhouse. In a subsequent paper they expand their work to treatments for four other diseases (Cutler and McClellan, 2001). Other efforts have focused on specific medical equipment (Baker and Wheeler, 1998) or surgical procedures (Weil, 1995). More recently, attention has been focused on technological change in the context of cointegration analysis of health expenditures, where proxies for technological change include a time index variable (Gerdtham and Lothgren, 2000) and research and development (Okunade and Murthy, 2002).

As Gelijns *et al*. (2002) point out, these studies demonstrate the importance of the impact of technological change on health expenditures, but they do not "illuminate which technologies and patterns of usage are specifically responsible for this growth (in health expenditures)". To better understand the mechanisms through which technological change affects health expenditures, a basic framework is required. There are three mechanisms through which technological change can affect health expenditures: 1) introduction of new or modified technologies; 2) intensity of use of existing technology; and 3) expanded application of these new technologies (Gelijns and Rosenberg, 1994).

In a model of technology adoption, following research and development, the *introduction* of new technologies occurs through the adoption of use in the medical field. Following the classic S-shaped curve of technological diffusion (Figure 12.1), the adoption of these technologies by providers is slow at first (earlier adopters part of the S-shaped curve). Several factors have been identified as exerting influence on this process. The fondness of the medical profession for the introduction of new innovations in medical care, the "technological imperative", especially in the United States, is often posited as a determining influence (Fuchs, 1996). However, as Gelijns and Rosenberg note (1994), this explanation is too simple to fully explain the complex dynamic of technology adoption. Feedback mechanisms between the medical profession, both clinicians and researchers, other actors and the research and development community affect the rate and direction of innovation. Prevailing institutional and economic incentives also play an important role (Weisbrod, 1991), with increasing emphasis being placed on the role of technology assessment.

While adoption of new or modified technologies may be slow at first, diffusion becomes more rapid as these technologies gain acceptance in the medical profession (take-off part of the S-shaped curve). Cross-country comparisons of utilisation levels become easier since data become more available as technologies are adopted into regular medical practice.

Figure 12.1. **S-shape diffusion curve for technology**



Source: Adapted from Pritchard (2002) and Rogers (1995).

Differences in *intensity* of use across countries become clearer. The preference of providers, and patients, in the US for the latest technologies has long been cited as a significant reason why the utilisation of "high-tech" procedures in the US is much higher than in other countries (Fuchs, 1986). However, there are other factors that are probably more likely to affect the intensity of use. Medical specialists are known to use high-tech more than generalists for similar conditions (Fleg *et al.*, 1989), so countries with proportionally more specialists than generalists are more likely to have higher utilisation rates of high-tech. Strict regulation of facilities can limit the number of facilities able to perform high-tech procedures, by extension affecting intensity of use (TECH, 2001). Economic incentives in the form of payments to providers are also significant determinants of utilisation.

Finally, as technologies mature and the medical profession becomes more efficient in their application, they will continue to *expand* use to new patient groups. On the familiar S-shape curve, adoption is still increasing but at a decreasing rate (later adopters part of the S-shaped curve). However, this simplified view of the technology diffusion process does not take into account modifications to existing technologies. Assuming modifications improve upon the specified technology, either the entire process begins anew at point on the S-shape curve of earlier adopters or the S-shape curve shift upward.

The diffusion of angioplasty provides a good example of the dynamic process of technology diffusion. First introduced in the late 1970s, angioplasty was rarely used as early clinical trials showing its effectiveness were, like all clinical trials, restricted to a precisely defined group of patients. As physicians gained expertise in using angioplasty, the evidence-base of its effectiveness in treating IHD grew, accompanied with gradual expansion its utilisation in the early 1980s. Continual improvements to the procedure, including improvements in balloon catheters and more recently the advent of intracoronary stents, provided further impetus to the expansion of angioplasty use where now more angioplasties are being performed than CABGs.

Underlying the technological diffusion process is the communication among physicians. The geographical variations literature in health care utilisation shows that underlying levels of disease are not sufficient to explain variations across regions and countries (Chassin *et al.*, 1987). While local influences are at play, the medical world is becoming increasingly global in nature. Physicians are reading the same journals, which can be readily accessible on the Internet, and attend many of the same conferences (TECH, 2001). An example of the influence of the communication process can be found with regards to carotid endarterectomy, a treatment for preventing ischaemic stroke. Tu *et al.* (1998) demonstrated a strong correlation between the publication of studies on the use of carotid endarterectomy and rates of utilisation in the United States and Canada. Following the publication of studies for which complications arising from carotid endarterectomy were unacceptably high, there was a fall in utilisation rates in the mid- to late-1980s. However, utilisation rates increased dramatically between 1989 and 1995 following the publication of two influential clinical studies demonstrating the effectiveness of the procedure.

2. ARD results and technology

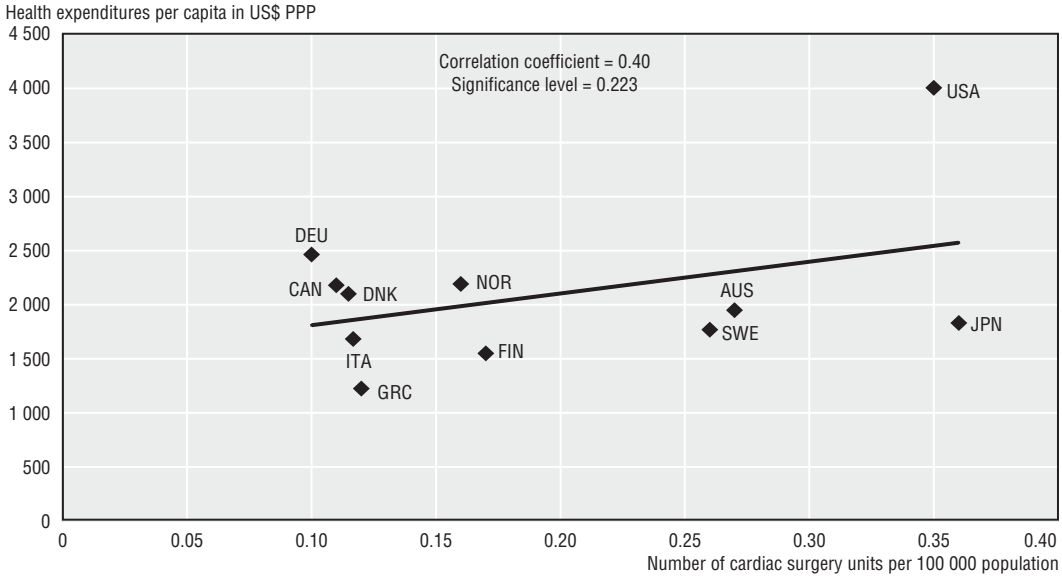
As the previous section demonstrated, a proper analysis of the relationship between health expenditures and technology is a difficult task. The type of time series analysis required when using health expenditures data from system of national health accounts is beyond the scope of the present paper. Instead, the following discussion focuses on a few technologies used in the treatment and diagnosis of IHD, breast cancer and stroke. By dint of the large amount of information collected in the IHD part of the study relevant to technology, most of the following discussion will focus on the results from that part of the study, with additional results from the two other disease parts included as appropriate.

2.1. Level of health technology

As mentioned previously, few studies have examined the direct link between technology and health expenditures, with difficulties in defining health technology being cited as a primary reason for the lack of such studies despite an overwhelming acceptance that technology is the main force driving health spending. While the ARD study wasn't designed to make the direct link between the supply of technology and health expenditures, we did collect information on supply factors that can shed some light on the subject. For IHD we collected information on the number of facilities equipped to handle invasive, complicated procedures such as CABG and PTCA. For stroke, we collected information on the number of computed tomography (CT) scanners and magnetic resonance imaging (MRI) scanners. And for breast cancer, we collected information on the number of mammography and radiotherapy machines.

IHD is a particularly useful disease for studying technology patterns since much of the treatment involves invasive, complicated procedures such as CABG and PTCA. These procedures can only be performed in facilities with the proper equipment. In the IHD part of the ARD study (Moïse, Part I in this volume), we collected information on cardiac surgery facilities, where CABG can be performed, and cardiac catheterisation laboratories, where PTCA can be performed. In order to study the relationship between the availability of facilities and health expenditure, Figure 12.2 and Figure 12.3 plot health expenditure per capita against the number of cardiac surgery facilities and cardiac catheterisation laboratories respectively.

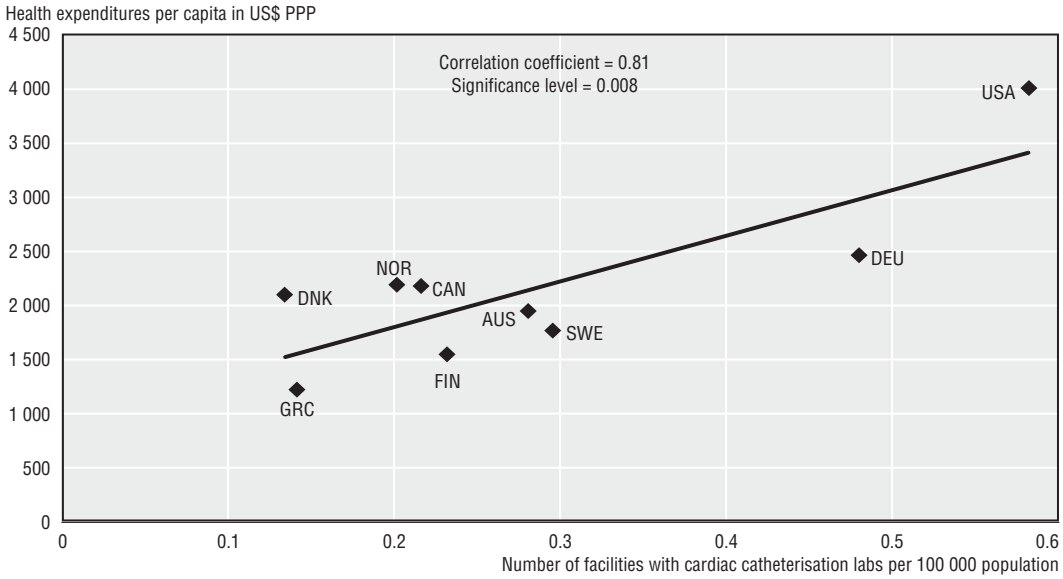
Figure 12.2. **Availability of cardiac care facilities and per capita health expenditure**



Note: A linear regression line using least squares was fitted to the data (y = 2 925.5x + 1 518.9). Data on cardiac surgery facilities are for the following years: 1995 – Canada, Denmark and Sweden; 1996 – Japan and the United States; 1997 – Italy; 1998 – Australia and Germany; 2000 – Finland, Greece and Norway. Data on health expenditure per capita are for 1997.

Source: Cardiac surgery facilities: data collected by the experts in the countries participating in the IHD part of the ARD study (see Moïse, Part I in this volume). Health expenditure per capita: OECD (2002).

Figure 12.3. **Availability of cardiac catheterisation laboratories and per capita health expenditure**



Note: A linear regression line using least squares was fitted to the data (y = 4 211.3x + 960.52) Data on cardiac catheterisation laboratories are for the following years: 1995 – Canada, Denmark and Sweden; 1996 – Germany and the United States; 1999 Greece; 2000 – Australia, Finland and Norway. Data on health expenditure per capita are for 1997.

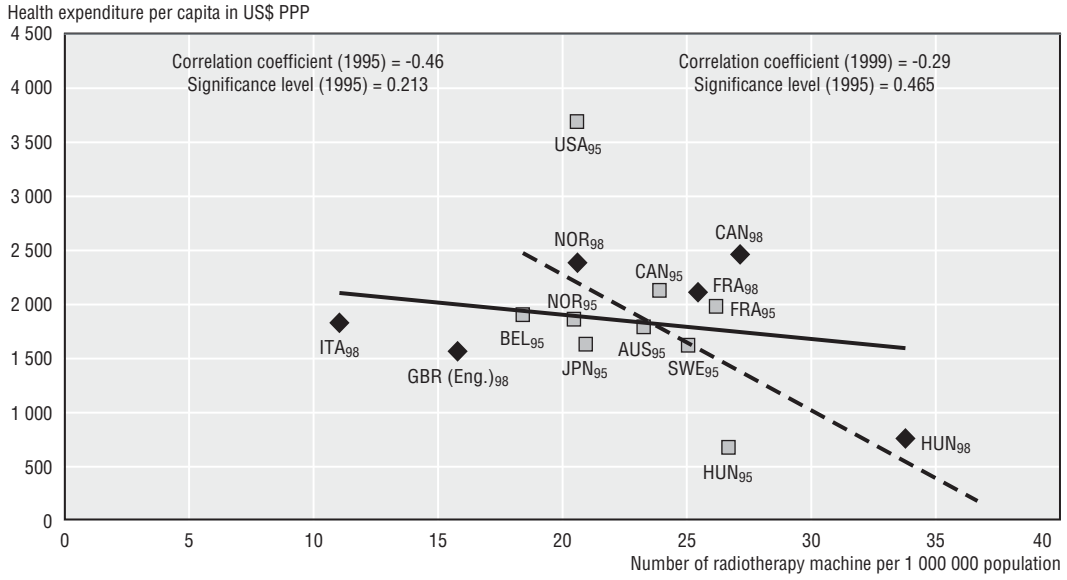
Source: Cardiac catheterisation laboratories: data collected by the experts in the countries participating in the IHD part of the ARD study (see Moïse, Part I in this volume). Health expenditure per capita: OECD (2002).

Ideally, the two charts would plot the number of facilities against health expenditure for the same year. Unfortunately, available data on the number of facilities are scattered across several years. This leaves one of two options for displaying the information in both charts. One option is to plot the number of facilities in each country against health expenditure in that country for the corresponding year for which data on facilities are available. The other option is to plot the number of facilities in each country against health expenditure in that country, but with the data on health expenditure corresponding to the same year across all countries. Since the year-to-year change in the number of facilities, especially cardiac surgery facilities, does not change as much as health expenditure, the latter option was chosen.

There is a positive, but weak correlation between the number of cardiac surgery units and per capita health expenditures based on this subset of OECD countries (correlation coefficient $r = 0.40$; level of significance $\alpha = 0.223$). The relationship is stronger between cardiac catheterisation laboratories and per capita health expenditure ($r = 0.81$; $\alpha = 0.008$). However, with such a small number of observations, the strength of the relationships are strongly influenced by the outlier in the data, the United States. If the data for the US are removed, there is no correlation between the number of cardiac surgery facilities and per capita health expenditure ($r = –0.15$; $\alpha = 0.700$), nor between the number of cardiac catheterisation laboratories and per capita health expenditure ($r = 0.52$; $\alpha = 0.162$).

For breast cancer, the relationship between technology and per capita health expenditure was examined using the number of radiotherapy machines as an indicator for the level of technology. For the availability of radiotherapy machines, data were available for 1995 and 1999, which allows for a more dynamic view of the level of technology by focussing the cross-sectional analysis over two time periods four years apart (Figure 12.4).

Figure 12.4. **Number of radiotherapy machines and per capita health expenditure**



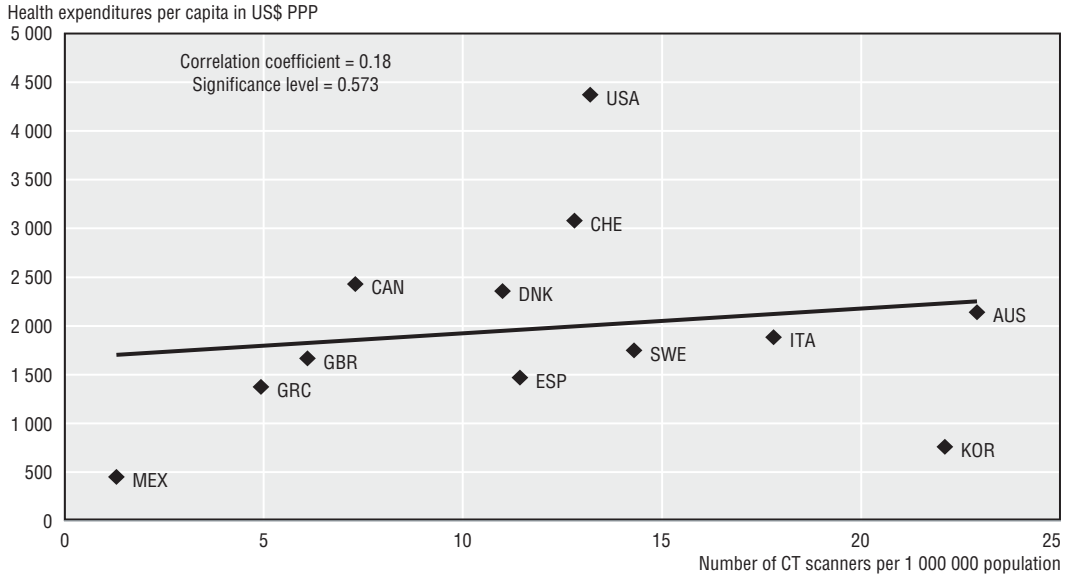
Note: The dashed line was fitted to data for 1995. Linear regression lines using least squares were fitted to the data ($y_{95} = –125.6x_{95} + 4\,787.6$; $y_{99} = –22.446x_{99} + 2\,355$).
Source: Radiotherapy machines: data collected by the experts in the countries participating in the breast cancer part of the ARD study (see Hughes, Part I in this volume). Health expenditure per capita: OECD (2002).

Figure 12.4 shows there to be an inverse relationship between the number of radiotherapy machines available per 1 000 000 persons and health expenditure per capita. The correlation coefficients between the number of radiotherapy machines and per capita health expenditure for both 1995 ($r = –0.46$; $\alpha = 0.213$) and 1999 ($r = –0.29$; $\alpha = 0.465$) are statistically insignificant. The patterns may be affected by outliers, in this case the USA and Hungary, as was the case with the previous charts. However, removal of data for Hungary does not alter the qualitative nature of the relationship for the 1995 data, but it does change the relationship for the 1999 data. Unlike the data on facility availability for cardiac care, the United States is in the middle of the countries in Figure 12.4 with regards to the number of radiotherapy machines available, which should not affect the relationship as significantly as with Figure 12.2 and Figure 12.3. However, the actual number of machines in the US may be underestimated since the figure is estimated as facilities with radiotherapy machines, where each facility may have more than one radiotherapy machine.

For the other disease studied, ischaemic stroke, we collected information on the availability of two diagnostic machines, computed tomography (CT) scanners and magnetic resonance imaging machines (MRI). Health expenditure per capita is plotted against the number of CT scanners and MRI machines in Figure 12.5 and Figure 12.6 respectively. Data availability posed a problem similar to that of Figure 12.2 and Figure 12.3. However, the problem is not as severe since the data on CT scanners and MRI machines spans only four years, 1997, 1998, 1999 and 2000 (the data in Figure 12.2 and Figure 12.3 spanned six years, 1995-2000). The same option for displaying the data used in Figure 12.2 and Figure 12.3 was used for Figure 12.5 and Figure 12.6.

The data plotted in Figure 12.5 show there to be a positive, but weak relationship between the number of CT scanners and per capita health expenditure ($r = 0.18$; $\alpha = 0.573$).

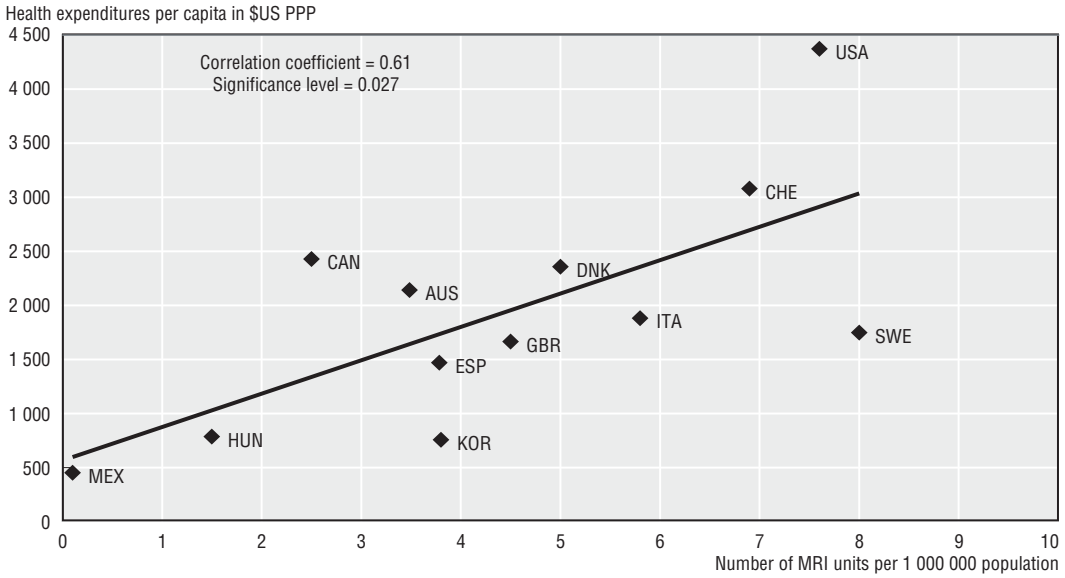
Figure 12.5. **Number of CT scanners and per capita health expenditure**



Note: A linear regression line using least squares was fitted to the data (y = 25.496x + 1 669.1). Data on CT scanners are for the following years: 1997 – Italy; 1998 – Korea, Mexico, Switzerland and the United States; 1999 – Australia, Denmark, Spain, Sweden and United Kingdom (GBR); 2000 – Canada and Greece. Data on health expenditure per capita are for 1999.

Source: CT scanners: data collected by the experts in the countries participating in the stroke part of the ARD study (see Moon, Part I in this volume). Health expenditure per capita: OECD (2002).

Figure 12.6. **Number of MRI machines and per capita health expenditure**



MRI: Magnetic resonance imaging.

Note: A linear regression line using least squares was fitted to the data (y = 308.76x + 565.56). Data on MRI machines are for the following years: 1998 – Italy, Korea, Mexico, Spain, Switzerland and the United States; 1999 – Australia, Denmark, Hungary, Sweden and the United Kingdom (GBR); 2000 – Canada. Data on health expenditure per capita are for 1999.

Source: MRI machines: data collected by the experts in the countries participating in the stroke part of the ARD study (see Moon, Part I in this volume). Health expenditure per capita: OECD (2002).

The relationship between the number of MRI machines and per capita health expenditure in Figure 12.6 is much stronger ($r = 0.61$; $\alpha = 0.027$), suggesting a positive relationship between the two variables.[4]

Consider again the S-shape curve of technology diffusion from Figure 12.1. The diffusion of the older technology, CT scanners, would be on the part of the S-shaped curve identified as "later adopters" as more physicians would have had a chance to adopt this technology than would be the case for MRI machines, which would be on the part of the curve labelled as "take-off", or quite possibly "earlier adopters".

2.2. Diffusion of health technology

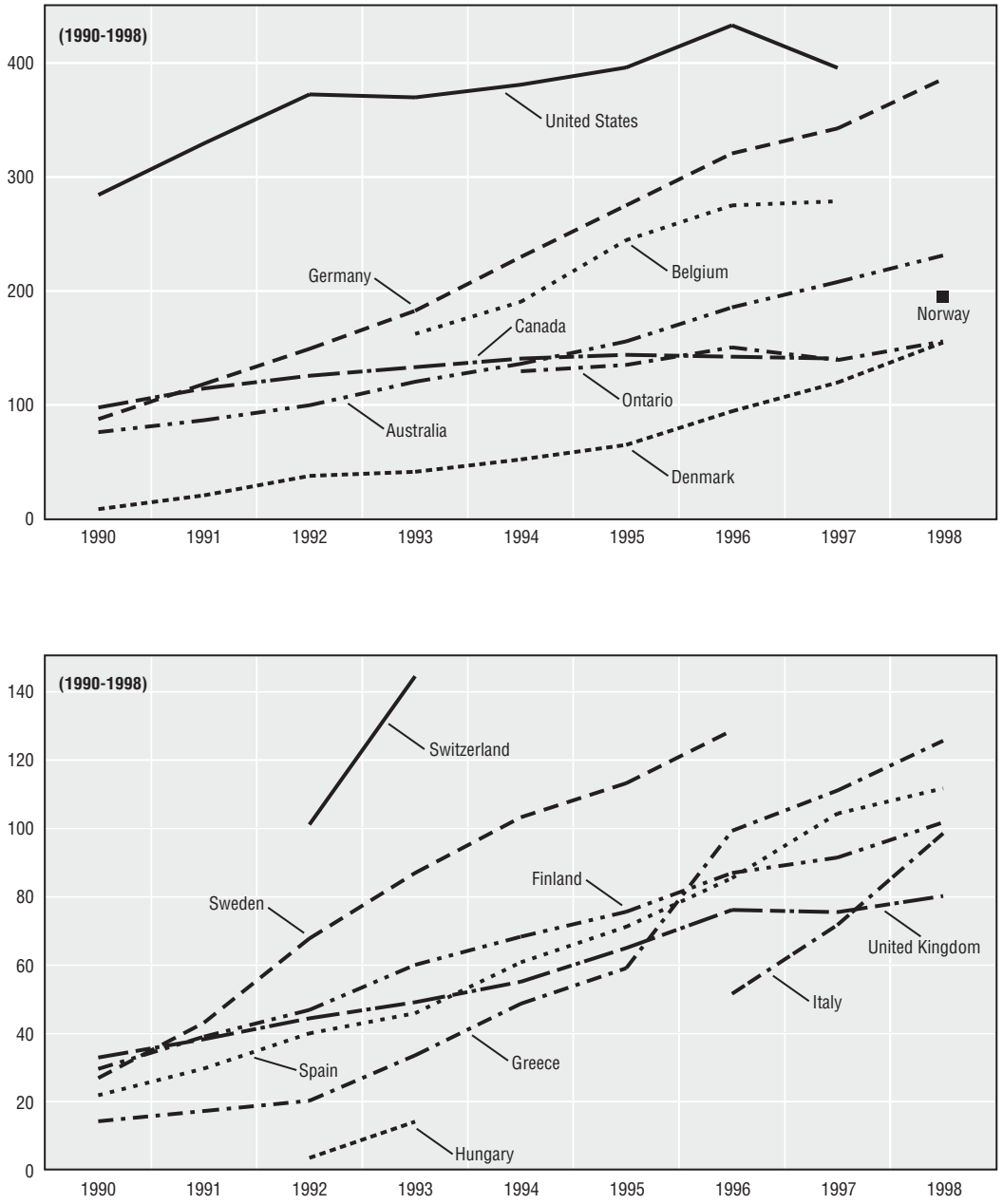
In order to obtain a better understanding of the diffusion process of health technology, it is better to analyse utilisation over time. The ARD results are well suited to this exercise since we collected information on the utilisation of several technologies over the course of several years, especially for technologies related to the treatment of IHD.

The utilisation of PTCA has increased dramatically during the 1990s (Figure 12.7). In Denmark, the number of PTCA per 100 000 persons aged 40 and over has increased from 8.6 in 1990 to 120 in 1997. Most other countries experienced less dramatic growth rates, but the only two countries for which the utilisation rate of PTCA did not double during the 1990s were Canada and the United States. In 1990 utilisation rates for PTCA were highest in these two countries. By 1997, the US still had the highest rates, but Canada had fallen to the middle of the group of countries. During this period the gap between the US and the other countries diminished, especially Germany and Belgium.

Growth rates were far lower during the 1990s for CABG than PTCA (Figure 12.8). Denmark also had the largest increase in the use of CABG; utilisation increased from

Figure 12.7. **Utilisation rates for PTCA procedures**

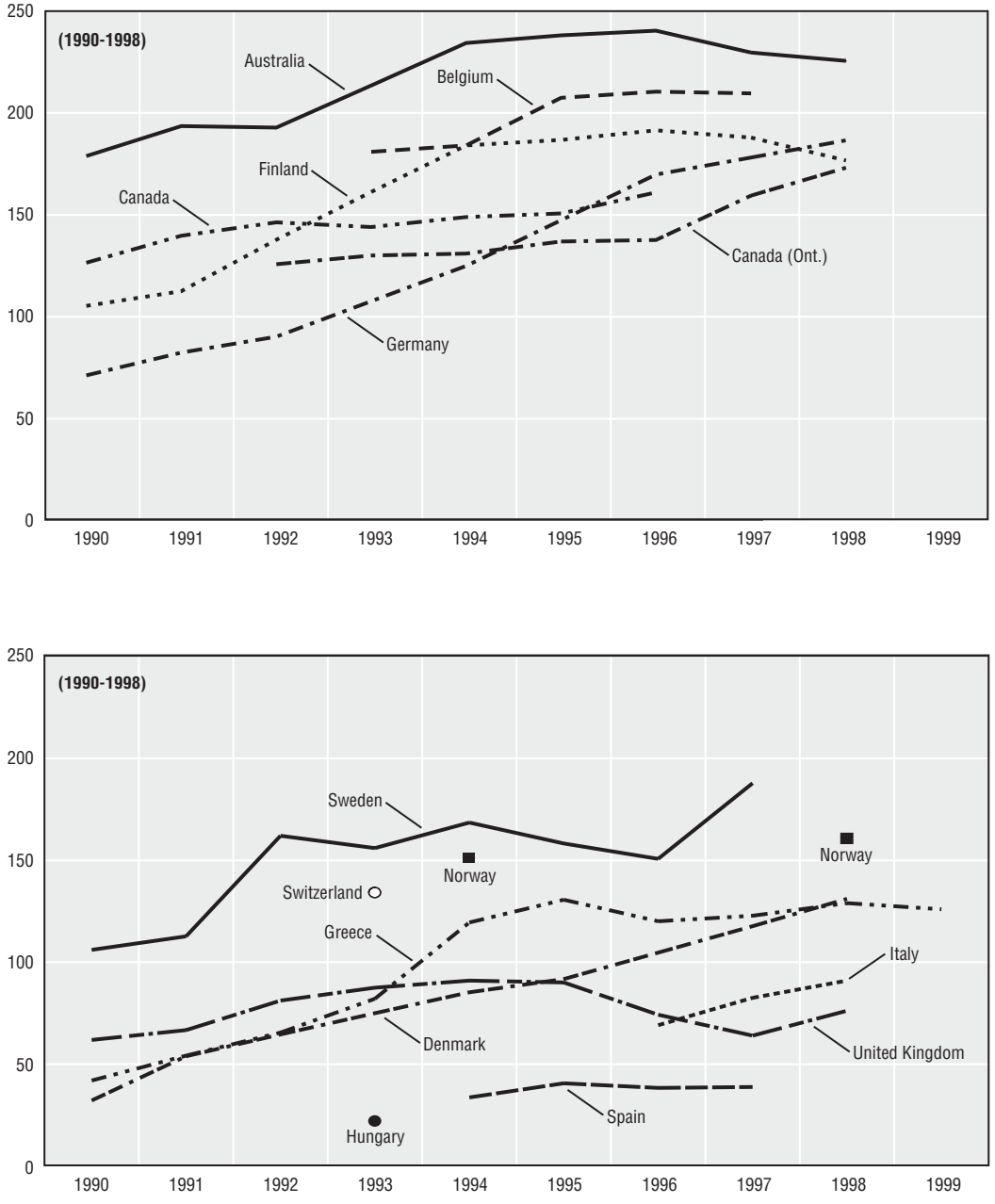
Number per 100 000 inhabitants aged 40 and over



Note: The population aged 40 and over was used as the denominator. Belgium, Germany, Italy, Norway, Spain and Sweden were able to provide rates using the 40 and over population as a denominator. For the countries that used the entire population as the denominator, the denominator was calculated as the ratio of the entire population multiplied by the ratio of the entire population to the population 40 and over.
The two charts use different scales for the number of PTCA per 100 000 inhabitants.
Greece: After 1996 only includes 17 out of a possible 24 hospitals.
Japan: Estimated number of procedures performed during a one-month period (*e.g.*, June 1997), since 1994.
Source: Data collected by the experts in the countries participating in the IHD part of the ARD study (see Moïse, Part I in this volume).

Figure 12.8. **Utilisation rates for CABG procedures**

Number per 100 000 inhabitants aged 40 and over



Note: Data for the United States are not presented here since their much larger values would distort the chart display. The levels are: 409 (1990), 416 (1991), 469 (1992), 475 (1993), 481 (1994), 538 (1995), 548 (1996), 541 (1997).
The population aged 40 and over was used as the denominator. Belgium, Canada, Germany, Finland, Italy, Norway, Spain and Sweden were able to provide rates using the 40 and over population as a denominator. For the countries that used the entire population as the denominator, the denominator was calculated as the ratio of the entire population multiplied by the ratio of the entire population to the population 40 and over.
Source: OECD Health Database 2000 (Hungary, Switzerland, the United Kingdom and the United States). Other countries, data collected by the experts in the countries participating in the IHD part of the ARD study (see Moïse, Part I in this volume).

32.3 per 100 000 persons aged 40 and over in 1990 to 117.8 in 1997. Greece and Germany were the only other countries in which the rate of CABG use more than doubled during this period. The United Kingdom, with an average 3.4% increase per annum had the slowest growth in CABG utilisation. As with PTCA, the United States had the highest utilisation rates for CABG, with 409 per 100 000 persons aged 40 and over in 1990 and 541 in 1997.

PTCA is the more recent innovation in treating heart disease than CABG, so the diffusion process may be further along for CABG than PTCA. Evidence of this is found in Table 12.1, which shows utilisation of CABG as a proportion of total revascularisation procedures (CABG + PTCA), for two years, 1990 and 1997. Combining the two procedures into a single variable called "revascularisations" (re-establishment of blood supply) is acceptable when examining utilisation at an aggregate level and when there is no need to take into account the medical reason why PTCA or CABG was used.

Table 12.1. **Utilisation of CABG as a proportion of total revascularisations**

	1990	1997	% annual change
Australia	69.9	52.2	–4.1
Belgium		42.7	
Canada	54.4	51.2	–0.9
Denmark	79.0	49.6	–6.4
Finland	77.9	67.0	–2.1
Germany	44.6	34.0	–3.8
Greece	74.6	52.5	–4.9
Italy		53.5	
Spain		27.2	
Sweden	79.8	55.6	–5.0
United Kingdom	65.3	45.9	–4.9
United States	59.0	57.7	–0.3

Note: Revascularisations are coronary artery bypass grafts (CABG) + percutaneous transluminal coronary angioplasty.
Source: Data collected by the experts in the countries participating in the IHD part of the ARD study (see Moïse, Part I in this volume).

An increase in utilisation rates for both CABG and PTCA during the 1990s means there was an increase in utilisation rates for revascularisations over this period. However, the faster pace at which PTCA utilisation was growing in all countries means there was a decline in CABG as a proportion of revascularisations during the 1990s in each country in the study. In 1990, Germany was the only country for which CABG made up less than 50% of all revascularisations. In 1997, in addition to Germany, CABG was performed less often than PTCA in Spain, Belgium, the United Kingdom and Denmark. Given the downward trend in CABG as a proportion of revascularisations, it is most probable that PTCA is now being performed more often than CABG in the countries in our study, with the possible exception of Finland where CABG made up 67% of revascularisations in 1997. These data conform to the process of technology diffusion described earlier, where PTCA has gradually replaced CABG as the revascularisation procedure performed most often.

Providing further impetus to encourage the use of PTCA during the 1990s is the advent of intracoronary stents. Intracoronary stents, or simply stents, reduce the probability of restonosis, a major complication from PTCA. The proportion of PTCAs where stents were used increased considerably in the mid-1990s, coinciding with the publication of a number of studies published around 1994 and 1995 that showed the efficacy of stents (Moïse, Part I

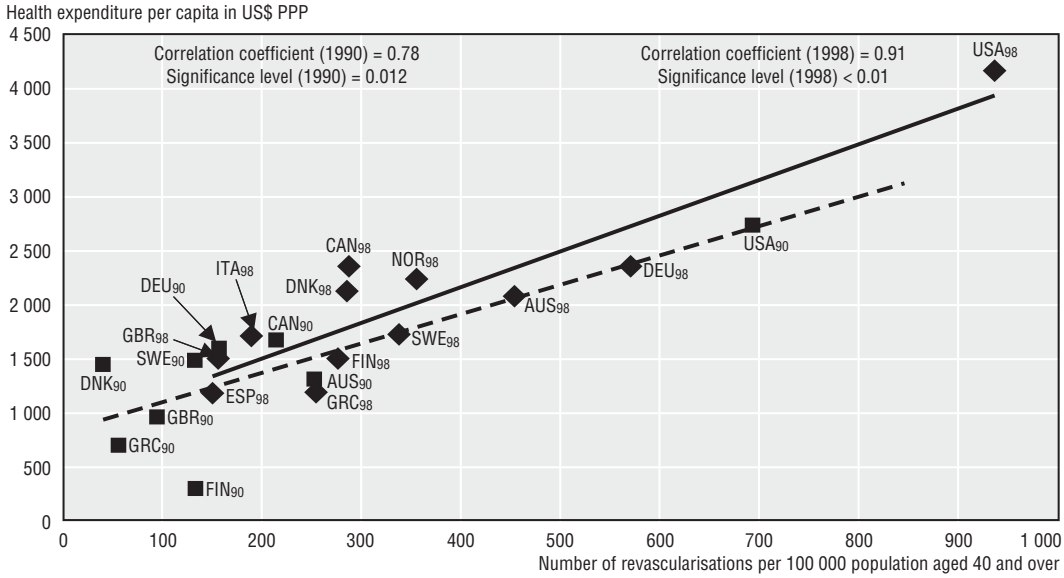
in this volume). This follows closely the increased use of PTCA during the 1990s observed in Figure 12.7 and Table 12.1.[5]

Keeping in mind the McClellan and Cutler argument for using IHD treatments as a proxy for overall health technology growth, the next step is to analyse simultaneously these patterns of technological growth for IHD treatments with the growth in health expenditures.

The best method would be to examine intertemporal changes in the utilisation of PTCA and CABG with health expenditure. Unfortunately, proper time-series analysis requires a large number of data points, something not possible with the available data. However, a more limited intertemporal analysis of technology and health expenditure across several countries is possible. This is the approach taken for the ARD study.

A concern when examining trends in utilisation of both PTCA and CABG is to take into account the possibility of substitution between the procedures.[6] To control for this substitution both procedures are combined as in Table 12.1 into one variable, revascularisations. Figure 12.9 is a simple scatter plot of health expenditure and the level of utilisation of revascularisation procedures for 1990 and 1998.

Figure 12.9. **Number of revascularisations and health expenditure per capita**



Note: The dashed line was fitted to data for 1990. Linear regression lines using least squares were fitted to the data ($y_{90} = 2.7152x_{90} + 826.48$; $y_{98} = 3.299x_{98} + 846.37$). Revascularisations are coronary artery bypass grafts + percutaneous transluminal coronary angioplasty.
Source: Number of revascularisations: data collected by the experts in the countries participating in the IHD part of the ARD study (see Moïse, Part I in this volume). Health expenditure per capita: OECD (2002).

The data plotted in Figure 12.9 show a strong relationship between the use of technology, as proxied by invasive IHD treatments, and spending on health. This information when taken together with the growth trends in revascularisation procedures during the 1990s and the fact that health expenditures have grown during this period, support the theory that a large part of the growth in health spending is fuelled by technological change.

High per capita income coupled with the early adoption and rapid diffusion of health technologies can help explain why the United States is such an outlier in the utilisation of revascularisation procedures (TECH, 2001; Slade and Anderson, 2001). Relatively high per

capita income may also help explain why utilisation rates of revascurlarisation procedures are higher in Norway compared to other Nordic countries with similar health systems and levels of IHD.

2.3. Expanding indications of use

Gelijns *et al.* (2002) refer to expanding the uses of technologies as they mature during the diffusion process, *i.e.* the process whereby the medical profession expands the application of the use of technologies beyond the original, narrowly defined indications. While it is not possible within the scope of the ARD study to address all of the possibilities, such as expanding use to more severe cases, the study does address the issue of expanding use from younger to older age groups.

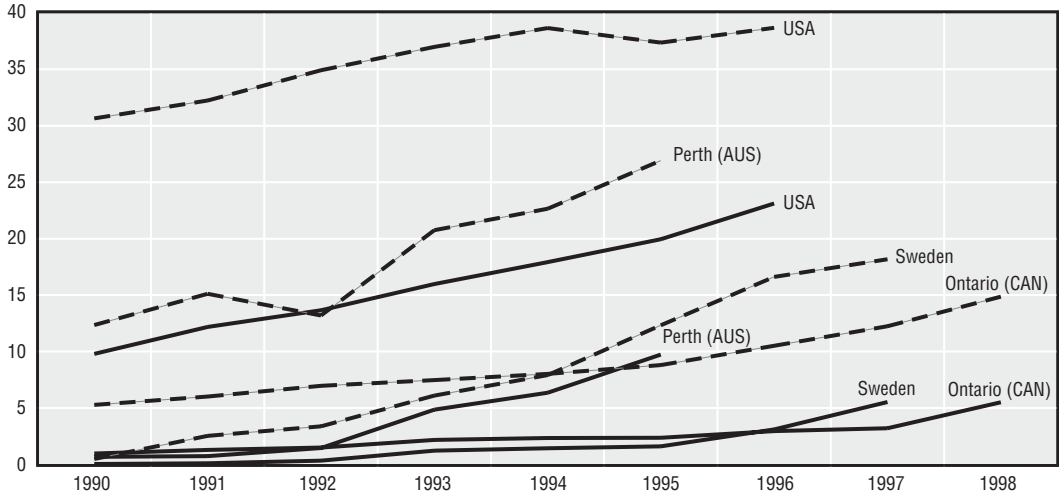
A simple way of observing whether a pattern of diffusion exemplifies an expanding use of a technology to older age groups is to examine data on utilisation of that technology over time and by age group. Clinical trials of a new health technology usually focus on highly selected patient populations, which generally do not include older persons (Bugeja *et al.*, 1997; Lee *et al.*, 2001). Physicians who are early adopters of a new health technology use the results of published clinical trials as guides to help them determine which of their patients will receive the new technology. Thus, in the early stages of diffusion, older persons are less likely to be treated with a new technology. During the take-off phase, early adopters are joined by other physicians who adopt the emerging technology. The later adopters at first are likely to apply the technology to the same select patient groups as the early adopters had during the earlier phase of technology diffusion. As their proficiency in application of the technology increases, early adopters will expand utilisation to patients previously not considered suitable candidates, which would include older persons. Application of the technology to older persons will continue to expand as more and more physicians adopt it in practice. Therefore, utilisation trends should initially show increasing use of a technology among younger patients with very little use in older ones. As the technology matures, the rate of increase of utilisation in older patients will increase.

In addition to the aggregate data on the utilisation of PTCA and CABG presented earlier, the ARD study also examined the utilisation of these procedures for patients admitted to hospital for acute myocardial infraction (AMI). The following analysis is based on data on the proportion of male patients admitted for AMI who received a PTCA within 90 days of hospitalisation.[7] Figure 12.10 shows these data for two age groups, 40-64 and 75-79, and for four countries, Australia (Perth), Canada (Ontario), Sweden and the United States (California for the 40-64 age group).

The data in Figure 12.10 show that in 1990, a noticeable proportion of male AMI patients aged 40-64 in California (United States) and Perth (Australia) received PTCA within 90 days from hospitalisation, 30.6% and 12.3% respectively. Physicians in both countries appear to have adopted PTCA earlier than physicians in Sweden, where less than 1% of similarly aged male AMI patients received PTCA within 90 days. By 1992, the first year for which data for Ontario (Canada) are available, 7% of males aged 40-64 underwent PTCA in Ontario, a higher proportion than in Sweden (3.4%) but lower than the proportions in Perth (13.2%) and California (34.9%).

For male AMI patients aged 75-79 in 1990, only physicians in the US appear to have adopted the use of PTCA to any significant degree (9.8%). In both Perth and Sweden, less than 1% of patients in this age group underwent PTCA within 90 days. By 1992, the first

Figure 12.10. **The proportion of AMI patients receiving PTCA during the 90-day episode of care**



Note: The episode of care is calculated as the period 90 days following the initial admission for acute myocardial infarction (AMI). The dashed lines represent data for male AMI patients aged 40-64 years. The solid lines represent data for male AMI patients aged 75-79 years.

Source: The data for Canada (Ontario), Sweden and the US were provided by the TECH Global Research Network (see TECH, 2001 and Atella, Part IV in this volume for more details on the TECH Global Research Network); The data for Australia (Perth) were collected by the experts participating in the IHD part of the ARD study. See Moïse (Part I in this volume) for more details.

year for which data for Ontario (Canada) are available, 1.5% of patients in the 75-79 age group underwent PTCA in Ontario, the same percentage as Perth. The adoption rate of PTCA for the older age group in Ontario appears to be similar to Perth and Sweden.

At the beginning of the decade of the 1990s, the data from Figure 12.10 show that physicians in the US were generally the first to adopt PTCA. For patients in both the 40-64 and 75-79 age groups, the proportions undergoing PTCA were highest in the US (assuming California physicians are not too disimilar from physicians in other states). The phenomenon of expanding indications of use to older patients had already taken root in the US, but judging from the low proportions of use for patients aged 75-79 in both Perth and Sweden, this had not yet taken place to any significant degree in these latter two countries. The situation in Ontario is less clear, but is likely similar to Perth based on an extrapolation of the trend backward from 1992 and similar utilisation rates based on aggregate data (Figure 12.7).

During the 1990s there was a significant increase in the proportion of AMI patients undergoing PTCA in all three countries. The US had the highest proportions with 38.7% of patients aged 40-64 undergoing PTCA. Utilisation of PTCA was next highest in Perth, where 26.9% of patients underwent a PTCA in 1995, the last year for which data are available. Until 1994 the proportion of 40-64 year old patients undergoing PTCA was higher than in Sweden, but afterward the proportion in Sweden was greater so that by 1997 18.2% of 40-64 year old patients in Sweden had undergone PTCA with only 12.2% in Ontario.

The largest increases in the proportion of patients undergoing PTCA were among those aged 75-79. Once againg, US patients were more likely to undergo PTCA with 23.1% of male AMI patients aged 75-79 having undergone a PTCA. In Perth, 9.7% of similarly aged male patients had undergone PTCA in 1995, with 5.5% in both Sweden (1997) and Canada (1998).

The phenomenon of expanding indications of use to older persons becomes clearer when data following 1990 are analysed. In all four regions, the rate of increase in the proportion of male AMI patients aged 75-79 years undergoing PTCA is significantly greater than the rate for patients aged 40-64. This is especially noticeable in the data for Perth, where the proportion increased 104% for 40-64-year-olds between 1992 and 1995 compared to 567% for 75-79 year olds, and Ontario, where the increases were 26% for 40-64-year-olds and 120% for 75-79 year olds during the same period. It is clear that, by 1995 later adopters had joined early adopters in using PTCA in all four regions.

These data show that physicians in the US were the first to begin expanding the use of PTCA to older patients. The expansion of indications of use for older persons next took place in Perth, while in Ontario and Sweden this phenomenon appears to have occurred around the same time.

The preceding discussion is based on a movement along an S-shaped diffusion curve. There are two factors not explored which would affect the discussion (see Moïse 2003 for further discussion of these factors). First, health system characteristics influence the adoption of new technologies into practice. The fact the proportion of patients undergoing PTCA in the US is consistently greater than in the other countries reflects a number of factors such as fee-for-service payment to physicians and looser regulation of technology that encourage the use of PTCA. The diffusion curve for the United States (see Figure 12.1) would be higher at a given point in time than in the other countries. Second, this discussion does not take into account the effect of new, potentially revolutionising techniques that increase the efficacy of a given technology. In the case of PTCA, the perfect example is the introduction of the intracoronary stent which has had a dramatic effect on the use of PTCA, contributing to significant increases in the use of PTCA (see Figure 12.7). In the case of stents, an increase in the proportion of AMI patients undergoing PTCA would entail both a movement along the S-shaped diffusion curve, but also an upward shift of the curve.

2.4. The impact of health system characteristics on health technology diffusion

One of the strengths of the ARD study is the demonstration of the impact health system characteristics can have on the diffusion of health technologies. In each of the three disease studies, health system characteristics were examined by analysing information on demand and supply-side constraints. The diffusion of certain health technologies were examined by analysing data on the utilisation of the treatments that characterised these technologies. Generally, it was found that demand-side constraints, *i.e.* health system characteristics that affect the individuals' demand for health services, had little impact on treatment utilisation rates. On the other hand, supply-side constraints, *i.e.* health system characteristics that affect how providers deliver health care services, appear to have a noticeable effect on treatment patterns. The supply-side constraints we found to have the most significant impact were technology regulation and payment methods for hospitals and physicians (Moïse, Part I in this volume).

This initial analysis of the effects of health system characteristics on treatment patterns was qualitative, reflecting the nature of the information collected. This type of analysis does not shed light on the magnitude of the effects of health system characteristics. Therefore, within the constraints of the data, we have undertaken some empirical analysis of these effects. As mentioned previously, the wealth of data we were able to collect from the IHD part of the study made it the logical starting place for our empirical work. In what follows, I summarise the results of the empirical analysis to-date.

In order to explore the relationship between health system characteristics (converted to index variables) and treatment trends, we estimated separate equations for PTCA and CABG,[8] rather than one equation using revascularisations as the dependent variable. This approach allowed us to examine two treatments for IHD at different stages of diffusion. The results are summarised in Table 12.2.

Table 12.2. **Analysis of the determinants of CABG and PTCA utilisation**

	Dependent variable	
	PTCA	CABG
Explanatory variables		
GDP per capita	1.695**	0.095
	(6.53)	(0.36)
Level of IHD	0.087	1.287**
	(0.59)	(7.01)
Hospital constraint	0.388**	0.702**
	(4.92)	(7.90)
Facility constraint	0.313**	0.13*
	(4.86)	(2.05)
Time index variables	> 0**	> 0**
No. of observations	85	81
Percentage of variation explained	87	79

t-statistics in parentheses; ** denotes significiant at 1%; * denotes significant at 5%.
Note: The constant term is negative. The time index variables are binary variables for 1991-97, the observations start in 1990. The coefficient on the 1991 variable was significant at 10% for the PTCA equation and was statistically insignificant for the CABG coefficient. The coefficient on the 1992 variable for the CABG equation was significant at 5%. The values of the coefficients on the time index variables increased for each successive year.
Endogenous variable: number of PTCA (CABG) per 100 000 population aged 40 and over
Exogenous variables:
GDP per capita Ln(GDP/capita) in US$ PPP
Level of IHD Ln(IHD mortality rate per 100 000 population aged 40 and over)
Hospital constraint Prevailing hospital payment method: 3. Fee-for-service, 2. Mixed or DRG, 1. Global budget.
Facility constraint Prevailing regulation environment: 3. No constraints, 2. Explicit constraints and no targeted funding, 1. Explicit constraints and targeted funding.
The two constraint variables were constructed so 3 = most likely to lead to increased use of PTCA(CABG), 1 = least likely. For more information regarding the use of IHD mortality rates as proxies for IHD and the constraint variables (see Moïse, Part I in this volume).
Source: OECD (2002).

The regressions were able to explain a significant amount of the variation in utilisation rates for both PTCA (87%) and CABG (79%). The positive coefficient estimates on the facility and hospital constraints index variables confirm our qualitative analysis of the effect these health system characteristics have on treatment utilisation.[9]

To control for the effect of technological change we included binary variables for each year. The coefficient estimates on these binary variables were found to be significant and positive. Furthermore, the coefficients for each separate yearly binary variable increased with each successive year, that is the coefficient for the 1997 dummy variable was greater than that for the 1996 variable, which in turn was greater than the 1995 estimated coefficient, etc. This result indicates that both CABG and PTCA are likely on the take-off part of the S-shape technology diffusion curve in Figure 12.1: a small movement forward in time, in this case measured as a year-to-year change, leads to an noticeable increase in utilisation rates.

We used IHD mortality rates as a proxy for the level of IHD, to control for the demand for revascularisation procedures (for an explanation of the rationale for using this method see Moïse, Part I in this volume). Drawing any meaningful conclusion from the magnitude of the coefficient of the demand variable would be problematic given the interdependency of the demand variable with the CABG and PTCA variables respectively. However, we do have an *a priori* expectation that the coefficient of the demand variable should be positive, which it was found to be for both the PTCA and CABG equations. The estimated coefficient on the demand variable was found to be statistically significant only for the CABG variable (Table 12.2).

The final exogenous variable we included in our estimated regression equation was per capita income, measured as GDP per capita in $US PPP. The regressions showed that income was not a statistically significant determinant of the use of CABG, but was for PTCA. This confirms the observation made earlier that CABG is the older of the two technologies and is further along the S-shape technology diffusion curve (Figure 12.1), since per capita income as an explanatory factor for the diffusion of medical technology is strongest for newer technologies and declines over time (Slade and Anderson, 2001).

3. Discussion

The first few sections have laid down some groundwork for exploring the relationship between health expenditure and technology using the ARD results. The nature of the following discussion is speculative in order to elicit discussion on possible future directions to take for the analysis. The main question to focus on in this section is: Should we control technological change in order to control rising health expenditures?

It is widely accepted that technological change is the largest contributor to rising health expenditures. If we are to control rising health expenditures than a logical course of action would begin by controlling technological change, or its components. Such a premise assumes that the benefits of curtailed spending outweigh the costs – foregoing the increases in longevity, declining disability, improvements in quality of life, etc that result from technological change. This trade-off is at the heart of Newhouse's 1992 *Journal of Economic Perspectives* article. If we are to control technological change then we must ask ourselves: Do the benefits outweigh the costs?

Leaving aside for the moment the issue of whether we are able to properly assess the costs *vs.* the benefits, let us view the question from the actions of how various societies have come to grips with this fundamental problem. Let us first consider two extreme cases. First, the United States health system has displayed the greatest preference for using the most advanced technologies. It also spends more on medical care per capita than any other country. It would seem reasonable to conclude that in the US, a consensus has emerged that the costs of curtailing technological advancement in medical care outweigh the costs of paying for the technology. At the other extreme, the National Health System (NHS) in the United Kingdom displays the least preference for medical technology. It also is near the bottom in terms of health expenditure per capita. A reasonable conclusion to draw from this last example is that in the UK, a consensus emerged that the benefits of curtailing technological advancement outweighed the costs. Intuitively, the first conclusion regarding the US seems accurate, but the second conclusion regarding the UK does not. Indeed, recent proposals by the current government in the UK to increase health expenditures to bring it to a level on a par with continental Europe suggests a re-thinking of the historical consensus has emerged.

There are also specific examples where the tradeoffs between the benefits of health technologies and the costs are not clear. For example, in the Canadian province of Ontario, the Ministry of Health and Long-Term Care sets targets for the number of CABG and PTCA to be performed in the province each year. Presumably this central planning is done in an effort to reign in health expenditures. Paradoxically, the federal government provided 1 billion (CDN) to the provinces in response to pleas from provincial health ministries for more funding for "high-tech" machines such as MRIs.

3.1. *Costs of technological change*

One explanation as to why we cannot properly guage the benefits of health technology *vs.* the costs is that we do not accurately measure health care output and therefore cannot gauge with precision the benefits that accrue from technological advancement. Most methods focus on national health expenditures collected for Systems of National Accounts. Indeed, much of this paper has been centred around explaining variations in per capita health spending across countries within the framework of other studies on the subject. However, this approach is ill suited to weighing the benefits and costs of technological change because technological change in medical care is best measured at the disease level whereas health expenditures data are collected on the basis of financial flows which are not straightforward to measure at the disease level.

There is a growing body of empirical work, including the ARD study but especially the work of David Cutler and Mark McClellan, that uses as its framework a disease-based approach. Beginning with their NBER Working Paper of 1996, Cutler and McClellan examine technological change and rising expenditure at a disease level rather than for the country as a whole. With their more recent paper in *Health Affairs* (Cutler and McClellan, 2001), they extend this approach to examining four other conditions, breast cancer, low-birthweight infants, depression and cataracts. Their study showed that for four of the diseases the cost of technological change, increased spending, was more than offset by the benefits, improvements in health outcomes. For the fifth, breast cancer, their results show changes in costs and benefits of equal magnitude. Thus, they conclude that technological change has been worth the cost.

In their concluding remarks, they cite a number of policy implications, in particular within the present context, the inaccuracy of medical price indices. Medical price indices, they state, adjust poorly to quality changes in medical care, which can be substantial. For example, the effectiveness of angioplasty today has increased dramatically from a decade ago. As Cutler and McClellan state:

> "*If price increases over time are matched by quality improvements, the quality-adjusted price of medical care will not increase. Our results imply that quality change has been greater than, or at least comparable to, price increases for a range of conditions. Thus, the quality-adjusted price index for these conditions should not be rising* (Cutler and McClellan, 2001)."

In other words, medical care productivity increases for the five conditions they studied was greater than, or at least comparable to, medical care productivity for treating other conditions. Medical care price indices may overstate actual medical care inflation because they cannot account properly for technological change.

3.2. Benefits of technological change

The cost of technological change, rising health care expenditure, is well understood if not well measured. Can the same be said of the benefits of technological change, improved health outcomes?

As defined by Hurst, health outcomes are "those changes in health status strictly attributable to the activities of the health system" (Hurst, 2002). Technological change improves health outcomes, assuming of course that technological change is progressive. Therefore, the health outcome indicators necessary for measuring the benefits of technological change need to reflect the improvements in health system activity. Health outcomes indicators vary according to the phase of the continuum of care for which they measure health activity: prevention, acute care, rehabilitation and ongoing care (Moon, Part V in this volume). Some of these indicators, such as population IHD mortality rates and cancer survival rates are relatively accurate measures. Others, such as indicators to measure improved functioning and well-being, are much more difficult to measure. This complexity makes it difficult to accurately assess the benefits of technological change.

Improved health outcomes bring with them an additional complexity to measuring the benefits of technological change. Increased survival can complicate measuring the net benefits of technological change because it can lead to additional increases in health expenditures due to a larger of proportion of the population being chronically ill. Increased survival due to technological change in medical care means persons who would have otherwise died in the absence of technological change are alive. Thus, there may be a higher prevalence of the disease in the population. These persons bring added health expenditures that would not have been required had these individuals died. Furthermore, these persons are likely to be sicker than the general population and possibly have more severe forms of the disease, meaning even greater increased health expenditures. Using IHD as an example, reductions in deaths from AMI led to increases in morbidity from IHD and congestive heart failure, which in turn increased the demand for new health care interventions for these conditions (van der Maas *et al*., 1996).

4. Conclusion

The ARD study has provided a unique opportunity to study health technology, the phenomenon that has had the greatest impact on rising health expenditures over the previous quarter century, across several countries. The data collected and analysed in the study have proved to be quite useful in this respect, but, from a broad health policy perspective, the importance of health technology is how it influences health expenditure. To this end, as the discussion in the previous section has shown, a better understanding of the benefits and costs of health technology will require: better measurement of health expenditure by disease, the framework within which most technological advances take place and more comprehensive measures of outcomes, to reflect the many aspects of the results of health care interventions.

This paper has used the results of the ARD study to show how countries compare to each other in their use of technology by comparing levels of utilisation of certain health technologies across countries and showing how these levels have changed over time. Two facets of technology diffusion in particular helped to pull the discussion together: the S-shaped curve of technology diffusion and expanding indications of use. This paper has

only scratched the surface of how these two facets of technology diffusion influence health expenditure. It demonstrates the need to study this relationship in greater detail.

Notes

1. The Solow approach accounts for economic growth by examining the growth in its component parts in an national accounting framework, attributing the unexplained residual to technological advancement. This approach takes technology as exogenous to the productive process. Endogenous growth theory takes this a step further to state that technology is in fact a by-product of economic systems.
2. For more detail on the subject of technology and economics the reader may wish to consult Varian (1992).
3. Techniques can also apply to the various applications of the same production process, or treatment, in this case there would be different methods of applying CABG, PTCA and drugs.
4. Data for Japan are also available (23.2 MRI machines per million inhabitants), but are not included because their effect on the relationship between the number of machines and health expenditure would far outweigh the signficiance of including one extra data point. If the data for Japan are included then the relationship becomes statistically insignificant ($\alpha = 0.358$).
5. It is also a demonstration of the influence of the transfer of knowledge into practice; an issue explored in the stroke analysis of the ARD study which examined growth patterns in carotid endarterectomy following the publication of two influential randomized control trials (Moon *et al.*, 2003). See also Tu *et al.* (1998).
6. Strictly speaking, there is not perfect substitution between the two procedures. While some substitution does occur, there are also confounding factors such as indications of use and substitution with other treatment methods, most notably the use of thrombolytics, that mitigate against PTCA and CABG being perfect substitutes.
7. CABG data are not presented here because of the limited use of CABG for patients admitted for AMI. Information on confounding factors, such as socio-economic status of the patient, severity of the disease and comorbidity, were not collected (see Moïse and Jacobzone, 2003, for more details).
8. For our initial estimations, we relied on ordinary least squares. In our subsequent work, we will rely on simultaneous equation models to take into consideration the dynamic relationship between per capita national income, health spending per capita and treatment utilisation rates.
9. We also estimated equations using an index variable for physician constraints, but it was found to be highly correlated with the facility constraint variable, rendering the use of both variables in OLS estimated equation impossible due to multicollinearity.

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PART IV

Chapter 13

The Relationship Between Health Policies, Medical Technology Trends and Outcomes

A Perspective from the TECH Global Research Network[1]

by
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Abstract. *The goal of this paper is to present new comparative evidence on heart attack care in 17 countries showing that changes in medical treatments are universal, but have differed greatly. We have collected a large body of comparable information that show how countries differ in treatment rates and why these differences are relatively marked. Countries appear to differ systematically in the time at which intensive cardiac procedures began to be widely used and in the rate of growth of the procedures. Our results show that differences in treatment rates are greatest for expensive medical technologies. Also strict financing limits and regulatory policies have affected the adoption of intensive technologies. These differences may have important economic and health consequences.*

Introduction

The continuous increase in the cost of the health care services recorded over the last two decades in many countries has raised major concerns among policy makers, who have been forced to adopt new restrictive measures in order to reduce the public budget deficits. Most of the OECD countries have been involved in such practices, with the EU governments that have been particularly sensitive to this issue, given the strict requirements imposed on their budgets by the Maastricht Treaty signed in 1991.

There is a widespread consensus about two main causes for the sharp increase in health care services utilisation and expenditures: population aging, and the use of new and more intensive medical treatments. The ongoing change in the age structure of industrialised countries is dramatic and is leading to a substantially higher proportion of older people. Population aging is especially pronounced in many European countries, especially in Germany, Italy and France. Particularly remarkable is the increase among the oldest old: in the year 2030, many countries will have almost twice as many elderly over age 85 as now. There are several distinct processes that are causing these dramatic changes. From 1950 to 1980, life expectancy at birth increased by about 7.2% on average in the countries of the OECD, while fertility in the industrialised countries declined to below replacement level. The effects of both processes sum to what is commonly termed "double aging" of the industrialised countries.

The scientific progress made in the health sector during the last 25 years is another distinct factor related to rising health care costs. In virtually all developed countries, health care costs are rising and population health and life expectancy are improving. Technological advances, a dominant player in the health care industry, likely contribute to these worldwide trends. Yet many previous studies have shown that medical treatment differs substantially around the world. If *changes* in medical treatment also differ across countries, then policies that affect technological change may have important implications for both the nature and magnitude of medical expenditure growth and for improvements in health.

The combined effect of technology and aging population will lead to an unprecedented increase in cost for health care services. In the United States, Shoven *et al.* (1994) have estimated that there will be an increase in health care costs of 125% between 1990 and 2040, from US$78 billion to US$176 billion, compared to an increase in the population of only 27.5%.

As a result, one of the most crucial problems that all countries will face in the near future is the financial sustainability of health programs. In fact, with an aging population that receives increasingly sophisticated and expensive technological treatments, some countries are already experiencing long queues for health care, and it is conceivable to envision a point in which financial sustainability will not be assured and access to care will be further limited. The way in which countries are reacting to this phenomenon is quite heterogeneous. Studies in the United States and a few European countries have demonstrated enormous variation in treatment patterns from region to region within

individual countries, as well as differences at a point in time across countries. Aside from early stage work in some affiliated projects, and the nearly completed OECD ageing projects, we are not aware of other studies providing an international comparison of the effects of the intertwined factors of technological changes, aging populations, socio-economic status, health policies, and health expenditures.

In response to this international issue, the global Technological Change in Healthcare (TECH) research network (a network of researchers from 17 developed countries) was formed to conduct medical technology trend analyses with detailed healthcare data. As a first step, the research activity has been organized to analyse changes in heart attack care (acute myocardial infarction, or AMI), an important health problem for populations worldwide, with the aim of providing insights into the determinants and consequences of medical technology changes over time. We chose to focus initially on patients hospitalised with heart attacks, for different reasons. First of all, heart attack is a well-defined clinical condition around the world. Second, inpatient data, which are the most reliable data in most countries, are relatively complete sources of information on acute care for heart attacks. Third, knowledge of effective heart attack treatments has changed much in recent years; clinical trials and other data from the United States and other countries suggest that changes in medical practices may account for a large part of the improvements in outcomes (McClellan and Kessler, forthcoming). Thus, if differences in technological change exist across countries, they are likely to show up in inpatient care for heart attack.

We have then analysed the consequences of different technology adoption and diffusion patterns in the AMI sector among a number of developed countries on health outcomes and health expenditures for different subgroups of society. Far from being concluded, this research activity has already produced interesting results. In particular, we have been able to assess directly whether, and how, differences in the economic and regulatory incentives underlying national policies appear to influence technological change. The initial results shed some light on several major topics relevant to the current policy debates in the health sector, including: *i)* how do different health care policies influence technological change; *ii)* what are the pattern of technology adoption and diffusion across countries; *iii)* what are the implications for patient health outcomes? By providing quantitative and qualitative answers to these questions, and by developing methods that can be applied to many other common health care problems, we will be able to provide insights for policy-level management of technology in society within the health care sector.

1. Unresolved issues in international comparisons of health and health care systems

Apart from the increasing number of elderly, many investigators have hypothesised that technological change is responsible for most of the substantial real growth in expenditures experienced by virtually all countries in recent decades; yet direct empirical evidence on this question is limited, especially outside of the American context. Moreover, the role of medical care in explaining the improvements in health outcomes of populations worldwide is unresolved. This lack of evidence is a crucial issue for policies on health care and, more specifically, for those on aging. If economic and regulatory incentives influence technological diffusion patterns, then national health policies may have dynamic, long-term consequences for the productivity of health care systems that are far more important than short-term, cross-sectional differences.

One major reason for the lack of clear evidence in this area thus far is the major challenge of accessing enough clinical details using available "macro" and "micro" data to evaluate the consequences of different health care systems on the relationship existing between medical technology adoption and health outcomes. In the following two sub-sections we briefly presents the main findings and limitations that arise from the main studies conducted at both "macro" and "micro" level on this subject.

1.1. Limitations of aggregate or "macro" statistics in assessing health care productivity

Most comparative studies across multiple countries are based on aggregate or "macro" statistics such as per-capita medical spending, gross domestic product (GDP) share devoted to health care, life expectancy, mortality rates from common diseases, and general surveys of population functional status and health. These statistics permit many useful international comparisons, but they leave many critical policy issues unresolved – particularly issues related to changes in expenditures and health. For example, the OECD and other international organisations annually document large differences in aggregate per-capita spending on health care across developed countries. In addition, medical spending has increased enormously in the past 25 years, commonly doubling or tripling. Using estimates from Newhouse (1993), Schieber *et al*. (1994), noted that substantial real expenditure growth occurred in most OECD countries, at least through the 1980s. Standardised measures of population health, such as life expectancy in middle- or old-age or disability-adjusted life expectancy (Murray and Lopez, 1996) also differ substantially across countries.

Standardised measures of population health, such as life expectancy in middle- or old-age or disability-adjusted life expectancy (Murray and Lopez, 1996) also differ substantially across countries. These health measures have generally improved greatly in the recent decades of worldwide growth in real medical expenditures, particularly at older ages as confirmed by OECD. But these aggregate measures of population health show little relation to the differences in health care spending just described. Many important confounding factors – cultural, and genetic differences, as well as differences in public health, educational, and income redistribution policies that lead to behavioural differences – have been cited as reasons for the absence of any clear correlation between spending and health outcomes.

Since aggregate statistics provide little direct evidence on the factors responsible for expenditure growth and health improvements, they are unable to resolve policy questions related to the productivity of the health care system. The likely cause for expenditure growth is derived from indirect evidence: at least in the United States, all factors other than technological change that might contribute to expenditure growth seem able to explain only a small fraction of increases (Newhouse, 1992). Population aging has been and remains an important policy concern, yet even in the most rapidly-aging countries it accounts for real growth rates of about 1% per year, much lower than most observed medical expenditure growth rates. Per-capita income has increased as a result of economic growth, and other factors such as competition and insurance generosity may have changed as well, but the medical spending increases are far greater than can be explained by all of these determinants of spending combined.

Because technology consists of particular drugs, devices, and labour inputs that differ from disease to disease, it could be not possible to summarise their effects in aggregate statistics. In order to overcome such limitation, many comparative studies have provided

somewhat more direct evidence on real increases in the quantities of medical services consumed based on national counts of such "high-tech" treatments as MRI scanners and catheterisation labs, and measures of the aggregate use of these procedures (*e.g.,* Schieber *et al.*, 1994). However, without linking their use more directly to changes in health for the conditions that they are intended to treat, it is virtually impossible using only counts of procedures or measures of the availability of devices to provide an answer to questions such as: Do technology and diffusion patterns also differ across countries, and if so, what policies might play a role? Do differences, in turn, have important consequences for health care expenditure growth?

Thus, while "macro" international comparisons have provided some important though indirect evidence to support the view that differences in technology use across countries are important explanations for differences in the magnitude and growth of health expenditures, still many important issues involving technological change patterns, its determinants, and its consequences remain unresolved. Are expenditure growth rates similar across countries, as Newhouse's (1993) preliminary study suggested? If expenditure growth is more similar than expenditure levels across countries, is it because technological change is identical but prices differ? Or is it because the nature or magnitude of change in actual medical practice differs across countries? Does the less-costly country use new technologies less extensively? Or does it tend to adopt different kinds of technologies? Or does it follow medical practices in the more costly country with a lag? And which health care policies are associated with these differences in technological change or expenditure growth?

When we confront ourselves with these questions we realize what are the main limitations of studies that rely just on "macro" data. The relationship between trends in resource use and changes in health status is even more elusive at the macro level. The absence of any clear relationship raises fundamental policy questions about whether some or all of the expenditure growth is worthwhile, and which of the highly diverse health policies across countries are most likely to encourage worthwhile changes in expenditures.

1.2. Limitations of previous "micro", or patient level, studies in assessing health care productivity

To overcome the shortcomings with "macro" international comparisons, some previous studies have compared clinical practices across countries for particular illnesses at the "micro" or patient level, and have speculated their health consequences, for two or several countries. We do not try to review all of these studies here. Instead, using two previous large-scale international research efforts at micro level, the study by McKinsey Global Institute and the McKinsey Health Care Practice (1996) and the MONICA (Multinational Montoring of Trends and Determinants in Cardiovascular Disease) Project, we illustrate some of the main conclusions from these comparisons. These studies are also useful in illustrating some key features of our research.

The study by McKinsey Global Institute and the McKinsey Health Care Practice (1996) was a detailed assessment of differences in medical practices and their consequences in three countries with quite different health care systems: the United States, the United Kingdom and Germany. The study assessed the treatment of lung and breast cancer, diabetes, and gall bladder disease, based on medical practices around 1990. The investigators documented substantial differences in practices, with generally higher intensity of care (more treatments) in the US and Germany. They also documented higher prices for clinician services in the United States. Through a combination of literature

reviews of treatment effectiveness and actual data on patient outcomes in the study countries, as well as estimation of reasonable valuations of the outcomes, the investigators concluded that US productivity was better for cancer and gall bladder disease care. However, productivity of care for diabetes in the United Kingdom was better, because the multi-disciplinary teams used to treat diabetics did a better job of triaging patients with different types and severity of diabetes to the most appropriate level of care. Studies of other conditions, including heart disease (*e.g.,* Tu *et al.*, 1997) that have compared large populations with apparently similar health problems have found less evidence of differences in health outcomes despite diverse practices across countries. Like most international comparisons, however, this study examined practices and their consequences at a point in time, raising the possibility that the differences across countries may be due to other country-specific factors.

An important exception is the World Health Organisation's MONICA Project, a major international epidemiological effort to document and understand possible national differences in reductions in death rates from ischaemic heart disease (IHD) (Tunstall-Pedoe *et al.*, 1998 and 2000). Reduction in mortality from IHD, of which heart attacks are an important component, is by far the most important source of overall mortality declines in developed countries in recent decades (Uemura and Pisa, 1988). MONICA implemented careful and consistent methods for capturing all fatal out-of-hospital coronary disease events, as well as all hospital admissions for coronary events (including both heart attacks and less severe forms of IHD), and has reported many important findings. First, the study confirmed the importance of a substantial decline in heart disease event rates over time in explaining the falling mortality rates from heart disease. Second, the study also documented substantial reductions in mortality among patients who reached the hospital alive. Both of these findings suggest an important role for technological change in explaining improved population health. Primary and secondary prevention of heart disease is the goal of pharmaceutical treatment to reduce blood pressure, cholesterol levels, and the workload of the heart, and these medications have become much more widely used over the past 20 years.

However, these findings also illustrate why it may be difficult to discern the impact as well as changes in medical treatment even in disease-specific mortality trends. Public health measures such as advertising campaigns, behavioural changes such as reduced smoking, and other non-medical factors may plausibly be more important contributors than treatment to the declines in IHD event rates that appear to account for the bulk of mortality reductions worldwide. The medications involved in prevention comprise only a small share of medical care and changes in resource use in the treatment of heart disease. In contrast, the hospital treatments for patients who reach the hospital alive are more representative of the bulk of health care resource use. But the third major finding of the MONICA project illustrates the limited importance of these treatments in contributing to the total mortality trends: the bulk of heart disease deaths are out-of-hospital deaths. Because the role of the health care system in preventing these deaths is limited (Heidenreich and McClellan, 1998), and because innovations in pre-hospital medical care have also been limited, it is perhaps not surprising that the aggregate health care spending levels and growth rates appear to have little relationship to the levels or declines in heart disease death rates documented in MONICA.

2. Innovative aspects of the TECH global research network

To address the limitations of previous works, the TECH Network has implemented a number of innovative approaches.

First, an important advancement of our research is the design of data collection protocols and standardised collaborative analyses of changes in medical care and health outcomes at the "micro" level, across many countries. Compared to the MONICA project we extend our collection of data to socio-demographic and institutional factors.

Secondly, the TECH Network conducts research which compares technological change and health care trends globally. Recent studies have put considerably more emphasis on the importance of technological change, though most of it is confined to the United States (*e.g.,* Shapiro and Wilcox, 1999; Cutler and McClellan, 1998; and Cutler *et al.,* 1998). Using a "micro" focus, Cutler *et al.* (1998) demonstrate that most expenditure growth in heart attack care is associated with the adoption of new treatments and the diffusion of intensive treatments; prices for particular treatments usually fall over time. Little comparable evidence exists for other countries, and comparative data studies within the TECH network aim to fill this gap.

Third, our understanding of the role of economic and regulatory influences on technological change is limited. Weisbrod (1991) argued that the kinds of incentives that economists often evaluate in a static context may have far more important dynamic consequences than static ones. For example, many studies (*e.g.,* Newhouse, 1993) have documented that a generous fee-for-service reimbursement system, in which patients and providers receive third-party reimbursement for all treatments used, results in more intensive treatment and higher health care costs. But fewer studies have assessed whether such "low-powered" reimbursement incentives create an incentive environment that encourages excessive or low-valued technological innovation in medicine. McClellan (1997a, 1997b) argues that technological change in the US Medicare program appears consistent with its low-powered incentives for the use of intensive procedures. TECH analyses extend the evidence on this question beyond a single country by comparing technological change in the care of similar patients in many different countries.

Fourth, longitudinal cross-country comparisons at the micro level appear to be an essential foundation for understanding how health policy may affect the contribution of technological change to health improvements and medical expenditure growth, and thus to guiding future policies to improve the welfare of populations worldwide. By examining not only the effects of incentives on technological change, but also the associated changes in health outcomes and expenditures, TECH is providing evidence about the consequences of different incentive systems for changes in health care productivity. The longitudinal perspective of TECH with a focus on trends also allows us to "difference out" important but relatively fixed differences across countries that might otherwise confound such cross-country comparisons of medical expenditures and outcomes.

Finally, our research builds upon the work undertaken by both the McKinsey study and the MONICA WHO study in several important ways. First, the TECH databases contain longitudinal data from patient discharge records from almost all participating countries, instead of the registry-based data used by MONICA or cross-sectional data used by McKinsey. Analyses of outcomes after AMI in selected countries have shown that national data differs from local MONICA data. Unlike data from the MONICA project, data collected by the TECH research network incorporate 1) at least a one-year follow-up when linked,

longitudinal data are available; 2) patients over 65 as well as patients under 65; and 3) large geographic areas, in many cases the entire country; and 4) The time frames covered by each study differ: MONICA ended its official data collection in 1992, while the TECH study is gathering more current data in a number of countries.

Furthermore, while MONICA is mainly an epidemiological study, this project incorporates methodologies from different disciplines, such as sociology and economics, when studying the regulatory and reimbursement systems in countries and socio-economic characteristics of patients, to explain the differences existing in health technology adoption and health outcomes at the country level.

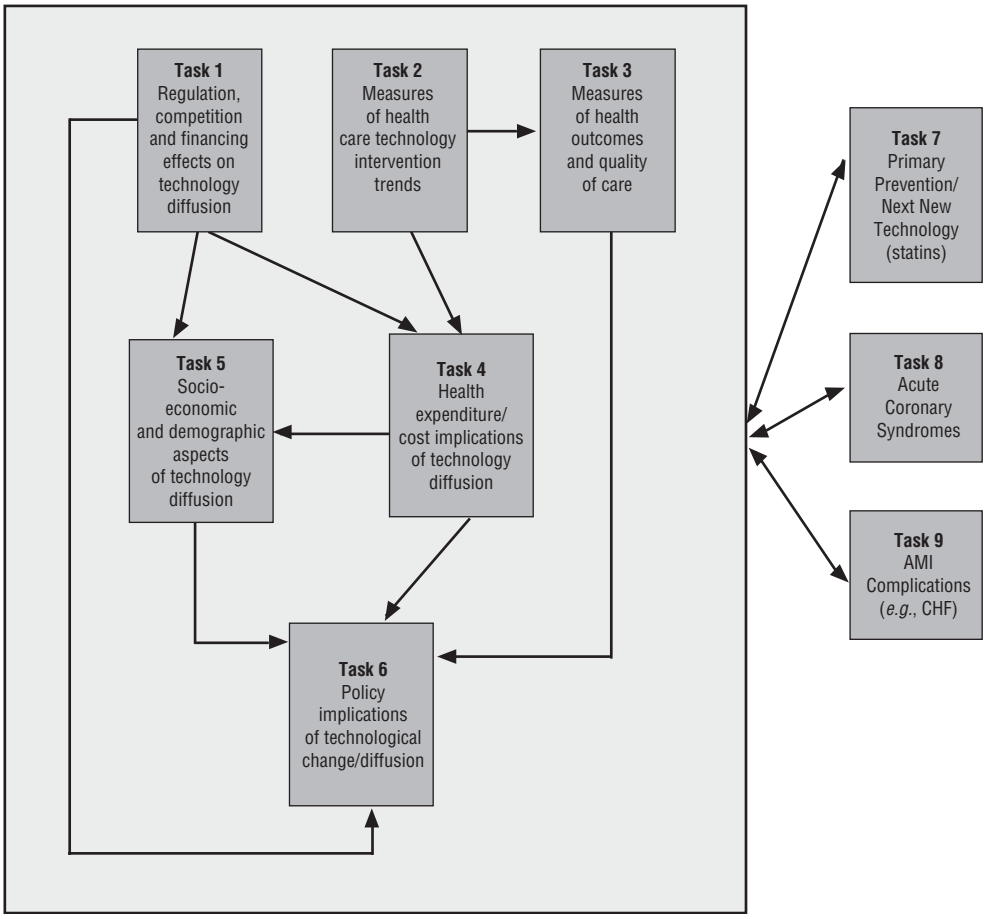
This research complements MONICA's focus on public health, and build on productivity studies like the analysis by McKinsey that have sought to compare resource use and evaluate the role of economic and regulatory incentives in influencing medical productivity. By adopting a longitudinal perspective with a focus on trend analyses across a number of countries, the TECH network provides insights into the causes and consequences of differences in medical practice, and especially technological change. Because of the detailed data, our approach includes the ability to evaluate various population groupings, *i.e.* by age or other meaningful categories.

3. Methodology used

In this section we illustrate the "global" approach we have adopted inside the TECH Research Network to deal with some of the "unresolved issues" discussed earlier in Section 1. First of all, it is important to underline that the our research activity has been organized around two distinct phases. The first phase has focused on a specific prevalent health condition with major mortality and quality of life effects: Acute Myocardial Infarction or more commonly, heart attack (AMI). Building on the results of the first phase, the second phase of the project will explores the feasibility of extending our methodology to other areas, especially cardiovascular disease prevention, acute coronary syndromes and AMI complications.

Having in our mind that the motivating goal of TECH research is to help policy makers design policies that can foster appropriate adoption and diffusion of new technologies with the aim of improving AMI patient health outcome without undo cost pressure, we have organized our work in six tasks related to each other as shown in Figure 13.1. Task 1 characterizes the existing structure of regulations, financing, health care organisation and competition in each country over the past decade, and hypothesises how these might affect health care technology adoption and diffusion. Task 2 deals with measures of health care technology intervention trends. The main objective of this task is to find reliable methods to describe these differences in a quantitative manner and to analyse the different treatment patterns for AMI patients across the participating countries. This is a very important task that involves the derivation of a new methodology to work with data from homogeneous patient groups at the international level. Based on the results obtained from Task 2, in Task 3 we determine mortality rates following hospital admission for AMI, studying and comparing: *a)* mortality rates in each of the participating countries; and *b)* within each country, trends over time in mortality rates. We also investigate the relationship between the use of health care technology for the treatment of AMI and the outcomes of care in different countries, as measured by mortality rates. In this way we can also investigate the relationship between *rates of change* over time in the use of

Figure 13.1. **Relationships between major tasks of TECH network**



Source: Author.

technologies and *rates of change* over time in mortality rates. In Task 4, as in the first three tasks, we document variations across countries in AMI expenditure levels and trends by decomposing micro level health care expenditure trends into relative cost and quantity trends. In addition, based on data from Task 2 and Task 3, we assess the impact of differences in expenditures on the up-take of new health care technologies across different health care systems. Then, based on results from Task 1 through 4, we assess the relative importance of unit costs and quantity provision on population health controlling for regulatory environment. In Task 5, based on additional data and information gathered from the previous tasks, we study how accessibility to new technologies, expenditures and health outcomes can vary according to patient socio-economic status (sex, education, race, income/poverty, etc.) for the treatment of heart attack. Differences in socio-economic status and their effects on treatments are reinforced by restrictions in the public health care financing and by the increasing privatisation process of the health care sector witnessed in several OECD countries.

Information collected from Task 1 through Task 5 are then used in Task 6 to explore the effects of regulation and incentives in health care systems on the diffusion of medical technology, and to discuss the potential policy implications of these findings. Understanding this process will serve to inform a multitude of policy issues internationally.

The remaining three tasks (7-9) explore the feasibility of extending our methodology to cardiovascular disease prevention, acute coronary syndromes and AMI complications. The focus in Task 7 on a specific health event (and ICD-9 code) enables a clean and valid comparative study. Cardiac events and their treatment include several further issues, which might affect the incidence, treatment and outcomes in the countries' AMI patients. Furthermore, during this phase we discuss the opportunity to apply our methodology to other health conditions. Other forms of coronary heart disease (*e.g.,* unstable angina and other acute coronary syndromes), stroke, breast cancer, and other cancers are possible candidates.

In particular, Task 7 is relevant to the diffusion of technology and the determinants thereof – in this case the diffusion of an emerging technology in coronary care (*i.e.* the use of highly efficacious lipid-modifying agents called statins in the primary prevention of CHD). It may be predicted that a considerable reduction in the clinical expression of acute coronary syndromes and hence of invasive cardiology will result from the successful management of hyperlipidaemia through primary prevention. Incentives in the health care systems, regulatory policies and cost considerations will strongly affect large-scale penetration of statins into the non-symptomatic population. Most current recommendations indicate use in patients at high risk (20-30%) of an event over the next 10 years – a restriction that overwhelmingly favours care of the elderly, while neglecting the younger population. Task 7 is closely linked to Tasks 1-6, as well as to Tasks 8 and 9, which explores outcomes of failed primary prevention.

Task 8 focuses on the management of acute coronary syndromes (ACS). Task 8 will explore the extent to which methods developed for Task 2 can be adapted for study of a related and increasingly prevalent variant of heart disease, acute coronary syndrome. The final goal of this task is to develop a protocol for obtaining administrative data that can allow valid comparisons across countries of trends in the use of technology for the management of ACS (other than definite heart attack). In this way we can compare and contrast results obtained for heart attack trends with those obtained for other ACS patients. Task 8 will also provide data that may allow extension of the exploration of inequalities, which is the focus of Task 5.

In Task 9 we try to assess how the management of congestive heart failure (CHF) is affected by the regulatory environment and financing of healthcare. In fact, as more patients survive after an AMI, the natural history of the disease results in increased prevalence of CHF in European countries. Overall, CHF represents between 5-10% of all hospital admissions and 1-2% of total health expenditures in EU countries. There is evidence that with appropriate ambulatory management, CHF patients can reduce the number of adverse events, for which hospital readmissions are a good marker.

3.1. A convenient taxonomy of technological change

For a better understanding of the dynamic of technology inside this sector and also for a better exposition of our findings in the next sections, we have divided technological change into three main categories: changes in *high-tech* care, *low-tech* care, and the *appropriateness* of medical care. Here below we provide a definition of such taxonomy.

High-tech changes

We define high-tech treatments as those with high fixed costs for provision, or high marginal costs with each use. An example of a high fixed-cost technology is cardiac

catheterisation, a technique for imaging the interior of the arteries which provide blood to the heart muscle. The high fixed-costs of cardiac catheterisation include hiring specialised personnel (not only interventional cardiologists, but also specialised nurses and cath technicians) and purchasing substantial specialised equipment (*e.g.,* cath tables and fluoroscopic imagers). The provision of open-heart (bypass) surgery also requires substantial fixed investments, and is also expensive to perform on a per-case basis. Each case requires substantial specialised surgeon, cardiologist, and nurse input, as well as costly supplies like blood products and heart-lung bypass filters and tubing. In the results presented in subsequent chapters, we find very large effects of differences in incentives on trends in the use of high-tech procedures in heart attack care. For example, Israel increased marginal reimbursement rates for bypass surgery in 1989 in response to public dissatisfaction with long waiting lists; immediately after marginal reimbursement rose, the number of bypass procedures rose dramatically. More generally, countries that use fixed payment systems and countries that regulate the diffusion of high-tech capabilities tightly have much less growth in the use of high-tech procedures over time, so that treatment involving high-tech services such as catheterisation, angioplasty, and bypass surgery across countries has diverged substantially. Payment levels also seem much less important for explaining the trends in high-tech procedure use than does the responsiveness of a payment system to increased use of high-tech procedures.

Low-tech changes

We define low-tech treatments as those with low fixed and marginal costs of use. Essentially, these are treatments that individual doctors or other health personnel could provide without the use of substantial input of labour, capital equipment, or materials. For example, clinical trials in the 1980s documented important survival benefits from the use of drugs such as aspirin and beta-blockers soon after a heart attack. These drugs have been available for some time in generic versions. Though data on trends in the use of low-tech treatments are more difficult to obtain in many countries, especially over long time periods, results from our study suggest that differences in incentives across countries are not that important in explaining trends in low-tech treatments. For example, aspirin use has increased at relatively similar rates to very high levels in almost all of our countries over the past decade, and beta-blocker use has also increased. The use of drugs found in clinical trials to be potentially harmful in heart attack care, including calcium-channel blockers and lidocaine, have also declined in use by relatively similar magnitudes in most countries studied.

Changes in expertise or appropriateness

We characterise technological change not only in terms of changes in the use of various types of technology, but also in terms of changes in the *appropriateness* or experience with which such technologies are used. For example, two countries may have similar rates of use of catheterisation and aspirin, but if medical professionals in the first country do a progressively better job of targeting the technology to the patients who would most benefit from it, then the first country is likely to have better outcomes after heart attack. Judgments about changes in appropriateness or the skill of physicians using the technology require detailed medical data over time to assess these issues, and such data are not currently available in most countries. However, many of the research teams were able to review research studies relevant to this question, and to identify better data for

future studies. We suspect that differences in the appropriateness of technological change are important determinants of differences in outcome trends. However, in the current study we are only able to develop speculative evidence on this topic.

4. Data used

To the extent possible, teams used nationally representative micro-level data sources – covering at least a large geographic area of each country – rather than reports from particular, possibly non-representative institutions.

Most countries were able to provide national data or data from large regional databases for the analysis. US data include all elderly, non-health maintenance organisation (HMO) beneficiaries with new heart attacks, and all heart attack patients in California. Canadian data are from three provinces, as described in the text. UK data are from the Oxford region and Scotland. Several centres provided data from the MONICA project: Swiss data are from several prefectures surrounding Lausanne, and Italian data are from the Friuli region. Both of these samples are confined to the non-elderly. Australian data are from the states of Western Australia (Perth and surrounding areas) and Victoria. Only two countries did not have approximately representative regional or national data. French data are from all public and non-profit private hospitals, which represent about two-thirds of heart attack stays. Japanese data are from a selected sample of six large, academically oriented hospitals. All other research teams analysed national data sets.

We have developed and applied consistent methods for conducting micro-level analyses, including standardized cohort and variable definitions and population weights.[3] In particular, we have created a data collection protocol according to which all countries/teams have produced their cohorts of AMI patients. *All* participating countries feature administrative and other data that rely on ICD-9 or ICD-10 diagnosis codes, or on country-specific coding systems for which our principal diagnoses of interest (AMI, ischaemic heart disease, congestive heart failure, etc.) have already been converted to these international standards. For most participating countries, we will use longitudinal patient data, allowing us to identify reliably a patient's first admission with AMI as well as treatment and outcomes of the initial and subsequent admissions. For countries without longitudinal data, we will construct "denominator" AMI population estimates from admissions with a primary diagnosis of a new AMI, and use both initial and subsequent (ICD-9 code 410 x2) AMI admissions to construct treatment rates.

Construction of diagnosis, treatment, co-morbidity, outcome, and resource use variables will follow the standard procedures developed in our preliminary studies and are incorporated into our protocol already. For that research, we developed standard statistical programs for constructing all of these variables using ICD diagnosis codes and ICD-CM and CPT procedure codes. We constructed identically defined variables for important high-tech treatments (catheterisation, bypass surgery, angioplasty, primary angioplasty, stent use). We have developed similar shared programs for constructing covariates for common co-morbid diseases and for co-morbidity indices such as the Charlson index.

For countries able to link individual hospital records over time, our principal outcome measures include all-cause mortality (for countries able to link death records), in-hospital mortality (especially acute mortality), and readmissions related to specific cardiac complications at various time periods after AMI. The complication measures of principal interest are recurrent admissions with new AMIs and admissions for congestive heart

failure (CHF) more than 30 days after the initial hospitalisation. For countries that do not have longitudinal data, we will construct measures of outcomes from the initial hospital stay (*e.g.,* CHF reported as a complication during the admission, and death at discharge); for comparability, we will construct analogous initial-stay measures from the countries with longitudinal data. All of this data when received will be thoroughly reviewed by the data manager at the coordinating centre.

These methods have enabled us to make cross-country comparisons with a degree of precision that has not been achieved before. Furthermore, in conjunction with methods developed by us, these data will enable investigators to estimate formal cross-country regression models assessing the effect of one or more aspects of health care systems on technology use and quality, *without actually pooling sensitive individual patient data*. We have then developed a methodology that will allow us to share such information without violating the privacy of the data itself. We will refer to this methodology as "sub-matrix method". Our method allows researchers to undertake formal cross-country regression analyses, while only sharing data in an aggregated matrix form that has all individual-level information destroyed.[4] None of these standardized matrices contains any individual-level information because all the individual-level information has been summed together to form the cross-product matrices.

5. Evidence on international differences in the causes, nature, and consequences of technological change

In this section we present and discuss the main findings of our ongoing research. In general, we find a great deal of technological change in most dimensions of acute heart attack care, in virtually all of the countries included in our analysis. However, technological change for heart attack care has differed in many ways across countries.

In order to have a better understanding of the causes, nature and consequences of technological change we have adopted a convenient taxonomy for both market and governmental forces as well as for definitions of technological change. Below we report on the consequences of these linkages between medical technology impediments and incentives for health care use and population health status. The results illustrate some clear relationships to health system characteristics, particularly for the case of intensive treatments for heart attack patients.

5.1. *International differences in the causes: regulations, financing, health care organisation and competition*

The results presented in this section reflect a review of the international and country-specific literature on economic influences on medical treatment, and extensive discussions with economists and other participants in the research network (see Table 13.1). We consider effects of health care payment systems, regulations, and a range of other economic and policy factors. Many of these factors have been the subject of cross-sectional studies, for example of the effects of co-payments or differences in physician payment on treatment choices. Following Weisbrod (1991) and others, we emphasize the *dynamic* consequences of these policies. For example, lower patient payments or more generous physician payments for a particular treatment may provide incentives to develop expanded uses of a medical treatment that would be less encouraged under different reimbursement systems. As a result, differences in health care incentives and regulations may have substantial dynamic implications.

Table 13.1. **Differences in economic and regulatory incentives for technological change in 1995**

Type of incentive	Strong limit	Intermediate limit	Weak limit
Costs borne by patient	*Substantial out-of-pocket payments*	*Some out-of-pocket payments and/or significant optional private insurance sector with premiums borne directly by patients:* France Switzerland	*Zero/very low patient payments for services:* Belgium Denmark Finland Israel Italy (for AMI patients) Sweden United Kingdom
Generosity of payments to hospitals (both *level* of payments and *responsiveness* of payments to intensity of treatment may differ; this table focuses on responsiveness)	*Fixed global budgets, more or less stringent:* Denmark Finland* Sweden* United Kingdom	*Some additional payments for the provision of more costly treatments:* Belgium France** Israel Italy	*Fee-for-service payments:* Switzerland France (private hospitals)
Generosity of payments to physicians (both *level* of payments and *responsiveness* of payments to intensity of treatment may differ; this table focuses on responsiveness)	*Physicians are mainly salaried:* Denmark (cardiovascular doctors) Finland France (public hosp.) Israel Italy Sweden United Kingdom	*Some additional payments for the provision of more costly treatments*	*Fee-for-service:* Belgium France (private hospitals) Switzerland
"Micro" technology regulation (mainly involves costly "high-tech" procedures, and potentially expensive patients)	*Extensive reviews of individual treatment decisions*	*Limited case-level review and/or "gatekeeping":* Denmark Israel United Kingdom	*Little or no case-level review:* Other countries
"Macro" technology regulation (includes regulation of physician supply)	*Strict regulation:* United Kingdom	*Intermediate regulation:* Belgium Denmark Finland France Sweden	*Little regulation:* Israel Italy Switzerland
Choice and competition among insurance plans	*No choice (universal insurance):* Denmark Finland Italy Sweden United Kingdom	*Limited choice (e.g. in supplemental coverage):* Belgium France Israel Switzerland	*Substantial choice:*

* Some districts have implemented diagnoses-related groups (DRG) like payments that provide additional revenues for supplying additional treatments.

** France has a well developed private hostipal system, with relatively generous incentives for technological change, operating alongside systems that have relatively strict incentives.

Source: TECH Research Network.

Patient payment incentives

The out-of-pocket payments by patients when they use medical services are quite different in different nations. Patient payments range from trivial or nonexistent in countries like Italy, Sweden and the United Kingdom, to very high rates in some Asian countries. For example, many insurance plans in Korea reimburse only a fraction of the cost of hospital admissions, procedures, and drugs. Along these lines, a substantial proportion of health care expenditures in Taiwan (approximately 40%) historically were financed by out-of-pocket

expenditures; however, this proportion declined dramatically after March 1, 1995, when Taiwan adopted a comprehensive National Health Insurance system (see below). Many of the countries with low patient payments in their "basic" public insurance systems have more or less extensive systems of private insurance, where patients are responsible not only for their premium payments but also for substantial co-payments when they use services. Australia provides a good example of this system, in which more than one-fifth of the population (largely those with higher demands for medical care) has private policies that provide coverage for a substantial amount of medical care.

Provider payment incentives

Countries also differ enormously in their provider payment systems. We considered two principal dimensions in which payment methods and changes in payment methods for hospitals, physicians, and other health care providers may differ: the *level* of payment ("average" payment generosity), and the *responsiveness* of payment to the use of more costly treatments for a patient ("marginal" or incremental payment generosity). Countries in our study vary enormously in these incentives. For hospital reimbursement, systems range from global budgets with relatively high (Canada) and low (United Kingdom, Denmark) average payments per bed or admission, to fee-for-service systems with relatively high (United States, for its "traditionally" insured and preferred-provider populations) and low (Japan, Korea) payment levels. Other countries use intermediate systems, ones that respond to some extent (or for some kinds of treatment only) to the use of more costly treatments. For example, Australia and Taiwan now rely on diagnosis-related group systems for hospitals, which are "prospective" payments that differ in amount based on the diagnoses and technologies used to treat a patient (McClellan, 1997a and b). Sweden offers a unique combination of systems, in which some districts reimburse hospitals on the basis of global budgets, and some reimburse hospitals with a DRG system. These countries also differ substantially in their average payment rate.

Payment systems for physicians also differ widely, in ways that differ from hospital reimbursement systems. For example, Canada pays physicians on a fee-for-service basis, so that more intensive treatments lead to more reimbursement (up to a cap), while "traditional" Medicare in the United States features a relatively more generous fee-for-service system. Physicians in Japan and Korea are also reimbursed largely on a fee-for-service basis. At the opposite extreme, physicians in Finland and Sweden are salaried. In between, the United Kingdom use a "fee-for-patient" (capitation) reimbursement system, again with quite different average payment levels. The level and responsiveness of payments for drugs, devices, and other medical services also differ across countries. Reimbursement for thrombolytic drug treatment of heart attack (discussed in detail below) illustrates the range of drug payment incentives. At one extreme, Belgium offers virtually unrestricted fee-for-service reimbursement for use of all thrombolytics. In contrast, Taiwan provides fee-for-service reimbursement for thrombolytics only under certain conditions, and Sweden finances most inpatient drugs through global hospital budgets.

Technology regulation

Countries vary equally widely in their regulation of medical technology and the use of various medical treatments. Our reviews of technology regulation suggested that countries differed primarily in two broad types of regulation: "macro" regulation of the adoption or aggregate level of use of medical technologies, and "micro" regulation of the use of medical

technologies in particular cases. At the *macro* level, countries such as Canada and the United Kingdom strictly review and limit the capabilities of providers to perform costly, intensive medical procedures. These government regulations generally affect "high-tech" medical technologies such as MRI scanners, cardiac catheterisation labs, and open-heart surgery facilities. At the opposite extreme, countries including Japan, Korea, Taiwan, and the United States have little or no macro-regulation of technological capabilities. In between, countries including Belgium, France, Italy, Singapore, and Australia regulate intensive technological capabilities on a limited basis, for example in public hospitals but not the large number of privately-owned hospitals.

Micro-regulation

Micro-regulation of technology use in individual patients, particularly the use of costly technologies, occurs on a more limited worldwide basis. The pre-approval requirements, second opinion requirements, and other features of utilisation review that are a major part of managed care in the United States are well known. However, other countries have also begun to regulate technology use at the micro level. For example, the province of Ontario uses a relatively detailed clinical evaluation system to prioritise its waiting lists for bypass operations and other procedures that are subject to "macro" regulation. The United Kingdom and Denmark also have "gatekeeper" requirements, involving pre-approval by a patient's primary physician, for visits to specialists and other intensive services to be covered. In Singapore, there is a cost-containment system that somewhat regulate the use of technology in public hospitals.

Hospital ownership

Our participating countries also differ in the ownership of their health care facilities. In Denmark, Finland, and Sweden, hospitals and other facilities are publicly owned. However, these countries differ in the level of government with institutional control, ranging from the national government to local municipalities. Many countries, including Australia, France, Taiwan, Singapore and the United States, have mixed systems of hospital ownership, and also differ in the extent to which private ownership is for-profit or nonprofit. Countries such as Japan and Korea rely relatively heavily on for-profit ownership, even of teaching hospitals.

Competition

Countries differ in the extent to which their populations have effective choices among medical providers and health insurance plans. For its non-elderly population, the United States has a high degree of choice and thus competition at the health plan level. Other countries, including Japan, Singapore and Switzerland, also have some freedom of choice of health plans. At the opposite extreme, universal government-funded health insurance programs such as those in Canada, Denmark, the United Kingdom, and Sweden have no choice in primary insurance plans, and (in some of these countries) only limited choices in supplemental private insurance policies. Many countries with little choice of insurance plans, such as France, Korea, and the United Kingdom, do have considerable freedom of choice among health care providers.

Physician supply

Many countries, including some that do not regulate technology use strictly or rely on public-payment systems, meticulously regulate their supply of health professionals.

Regulations may affect both the total supply and their distribution across specialties. Countries with relatively strict limits include the United Kingdom; countries with relatively little regulation include Israel and the United States.

Other factors

Virtually all research teams suggested that the factors listed above were likely important determinants of technological change in their countries. Research teams in some particular countries also noted some additional factors. Investigators from several countries mentioned the importance of public and private policies on the provision of information about providers and the effectiveness of medical technologies. For example, press coverage of waiting lists was mentioned by investigators in Israel and Sweden as having altered government policy about allocation of resources to the provision of intensive cardiac procedures; direct advertising to patients in the United States may have similar effects on diffusion of the use of certain prescription drugs. Information provided to physicians and hospitals on such topics as the effectiveness of treatments (*e.g.*, policy initiatives to educate doctors on treatment effectiveness in the United Kingdom) and on how their practices differed from those of their peers was noted as an important determinant of treatment changes in some countries. However, many more research teams reported that such information provision was likely to become a more important determinant of medical practice in the future, with further improvements in data collection systems on medical practices and outcomes.

5.2. *The nature and magnitude of technological change*

In this section we present evidence about the substantial differences in the nature and magnitude of technological change across countries that are associated with differences in economic and regulatory incentives.[5] At this stage the analysis has been limited only to health outcomes, especially mortality, leaving expenditure and resource use outcomes to future analyses. Our analyses strongly suggest that the nature and magnitude of technological change are systematically related to the economic and regulatory incentives in a country's health care system. However, the way in which medical practices have changed has differed.

For intensive procedures, we found three very different patterns of technological change. The United States and (based on more limited evidence) Japan and possibly France illustrated an early start/fast growth pattern: intensive procedures tended to diffuse early, resulting in relatively high-treatment rates in the overall population in any given time period. This pattern is also associated with relatively rapid diffusion for these countries' elderly populations.

A second pattern, late start/fast growth, involves relatively rapid diffusion of intensive technologies, but diffusion that starts later and thus from a lower "base rate". These countries show diffusion rates that are similar to US rates, and indeed in some cases converge toward US rates. But the overall intensity of treatment at any given time tends to be somewhat lower than in the United States because of the later start of diffusion (and, in the case of Canada, because the trend rate is somewhat slower than the US rate). In addition, diffusion of procedures to elderly patients in these countries tends to be slower. Countries with this pattern include Australia, Belgium, most Canadian provinces (although their growth rates were somewhat slower than those of most other countries in this group), France, Italy, Singapore, and Taiwan.

The third pattern involves late start/slow growth: later adoption and slower diffusion throughout the decade. Countries with this pattern include the United Kingdom, most of the Scandinavian countries, and (at least on some measures) Ontario.

The factors influencing diffusion of drug and other low-tech procedure/therapies are somewhat less clear-cut; and their use is not strongly related to financial incentives. No such systematic differences in trends were evident for relatively low-cost, easy-to-use drugs. In general, many drug treatments diffused widely in all developed countries, but the patterns of diffusion were not so clearly different. Drugs with very high costs, illustrated by tPA, showed differences in trends more like those observed for the intensive procedures.

Since the costs of these low-tech treatments are relatively modest, it is possible that institutional and cultural forces, as well as specific initiatives related to quality of care, are primary determinants.

In our ongoing work, we are conducting more comprehensive analyses of the extent to which these broad patterns of technological change are related to the underlying regulatory and economic incentives for providing medical treatments in each country. While much remains to be done, our results suggest that "supply side" incentives – particularly those affecting hospitals and, to a lesser extent, physicians – have an important relationship to observed trends in costly treatments, including intensive procedures and certain very expensive drugs. Countries such as the United States and Taiwan with relatively "weak" supply-side restrictions on the adoption of intensive treatments – such as the provision of additional reimbursement to hospitals based on the treatments they provide, and limited regulatory restrictions on particular technology adoption decisions by hospitals – have relatively rapid growth rates. Countries such as Canada, Sweden, Denmark, Finland, and Norway with stricter supply-side restrictions – such as global budgets for hospitals and central planning of the availability of intensive services – have considerably slower growth rates.

5.3. The consequences of differences in technological change

Our analyses of differences in outcome trends suggest that the improvements in mortality after heart attack are large in most countries, and generally appear to be only modestly related to technological change, especially high-tech technological change. However, countries with greater high-tech changes had somewhat less growth in the occurrence of heart disease complications in the additional heart attack survivors, especially at older ages, suggesting that the more rapid growth in intensive treatments did have some consequences for patient quality of life. Even in our longitudinal analysis, other factors may explain the absence of a stronger relationship besides the lack of mortality benefits from greater high-tech changes in care.

The formal evidence from clinical trials on the effects of such high-cost intensive procedures is and will likely remain limited. Especially in countries with relatively wide availability of intensive procedures, it has been difficult to find both adequate funding and adequate willingness among patients and providers to participate in randomisation for such major therapeutic decisions. Moreover, because providers' experiences and use of procedures change so rapidly, the results of randomised trials may be viewed as having only limited relevance to current practice by the time they are published.

This seems to have been the case in trials of primary angioplasty. The early trials in the late 1980s and early 1990s showed no benefit over thrombolytic drugs, but these trials appear to have had almost no impact on the rate of diffusion of primary angioplasty. In contrast, more recent trials have shown at least a slight advantage (one percentage point or so case survival), at least in experienced centres.

Very recently, the development of complementary drugs and devices (stents) may have improved outcomes even more. Large differences in outcome trends between countries would not be expected even if differences in procedure rates were substantial. For example, if intensive procedures convey a nontrivial mortality benefit – say, two percentage points – then even when a difference of twenty percentage points in treatment rates emerges, the associated difference in the population mortality rate would be 0.4 percentage points.

Of course, this does not necessarily imply that the more intensive procedures are not worthwhile; it simply implies that careful analysis of outcome trends and the factors influencing the trends is necessary. We are conducting more detailed analyses of short- and long-term outcome trends for heart attack patients in our participating countries, and our large sample sizes provide an opportunity to detect trend differences with a very high level of precision.

6. What policy-makers can learn out of these findings

Policy conclusions about which of these diverse patterns of technological change are optimal depend on their consequences for patient health outcomes and costs of care in each country, and on the value placed on these outcomes by each country's population. However, it is clear that if high-quality care requires rapid innovation and diffusion of valuable high-cost as well as low-cost treatments, quality of care may differ greatly around the world, and national health policies may influence quality in important ways.

Productive health care maximises the quality and quantity of life to citizens for a minimum investment. However, research is needed to inform policy makers as to which strategies will best achieve the highest value in health per dollar spent. When health care budgets pay for less than optimum medical technologies, the population at large pays the price in terms of higher cost, lower quality, and worse access to limited resources.

On 16 May 2000 the European Commission agreed to proposals from David Byrne, Commissioner for Health and Consumer Protection, on an ambitious package of public health measures. Three main activities where highlighted: *i)* put in place a comprehensive data system on the major determinants of health in the EU, together with mechanisms to evaluate this data; *ii)* ensure that the Community is in a position to counter threats to health which cannot be tackled by member States in isolation; *iii)* put in place strategies to identify the most effective policy for combating disease and promoting health.

At present, EU member States operate their healthcare systems in virtual isolation from one another. Efforts at identifying the strengths and weaknesses of individual systems, through improved co-operation, are still only in their infancy. This represents a missed opportunity. The potential for improved health through Community action seems hugely under-exploited. A first step in addressing this weakness should be a very comprehensive data system to allow critical review of individual health care systems in a Community context. member State should have available a wide range of information on what impacts on their health and how public health systems cater to their needs. For example, how long patients wait for particular treatments, how much these treatments cost and how effective they are in treating diseases.

The results achieved so far may allow health care systems to be critically compared, in order to characterize health system performance/productivity. This should also allow scarce resources to be utilized to best effect while also ensuring that a vital public interest is ensured. In this respect, it is worth emphasizing the level of effort that has already been

invested to obtain data sets, refine them, and develop and test analytic approaches to querying these important data for useful information.

So far, this project has developed a scientifically sound methodology that can be adapted to practical needs and requirements, and will be flexible enough to be used in a policy-making context and will serve to interpret and to improve the above mentioned health-related policies. In fact, although heart disease affects many Europeans, other diseases and technologies used to combat them are also important. The potential for extending our methods for gaining insights from existing, but not adequately analyzed, data sources is great.

7. Conclusions

The goal of this paper has been to show the recent advancements and findings obtained by the TECH Research network on the relationship between health policies, medical technology trends, and health outcomes. So far relatively little evidence was available on whether changes in health care differ across the very different health care systems of developed countries. We have been able to present new comparative evidence on heart attack care in seventeen countries showing that technological change – changes in medical treatments that affect the quality and cost of care – is universal, but has differed greatly around the world.

Here below we summarize the main findings:

1. medical practices for heart attack care have changed dramatically around the world in the past decade;
2. supply-side incentives are important for "high tech" treatments, but less influential in "low technology" treatments like drug use;
3. treatment has become more intensive, with more use of potentially valuable medications and more use of intensive cardiac procedures. The utilization of costly treatments is increasing in virtually all developed countries – both "high tech" (intensive cardiac procedures) and "low tech" (drugs);
4. although there seem to exist only slight differences in when new treatments become available in each country, enormous differences have been recorded in the rates of diffusion of new technologies into medical practice;
5. mortality rates for heart attack patients are improving in virtually all countries, but at somewhat different rates. In general, they appear to be only modestly related to technological change, especially high-tech technological change. However, countries with greater high-tech changes had somewhat less growth in the occurrence of heart disease complications in the additional heart attack survivors, especially at older ages, suggesting that the more rapid growth in intensive treatments did have some consequences for patient quality of life.

Our ongoing work also suggests that more rapid diffusion of intensive technologies has had clearer implications for health care costs. If the patterns we observe for heart attack care apply more generally, then they would suggest somewhat faster medical expenditure growth in countries with the two more rapid patterns of intensive technology diffusion compared to countries with the third, slower pattern. Moreover, the material and personnel costs ("prices") associated with the use of intensive treatments also differ greatly across countries; the countries with more rapid diffusion tend to have somewhat higher payments for these inputs.

Even if the consequences for outcomes imply that the more rapid technological change involving intensive procedures is worthwhile, other important unanswered questions remain. Do the patterns we have observed for trends in acute treatments also apply to preventive services and treatments for chronic illnesses? What are the equity effects of different patterns of technological change: Does more rapid diffusion tend to exacerbate or reduce differences in utilization across socio-economic groups, or are socio-economic differences in use of intensive treatments unaffected? Are differences in technological change by age and by gender consequential? Does the rate of technological change affect variations in medical practice and quality of care within countries? Do countries with similar overall patterns of technological change have different outcome and cost consequences, because of differences in quality and appropriateness of treatment in patients who undergo procedures? Virtually no evidence exists on these questions.

We are currently involved in: *i)* estimating the effect of incentives for technological change on treatment decisions and health outcomes; *ii)* determining the effect on health care expenditure and the cost-effectiveness of health-care; and *iii)* evaluating the impact of socioeconomic status on care: do effects of socioeconomic status differ in countries and for populations with and without universal insurance?

We believe these are important advancements for international comparative studies on how health care changes over time, and how policies can affect these changes.

Notes

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3. See McClellan and Kessler (forthcoming). Following previous validated studies in multiple countries, all research teams used a consistent case definition for AMI patients based on discharge data, applying the same exclusions to avoid cases unlikely to represent true new AMIs. See McClellan *et al.* (forthcoming). We have also compared co-morbidities and co-morbidity trends across countries, and have estimated multivariate models with and without various sets of co-morbidity control variables. See Tu *et al.* (2001). In general, these models show that after demographic adjustment, little to no difference exists between trend results estimated using models that account for co-morbidities and those without.

4. For simplicity, consider the problem of pooling data on across two countries for a single year, Country A and Country B. Some elementary matrix algebra shows that the OLS estimator of φ, (X'X) – 1 X'Y, can be rewritten (XA'XA + XB'XB) – 1 (XA'YA + XB'YB) where XA has k columns, one for each variable in the joint analysis, and NA rows, one for each individual patient in Country A, and XB is defined similarly. This has great importance. Simply by sharing four matrices – (XA'XA), (XB'XB), (XA'YA), and (XB'YB) – investigators in either of the two countries can conduct a joint regression analysis.

5. See TECH Research Network (2001) for more details.

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PART IV

Chapter 14

How Health Technology Assessment, Regulation and Planning Affect the Diffusion of Technology in Health Care Systems

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Abstract. *Given the frequent observation regarding a lack of impact of health technology assessment (HTA), this paper reviews some of the available evidence. Surveys have found that decision makers consider HTA among other factors, while case studies indicate that specific HTA exercises can be effective. One component of HTA, economic evaluation, has become increasingly important as a policy criterion for the reimbursement of new drugs. However, evidence of barriers to the use of economic evidence more generally and the wide range of influences on health care decisions suggest that optimizing their impact will remain an important issue for HTA organisations.*

Introduction

Health technology assessment (HTA) has been defined to include (Jonsson *et al.*, 2002):

- identifying evidence or lack of evidence on the benefits and costs of health interventions;
- synthesizing health research findings about the effectiveness of different health interventions;
- evaluating the economic implications and analysing cost and cost-effectiveness; and
- appraising social and ethical implications of the diffusion and use of health technologies.

This is a particularly broad definition of HTA but, apart from the final bullet point, is similar in spirit to the notion used by the UK HTA programme as a form of assessment which "considers the effectiveness, appropriateness and cost of technologies". It is significant that both definitions include the assessment of the costs of health care technologies, reflecting the wider acceptance today of cost as a legitimate factor to take into account when making decisions in health care than was the case in the past. Multilateral projects such as EUR-ASSESS (Banta and Oortwijn, 2000) and the Analysis of the Scientific and Technical evaluation of health interventions in the European Union (ASTEC) project (Maynard *et al.*, 2001) suggest that, in general, HTA activities are less ambitious than this and tend to concentrate on the assessment of clinical outcomes, rather than cost-effectiveness. In a number of EU countries and elsewhere, it appears that HTA is an embryonic activity, with a number of central or local government organisations with small budgets attempting to come to terms with the challenges of systematically evaluating the evidence on health care technologies.

This paper reviews evidence on the impact of HTA on the diffusion of health care technologies. It considers why HTA might not have the impact that health care decision makers would like, and which other factors have a powerful effect on diffusion. The literature reviewed was identified primarily through a search of Medline.

1. What impact does health technology assessment (HTA) have on decision making?

In principle, HTA activities, despite their relatively recent introduction into the policy making environment, should have a significant part to play in the adoption and diffusion of medical technologies. However, a concern of the evidence-based medicine community is the lack of correspondence between evidence and clinical practice (Haynes *et al.*, 1997). Examples can be cited of technologies diffusing rapidly before reliable evidence on effectiveness and cost-effectiveness was available, such as computed tomography (Drummond and Weatherly, 2000). "It is widely acknowledged that clinicians have not actually changed their practice to agree with HTA results" was the conclusion of a recent survey of HTA initiatives throughout the European Union (Banta and Oortwijn, 2000). The

following sections review evidence on the use or otherwise of HTA to inform decisions in health care and considers evidence on the impact of particular HTA initiatives. Of the literature retrieved, these sections, and the later discussion of other factors affecting decision making, draw on those studies which addressed the impact of one or more factors on technology utilisation patterns in health care.

1.1. Survey-based evidence

Several interview-based studies have been undertaken to explore decision-making processes within individual health care provider organisations. Amongst the evidence from hospital-base surveys, Juzwishin *et al*. (1996) reviewed four studies. In the first, among 50 Canadian hospitals, 86% of respondents indicated that assessments were being conducted in their hospital with a lower figure of 68% using this information in their acquisition decisions.

In the second, among 509 Canadian hospitals, the researchers concluded that, while there was an acceptance of the concept of HTA, the organisational structures to implement its use were absent. These findings were reflected in responses to the third survey conducted in 1990 among 524 US hospitals, in which acquisitions tended to be determined by opinions of medical staff and/or department heads. In the most recent of the four surveys, conducted among 12 US academic medical centres, the term "technology assessment" had a low level of recognition and technology decisions were not generally based on explicit criteria, decisions being described rather as "political", "informal" or "*ad hoc*".

Mitton and Donaldson (2002) used face-to-face interviews to elicit the views of key decision-makers on priority setting within regional health authorities in three health regions of southern Alberta, Canada. Most respondents in Calgary Regional Health Authority stated that the allocation of resources across programmes within the health region occurs on the basis of historical trends, with some allowance for expected changes in demography. Some respondents cited crises in the form, for example, of pressure points and wait times, as important influences. Historical factors were mentioned by respondents in the other two regions as having an effect on resource allocation.

A joint US/UK interview survey undertaken by the Milbank Memorial Fund (2000) among 55 health care purchasers found that few used HTA and clinical effectiveness evidence to make purchasing decisions, despite regarding this information as valuable. The study identified some sporadic application of these types of data but no proactive, systematic use.

A survey conducted in the UK by Rosen and Mays (1998a) investigated decision making processes with respect to three particular technologies, vascular stents, the triple test for antenatal detection of Down's syndrome and the excimer laser, in three hospital/health authority (purchaser) sites. This study found that different health care professionals used evidence in different ways. For example, in the purchaser-led triple test adopter site, the decision to offer universal access to the technology was taken after a full review of the evidence on the test's effectiveness by a public health registrar. In the two sites which did not adopt the test, decisions were made by clinician-only groups not through a systematic review of the evidence but through informal discussions, with previous personal experience and the advice of colleagues also being influential. In one site, the triple test was rejected partly so that the site could participate in an evaluation of an alternative test being conducted at another hospital because of the close relationship between the two.

1.2. The impact of specific HTA exercises

Although the survey evidence above suggests a limited impact of HTA, some influence has been identified in other studies of specific technologies. In a review of 20 technology assessments undertaken by the Australian National Health Technology Advisory Panel (NHTAP), Hailey *et al.* (1990) considered that the NHTAP reports had a significant influence in the short- to medium-term for 11 technologies and some short-term influence in three cases.

Hailey (1993) classified detailed assessments conducted on 26 technologies by Australian advisory boards, mainly the NHTAP (some of which featured in the earlier paper) according to the extent of their influence. The categories were major policy influence, direct but more limited policy influence, minor or uncertain policy impact and no obvious policy impact. Overall, he found support for an influence on policy in 17 cases, and reckoned that there was an influence on practice for at least 11 technologies. For eight technologies, it was thought that the HTA had a major influence on policy and practice.

In Quebec, Battista *et al.* (1999) have documented the relationship between the Quebec Health Technology Assessment Council (CÉTS) and the decision making process. They argue that the CÉTS report on prostate cancer screening resulted in clinical guidelines being developed and "enabled the Ministry of Health and Social Services to decide not to launch a province-wide screening programme". Although it may be questioned whether the evaluation changed the government's decision, an audit of CETS referred to by Rosenau (2000) concluded that, overall, the organisation did have an effect, saving around US$25 million.

In Alberta, Hailey *et al.* (2000) report on the impact of a series of rapid HTA reports ("Technotes") prepared in response to specific requests from the provincial health ministry or health authorities. The policy issues which the reports addressed related to the possible referral of patients for treatment outside the province, the case for introducing new technology, the purchase of particular items of equipment and the appropriateness of existing clinical practice. Based on discussions with those making the requests and written feedback, the authors concluded that 14 out of 20 reports had exerted some influence on decision making.

In the UK, the English Department of Health has financed the production of a series of reports entitled "Effective Health Care Bulletins", summarising evidence and targeted at decision makers in the health service. In an evaluation of the impact of the Bulletin on persistent glue ear in children, Mason *et al.* (2001) estimated that 89 800 fewer procedures were conducted in the four years after the Bulletin's publication than would have been carried out otherwise, resulting in savings of £27 million.

2. The use of economic data

Although economic evaluation does not seem to have a significant part to play in much HTA activity, it is achieving greater prominence in one particular area of health policy, namely deciding whether or not a new drug is to be publicly reimbursed. In the last decade, Australia, New Zealand and two provinces of Canada (British Columbia and Ontario) have introduced requirements for an economic evaluation to be submitted in support of a claim for the formulary listing of a new product. This policy has been taken up to varying degrees in some European countries, including Denmark, Finland, Netherlands and Norway.

Two managed care organisations (MCOs) in the US now require pharmaceutical companies to submit economic evidence when requesting that products be included on the MCOs' formularies. In the UK, it is generally at the discretion of general practitioners (primary care physicians) whether or not to prescribe a licensed product under the NHS. Since 1st January 2002, however, there has been a statutory obligation for the NHS to make funding available for those drugs (and other technologies) recommended by the National Institute for Clinical Excellence (NICE). NICE's guidance to the NHS is based largely on a systematic review of the evidence on clinical and cost-effectiveness.

NICE has undertaken a number of technology appraisals in disease areas related to ageing. For example, it has made recommendations on implantable cardioverter defibrillators for arrhythmias, drugs for Alzheimer's disease and newer agents for the treatment of rheumatoid arthritis. According to NICE's estimates of the total cost impact of its guidance, these three appraisals together could increase NHS expenditure in excess of £150 million per year. However, there has been some doubt as to whether take-up rates would match NICE's expectations given the apparent reluctance of some health authorities and general practitioners to divert funds from other valued uses in order to implement NICE guidance.

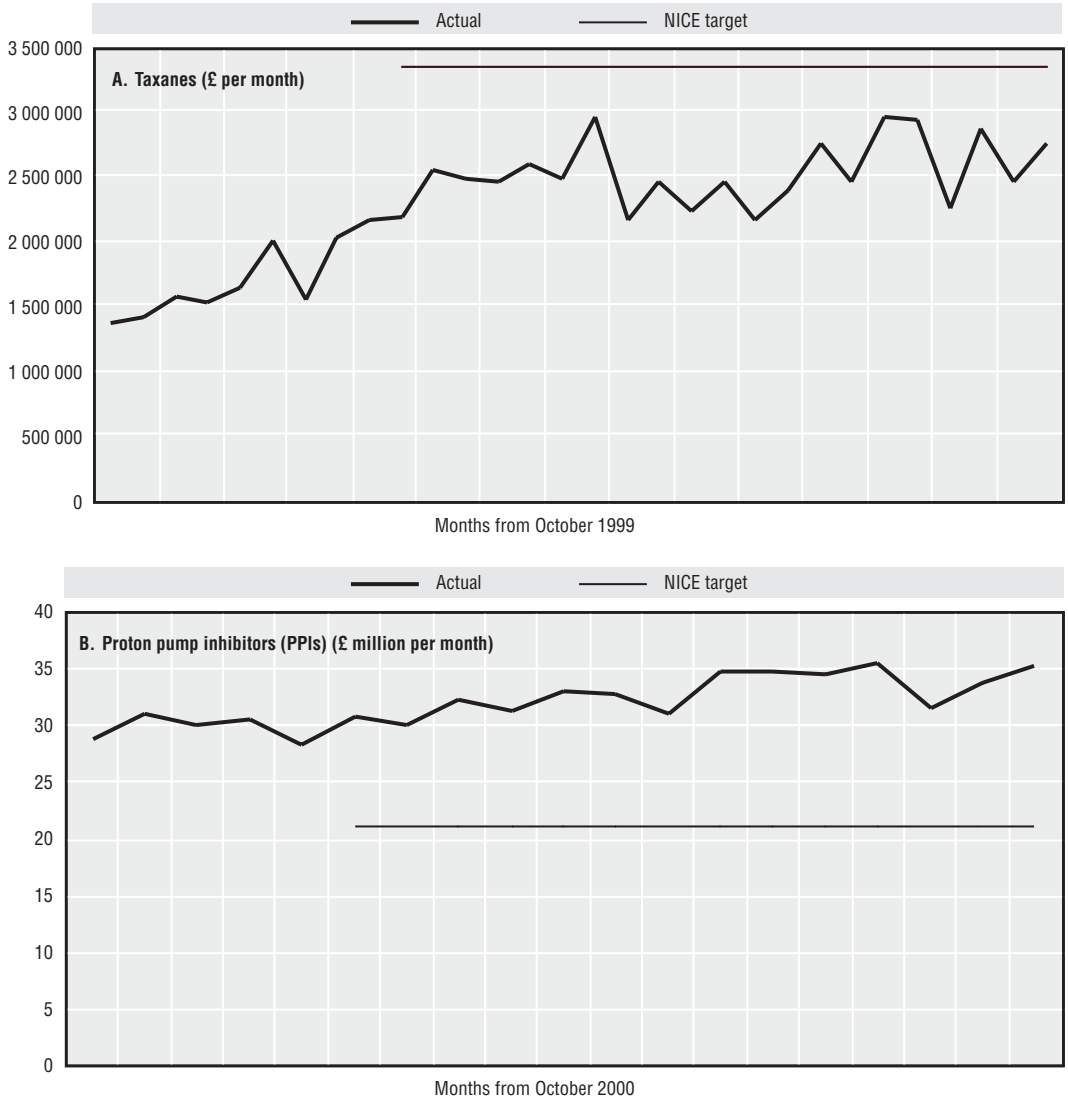
Evidence presented to the UK House of Commons Health Select Committee inquiry into NICE suggested that the utilisation of some drugs undergoing a NICE appraisal has not been in line with NICE's predictions. Figure 14.1 provides an illustration using the taxanes, which NICE recommended for breast and ovarian cancer, and the proton pump inhibitors (PPIs), for which NICE calculated that some savings could be made with appropriate restrictions on use. These groups of drugs were chosen on the basis that at least 12 months of sales data were available following NICE's decision. In each panel, the NICE target is based on the change in expenditure estimated by NICE in its guidance.

The necessity felt by policy makers to introduce a requirement for funding to be made available to support NICE's recommendations indicates that it is not a straightforward task to persuade local decision makers to adopt the recommendations of HTA exercises conducted centrally. A second challenge for NICE, and similar authorities in other countries, is to discourage the use of drugs and other technologies not deemed cost-effective. Like its counterparts elsewhere, NICE has issued guidance rejecting any use of some technologies in the NHS or recommending that they be restricted to a sub-group of eligible patients. An example of the latter is provided by Alzheimer's drugs which NICE recommended be restricted to patients with a "mini mental state examination" (MMSE) score above 12.

Restricting public reimbursement to those technologies which satisfy a cost-effectiveness criterion could limit the diffusion of new pharmaceuticals. It is clear from the albeit limited experience reported to date that reimbursement bodies are prepared to deny coverage where a product fails the cost-effectiveness test.

In Australia, a review of 355 submissions to the Pharmaceutical Benefits Scheme (George *et al.*, 2001) reported that 73 were re-submissions, indicating the failure of a previous submission. This implies an original rejection rate of at least 26%, the same figure as given by the review of just over 200 submissions between 1993 and 1996 presented in Hill and Henry (1997). Of 88 submissions reviewed by the Pharmacoeconomic Scientific Committee in British Columbia between January 1996 and April 1999 (Anis and Gagnon, 2000), 74% (65) were rejected. In New Zealand, 32 new chemical entities were denied listing in the year to end June 2001 compared with 20 which were accepted (PHARMAC, 2001).

Figure 14.1. **NICE target *versus* actual monthly expenditure to March 2002**



Source: NICE, IMS (Intercontinental Medical Statistics Inc.).

In the Canadian context, however, as Menon (2001) points out, drugs not on the formulary in one province may be available in another and despite restrictions on reimbursement and other policy measures to contain costs, drug expenditures in Canada continue to rise. Similarly, in Australia, where a cost-effectiveness criterion was first introduced, Birkett *et al.* (2001) argue that drug costs continue to increase at a potentially "unsustainable rate". A "fourth hurdle" (demonstration of cost-effectiveness in addition to efficacy, safety and quality), as implemented in a number of countries, may by itself be insufficient to control expenditure on drugs; rather, it may act as an additional bargaining tool between government and industry.

To gain greater control over expenditures, one approach noted by Birkett *et al.* (2001) in the Australian context is for price-volume agreements to be struck. This allows for the possibility that drugs will be prescribed outside those patients in whom it is considered acceptably cost-effective. However, when use is higher than estimated, a price reduction

Box 14.1. **"Bundling" agreements in New Zealand**

Parke-Davis: the listing of one cholesterol-lowering drug (atorvastatin) was accepted in exchange for a 60% price reduction in an angiotensin converting enzyme (ACE) inhibitor (quinapril). The establishment of a new reference price for all ACE inhibitors at the agreed price for quinapril encouraged a move away from the more expensive drugs in the same category, for which patients became liable for a "manufacturer's surchage", towards the fully subsidized products, including quinapril. In addition, an expenditure cap was introduced for atorvastatin.

Pharmacia and Upjohn: their latanoprost eyedrops were listed in exchange for a price reduction on their salbutaomol nebulas.

AstraZeneca: their candesartan was listed in exchange for price reductions on metoprolol succinate and felodipine.

Source: Braae *et al.* (1999); PHARMAC (2000).

comes into effect. The authors characterize this as a form of risk sharing, a term also applied by Braae *et al.* (1999) to the expenditure caps agreed between companies and the New Zealand government. These simply dictate that the company refund any amount above the agreed expenditure limit, or "cap". In addition, the Pharmaceutical Management Agency (PHARMAC) is willing to relax the restrictions on a drug's use in exchange for a price cut. The same review draws attention to a more innovative and sophisticated approach used in New Zealand, known as "bundling", under which package deals can be made involving two or more drugs in different therapeutic subgroups but produced by the same company. Examples of such agreements are presented in Box 14.1.

The overall package of measures used by PHARMAC appears to have had an impact on the growth in spending on drugs. Braae *et al.* (1999) note that, following growth of nearly 20% per year in government drug costs during the 1980s, the government introduced patient copayments, a limited reference pricing system and a more intense process of negotiation with drug companies over drug prices and subsidies. Nevertheless, the underlying growth rate of expenditure remained close to 10%. In comparison, between 1993, when PHARMAC was established, and 1998, growth of government expenditure on drugs averaged 5%, and expenditure fell by 5% in the year prior to 30 June 1999. In the year to June 2001, expenditure grew by about 2%, compared with the 9% PHARMAC estimates spending would have grown in its absence (PHARMAC, 2001). Given that the organisation has continued to add new drugs to the formulary and to broaden access to drugs already listed, it is likely that New Zealanders are receiving more medicines for the public dollars spent than would be the case in the absence of the system.

Innovative agreements such as risk sharing have been used elsewhere. For example, outcome-based risk sharing agreements have been struck between drug companies and health care providers in the US, where Merck agreed to refund the cost of its benign prostatic hyperplasia therapy – Proscar – if patients did not respond to treatment after six months. In a similar move, Ortho Biotech entered into an agreement whereby it would replace its product Procrit free-of-charge if it was used appropriately but patients failed to respond. In the UK, the government responded to NICE's decision not to recommend the use of beta interferon or glatiramer for patients with multiple sclerosis by entering into a risk-sharing arrangement which is summarised in Box 14.2.

Box 14.2. **UK Department of Health risk-sharing agreement in multiple sclerosis**

- The model commissioned by NICE will be used to predict the progress of a cohort of patients recruited into the scheme through Expanded Disability Status Scale (EDSS) states without treatment and with treatment on the assumption that a target reduction in rate of disease progression is achieved.
- Target outcomes and the price of the drug must combine to deliver an acceptable level of cost-effectiveness based on a 20-year time horizon.
- For the purposes of this agreement only, the threshold has been set at £36 000 per QALY gained rather than NICE's implicit £30 000 ceiling, taking into account two factors unquantified by NICE: the impact of treatment on the severity (as well as frequency) of relapses and possible savings in Personal Social Services costs.
- The outcomes for a cohort of patients will be monitored annually and compared with the previously agreed target outcomes for each product in the scheme. Reimbursement arrangements will be formally reviewed every two years.
- If actual benefit falls short of expected benefit (based on the target), the price for the period up to the next review will be reduced sufficiently to restore an acceptable level of cost-effectiveness. The formal monitoring of cost-effectiveness and process of price adjustments is expected to continue for up to ten years.

Source: Department of Health (2002).

We have seen that much of policy makers' interest in cost-effectiveness evidence has centred on drugs and that this appears to have given some impetus to governments and pharmaceutical companies entering into risk-sharing arrangements for specific products.

However, there are more general issues about the influence of economic evaluation on health care decision making. In particular, there are reasons for believing that there may be a number of barriers to its application.

3. Barriers to the use of economic evidence

Duthie *et al.* (1999) identified two categories of factors which might explain why decision makers tend to make limited use of economic evaluations:

- structural features of the health care system;
- The data provided are not perceived as being relevant to the decision-making process.

These factors were initially highlighted in the context of prescribing decisions by UK general practitioners but also emerged from interviews with a range of other NHS decision-makers. With respect to the structure of the health care system, one of the key issues mentioned by a number of respondents was the lack of scope for transferring money between budgets. Within health authorities, evidence on cost savings was only of interest if they were of direct benefit to the authority, that is, a reduction in physical resources was made possible. This factor, as well as the need expressed by decision makers for economic evaluations to be presented differently, has emerged from a number of other studies.

An earlier postal questionnaire administered by Drummond *et al.* (1997) to key decision-makers (prescribing advisers, hospital pharmacists and directors of public health) in the UK NHS found similar concerns being expressed. The statements "Cannot move

resources from secondary to primary care" and "Budgets are so tight we cannot free resources to adopt therapy" were mentioned as important barriers to the use of economic evaluation by more than half of respondents, as was the statement "Industry funded studies not credible". In a European survey (Hoffmann and Graf von der Schulenburg, 2000), the three most important barriers to the use of health economic study results were "Difficulty in moving resources from one sector (budget) to another", "Sponsorship of studies (*e.g.* by the industry) biases the results" and "Budgets are so tight that resources cannot be freed to adopt new therapies".

More detailed information on the informational needs of decision makers in the UK is provided by Hoffmann *et al.* (2002). They conducted a focus group exercise among decision makers from two health authorities based on the structured abstracts of economic studies in the NHS Economic Evaluation Database (NHS EED), an information source intended for use by UK decision makers. While economic considerations were generally felt to be essential to the pursuit of value for money in health care, focus group participants were concerned about the lack of generalizability of economic studies that had been performed, considering that many were conducted outside the UK (principally in the US). Other methodological problems identified were that economic evaluations tend to focus on a much narrower question than the one in which decision makers were interested, and the poor quality of the effectiveness evidence on which economic analyses are based.

In the US, the use of economic evaluations by hospital pharmacies has been investigated by Sloan *et al.* (1997) and in pharmacy benefit management (PBM) organisations by Grabowski and Mullins (1997). Responses to the former study suggested that nearly three quarters of hospital pharmacy departments used "some type of cost-effectiveness in decision making". Only 37% of respondents, in comparison, indicated that evidence on the cost-effectiveness of new drugs was often put before the pharmacy and therapeutics committee when considering whether or not to add a drug to the formulary. Some of the reasons given for not using cost-effectiveness analysis more often were: the inability to generalize the results of studies to the hospital setting, the lack of timely studies and the perceived bias of studies due to industry sponsorship. PBM decision-makers were found to be concerned with: a lack of studies comparing closely substitutable products in the same class (placebo or an older therapy was a more frequently used comparator), the absence of studies on the populations relevant to the PBM and the objectivity of studies sponsored by pharmaceutical companies (Grabowski and Mullins, 1997).

In a variety of health care systems, therefore, decision-makers feel that budgetary arrangements do not encourage the use of economic evidence or that the economic evidence available has a number of deficiencies for decision-making purposes. However, the literature indicates that there are a variety of factors relating either to the overall characteristics of the health care system, or individual parts of it, which have an influence on the diffusion of health care technologies. These could also help to explain the apparently limited impact of health technology assessment, and why this situation could persist even if concerns about the budgetary environment or the nature of the available evidence were addressed.

3.1. *Organizational behaviour and knowledge transfer*

At the level of the individual organisation, some commentators suggest that informal contact and shared experience between health care professionals may be more influential than formal HTA exercises. Organizational behaviour-based theories emphasise the role of

different types of actors in promoting the use of particular types of technology. Rogers (1995) has argued that, as with other kinds of technological development, health care technologies are initially adopted by a few innovators followed by a group of early adopters who are opinion leaders in their field. Subsequently, communication between these well-respected opinion leaders and their peers leads to take-off in the rate of adoption. Knowledge gained through these channels can be a more important influence on the adoption decision than consideration of the scientific evidence. Some support for the S-shaped diffusion curves characteristic of Rogers's proposed mechanism of diffusion has been found by Sillup (1992).

The potential impact of direct experience of a technology on the utilisation decision is illustrated by Ketley and Woods (1993). Noting that thrombolytic therapy had been shown, in several large trials published between 1986 and 1988, to reduce mortality after acute myocardial infarction (AMI), they examined the use of thrombolytics in the 12 districts of one English region over the period 1987-92. The authors found a significant positive association between districts' contribution to multicentre trials of thrombolysis during the period 1989-91 and their use of thrombolytics in 1991-92. Mamdani and Tu (2001) suggest that simply the publication of trial results may have an influence on practice. Their conclusion was made on the basis that the publication of each major randomized trial of a statin was associated with a positive shift in the Canadian market share of the featured drug.

In contrast, Majumdar *et al.* (2002) failed to find an effect of trial participation in the Survival and Ventricular Enlargement (SAVE) trial which showed a beneficial effect of angiotensin converting enzyme (ACE) inhibitors after myocardial infarction. No significant difference was detected in the proportion of MI patients receiving an ACE inhibitor at discharge from sites taking part in SAVE *versus* non-participant sites. The authors concluded that "we should not expect passive forms of information transfer (…) to improve the quality of care rapidly or reliably".

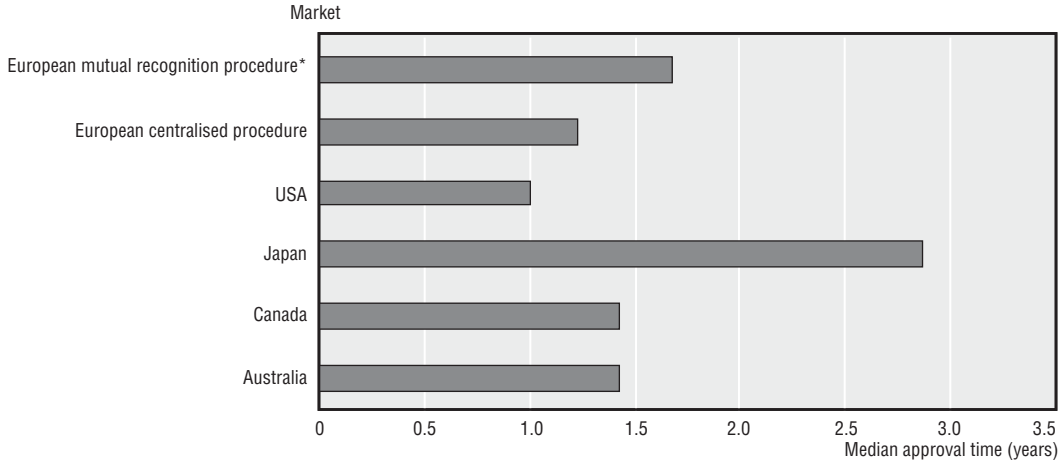
Although we should be cautious of the results of individual studies, especially when allowance may not have been made for some potentially important variables, a systematic review by Bero *et al.* (1998) provides support for Majumdar *et al.* (2002) in concluding that passive dissemination is ineffective. No doubt, the way in which information is communicated and interpreted will be important to decision makers' behaviour, but it should also be borne in mind that they will be influenced by the overall characteristics of the health care system in which they operate. Broadly speaking, their behaviour will depend on planning and market mechanisms.

3.2. Planning mechanisms

One aspect of health care planning is the regulatory regime controlling the introduction of new technologies, particularly drugs and devices. As Figure 14.2 shows, different systems can result in more rapid availability of new drugs in some parts of the world than others.

Devices are another technology where regulation has been brought to bear. In addition to undergoing a process of testing before they are approved for use, some devices have been subject to planning regulations after they have been licensed. In the US, for example, certificate of need (CON) legislation has allowed individual state planning agencies to refuse hospitals reimbursement for large items of capital expenditure. The effect of these regulations appears to have been mixed, depending on the extent to which states have enforced them and whether or not loopholes have been exploited (*e.g.* coverage of CON legislation being restricted to hospital-based rather than outpatient provision).

Figure 14.2. **Median product approval times in major markets, 1999**



Approval times for the centralised procedure are taken from the EMEA application date to the Commission's decision date; for MR*, from the date of application to RMS to the end of the 90-day discussion phase
Source: CMR International (2001).

Since most health care systems are governed to a greater or lesser extent by public financing, the reimbursement system can be viewed as another feature of planning. Some rules governing public reimbursement, such as the requirements discussed earlier for cost-effectiveness to be demonstrated, can almost be seen as a regulatory requirement but, more generally than this, the way in which health care is funded may have important incentive effects. Payment mechanisms can be classified into two broad types, fee-for-service and prospective payment systems. The open-ended nature of fee-for-service reimbursement gives less control over aggregate health care costs than a system such as the NHS based on global budgets, and Battista *et al.* (1999) have argued that "fee-for-service remuneration … often creates incentives for practitioners to adopt and use technology". The OECD's Ageing-Related Diseases (ARD) study found that those countries with relatively restrictive methods of reimbursement (global budgets for hospitals and salaried physicians) tended to have relatively low rates of coronary revascularisation procedures.

3.3. Market mechanisms

The term "market mechanisms" is intended to capture the degree of competition in the health care system. In this regard, Hirth *et al.* (2000) found less competitive markets to be associated with lower rates of use of new technologies, an observation supported by Bryce and Cline (1998). The latter authors argued that "hospitals have competed, in part, by acquiring technologies to attract and retain physicians and their patients".

Richardson (1988) investigated the impact of various characteristics of hospital organisation on the diffusion of 11 separate technologies. These were: CT scanning, real time ultrasound, echocardiography, panendoscopy, colonoscopy, ERCP, urodynamics, percutaneous stone removal, coronary artery bypass graft, balloon angioplasty and intra-ocular lens implantation. At least one of the coefficients on distance to a substitute technology was negative for the seven technologies where data were available, indicating that a hospital is more likely to possess a technology when a competitive hospital with the technology is in close proximity.

In the environment of the UK National Health Service (NHS), there is some evidence on the effect of the internal market reforms of the early 1990s whereby purchasing and providing health care were separated – the "purchaser-provider split". In principle, this meant that providers would compete for business from purchasers. The introduction of contracts between purchasers and providers, according to Rosen and Mays (1998b), presented the opportunity to use financial incentives to ensure that diffusion was research-linked, but they argue that most contracts have been "too crude to influence technological innovation".

The study undertaken by same authors (Rosen and Mays, 1998a) using the three case studies mentioned earlier (vascular stents in the treatment of blocked blood vessels, the triple test for the antenatal detection of Down's syndrome and ophthalmological applications of the excimer laser), is also worth mentioning. Interviews were conducted with those who had been involved with the introduction of these technologies in a sample of hospitals, including adopters as well as non-adopters, and teaching as well as non-teaching hospitals. These interviews indicated that there was some purchaser involvement in the use of technology on the two stenting sites included in the study, but that the introduction of the triple test in one district was the only example of a purchaser-led introduction of new technology. Purchasers' role in decision making was limited if they were unable to provide additional funding, a situation which the authors argued was similar to that prevailing before the 1991 reforms.

4. Conclusions

HTA activities are now well established in OECD countries, albeit they are frequently the responsibility of relatively small organisations with few resources. It is currently unclear what input many HTA activities have into the policy making process and it is a frequent complaint of those in the HTA and evidence-based medicine communities that HTA has little effect on the practice of health care.

The evidence is mixed. Some evidence supports the contention of a weak effect for HTA, but some experience has been reported to indicate the impact of certain specific HTA exercises. Much of the evidence is, however, subject to confounding factors.

Where a clearer impact can be seen is with regard to economic evaluation which is now being used in a number of countries to determine whether or not a new drug is reimbursed. This has been motivated at least partly by a desire by payers to restrict expenditure on drugs, although the introduction of this "fourth hurdle" is no guarantee that drug costs will be brought under control. If drugs are found to be cost-effective, then expenditure will increase, as appears to be the case with NICE in the UK. New Zealand appears to have been successful in reducing drug costs but the cost-effectiveness criterion is only one of a number of tools used to control medicines expenditure.

Experience in several countries suggest that the increasing use of economic evaluation in policy making towards drugs worldwide may be a catalyst for further use of risk sharing between the pharmaceutical industry and health care purchasers.

With regard to the use of economic evaluation more generally, a number of obstacles have been identified. These have been elucidated largely through surveys of decision-makers, suggesting that information may be in an unsuitable format or not easily applicable to the circumstances faced by health care decision-makers. It is worth bearing in mind, when assessing the impact of economic data, and HTA more generally defined,

that it is one of a number of influences on the decision to utilise or not utilise a technology. Theories of organisational behaviour emphasise less the formal appraisal of evidence than informal communication of experience and the influence of opinion leaders. Furthermore, some aspects of health care institutions may not be conducive to the incorporation of HTA messages into clinical practice. Separation of responsibility and budgets between primary and secondary care or between health and social services may result in sub-optimal decisions from a societal perspective given that plans are made with a view to the implications of treatment for a particular budget rather than for overall resource use. An important consideration for HTA bodies therefore is the best means of communication to influence a set of clinical decisions which may be constrained by institutional and perhaps regulatory factors or, in some systems, swayed by the incentives created by competitive pressures. More research could usefully be done to identify the relative importance of different variables in the uptake and utilisation of health care technologies and to examine the impact of HTA bodies' recommendations within their own health service context. Understanding what influences its use may also provide information as to how clinicians and managers should be involved in HTA processes and indeed at what level in the health care system HTA should be undertaken.

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PART V

Health Outcomes Over the Continuum of Care

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PART V

Chapter 15

Comparable Measures of Population Health with a Focus on OECD Countries

by

Ritu Sadana, Ajay Tandon, Colin D. Mathers,* Joshua A. Salomon, T. Bediran Üstün, Alan D. Lopez and Christopher J.L. Murray**

Abstract. *The objective of this paper is to present new approaches to improve the comparability of population health measures in order to compare average levels of population health within OECD countries. The analysis is based on healthy life expectancies for OECD countries for the year 2000 and an analysis of 34 health surveys in 28 OECD countries using novel methods to improve the comparability of self-reported data. The new methods used in the WHO Multi-country Household Survey Study have increased the comparability of self-reported data obtained from interview based surveys, across OECD countries. Building on this experience, WHO is developing improved health status measurement techniques for a World Health Survey to be carried out in 2002-2003.*

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Introduction

Along with member States, research institutions, and technical experts, the World Health Organisation has expended considerable efforts since its inception in the collection and routine reporting of information on population health primarily covering mortality and its risk factors. Over the past decade, the locus of these efforts has extended to the improvement and standardization of methods to assess non-fatal health (covering epidemiological estimates of morbidity and disability, and assessment of health status from population based surveys), reflecting the conclusion that mortality alone does not provide a complete picture of health (Murray and Lopez, 1996; Field and Gold, 1998). For example, average life expectancy at birth is becoming increasingly uninformative in many populations where, because of the non-linear relationship between age-specific mortality and life expectancy at birth, significant declines in death rates at older ages have produced only relatively modest increases in life expectancy at birth. At the same time there is considerable uncertainty in many populations as to whether – and to what extent – gains in life expectancy have been accompanied by improvements in health status (Manton, 1982; Olshansky *et al*., 1991). The use of summary measures of population health – measures that combine information on mortality and non-fatal health outcomes to represent health of a particular population as a single number – enable comparative judgements on the average levels of population health between populations and over time (Murray *et al*., 2000).

Since 2000, the World Health Organisation (WHO) has been reporting annually in its *World Health Report* on average levels of population health for its member States using healthy life expectancy (HALE), one type of summary measure that combines information on mortality and morbidity (Mathers *et al*., 2001; WHO 2000, 2001a). To better reflect the inclusion of all states of health in the calculation of healthy life expectancy, the name of the indicator used to measure healthy life expectancy was changed from disability-adjusted life expectancy (DALE) to health-adjusted life expectancy (HALE) in the *World Health Report 2001*. Healthy life expectancy has previously been calculated for Canada and Australia using population survey data on disability (Wilkins and Adams, 1983; Wolfson, 1996; Mathers, 1999).

The *World Health Report 2000* also carried out an assessment of the performance of health systems of member States in achieving three main (intrinsic) goals for the health system: 1) health; 2) responsiveness; and 3) fairness in financing, and used healthy life expectancy as the measure of goal attainment for level of health. This paper will focus on the group of 30 mainly developed countries sharing a commitment to democratic government and the market economy, *i.e.,* those belonging to the OECD (OECD, 1999, 2001). In this paper, we review approaches to improve the comparability of survey data on health status and examine more closely the analysis of healthy life expectancy for the year 2000 for OECD countries.

1. Cross-population comparability of health

Calculation of healthy life expectancy requires three inputs: life expectancy at each age, estimates of the prevalence of various states of health at each age, and valuations of time spent in these health states compared to full health. Concerning prevalence of various health states, two basic approaches exist to obtain estimates. The first is "bottom up" through burden of disease analysis of a defined population which provides consistent estimates of incidence, prevalence, and disability by cause. However, in practice there is limited information on disability and difficulties in assessing and analyzing co-morbidities. The second is "top down", *i.e.,* estimates based on prevalence of health states from population representative surveys.

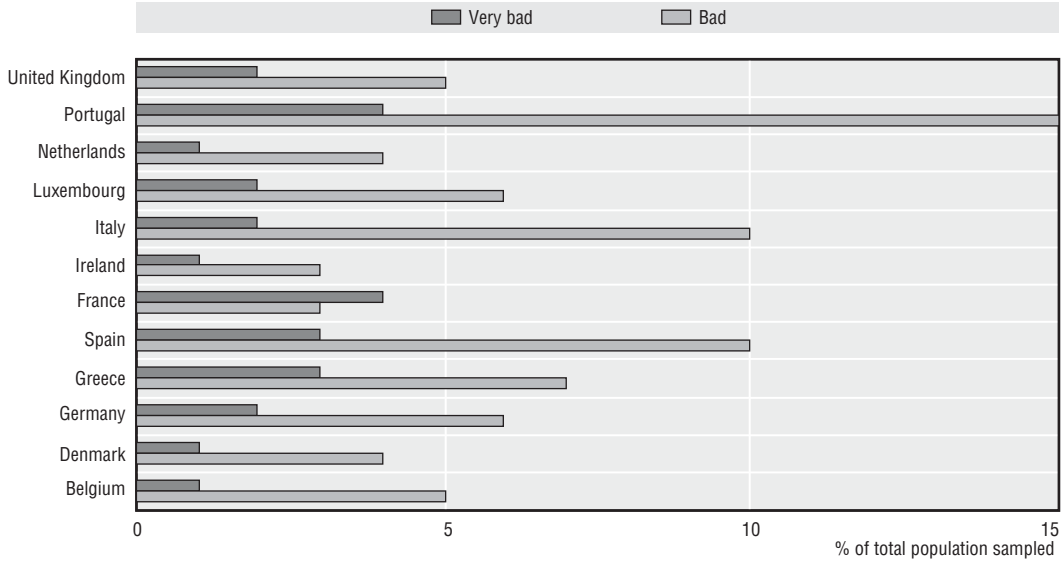
Self-reported responses on health status in interviews are widely used to assess the health status of populations or clinical sub-groups. These data typically take the form of ordered categorical (ordinal) responses, such as excellent/very good/good/poor/bad or none/mild/ moderate/severe/extreme. One key analytical issue is that these self-reported ordinal responses are not necessarily comparable across or even within populations primarily because of response category cut-point shifts. This phenomenon differs from other numerous factors – such as differences in language or measurement error – that may also contribute to the difference between what is the true, underlying level of health and what is ultimately reported within an interview. If the meaning of response categories differ systematically across populations, or even across socio-demographic groups within a population, unrelated to health status, then the observed ordinal responses are not cross-population comparable since they will not imply the same underlying level of health (Tandon *et al*., 2001).

For example, a recent article presenting self-reported data on the single question "*how is your health in general?*" and a five point Likert response scale "*very good, good, fair, poor, very poor*" collected in 12 countries of the European Union, based on the same survey and methods in all countries, illustrates the problem of response category cut-point shifts. Figure 15.1 shows the proportion of the population reporting *bad* and *very bad* general health, age-standardized and aggregated responses for males and females. It is unlikely that solely differences in the underlying true level of health status, "language," or measurement error, account for such large variations within the European Union, *e.g.,* that the fraction of respondents reporting "very poor" or "poor" health varies from a high of 19% of the Portuguese to as little as 5% of the Irish population (Eurostat, 1997). Such divergent levels of health are not expected, given other major health indicators, and can not be explained solely by differences in language.

A recent analysis of existing data from 64 household interview surveys covering health status from 46 countries suggested response category cut-point shifts across populations (Sadana *et al*., 2002) and that the information content and comparability of existing surveys were limited. Evidence leading to this conclusion included the interpretation of data analyzed from surveys in conjunction with other, non-health data from the same countries. A scatter plot of the per capita GDP (purchasing power parity) and the average level of health for the over 65 population (males and females combined) for each of the 46 countries included, showed that *higher* levels of per capita GDP are correlated with *lower* average levels of health (Figure 15.2). This negative correlation, even if weak, is consistent with earlier findings in that countries, regions, or socio-demographic groups that are wealthier and spend more resources on health, also report worse levels of health (Kroeger *et al*., 1988; Waidmann *et al*., 1995), where

Figure 15.1. **Proportion of population ≥ 16 years of age, reporting bad and very bad general health**

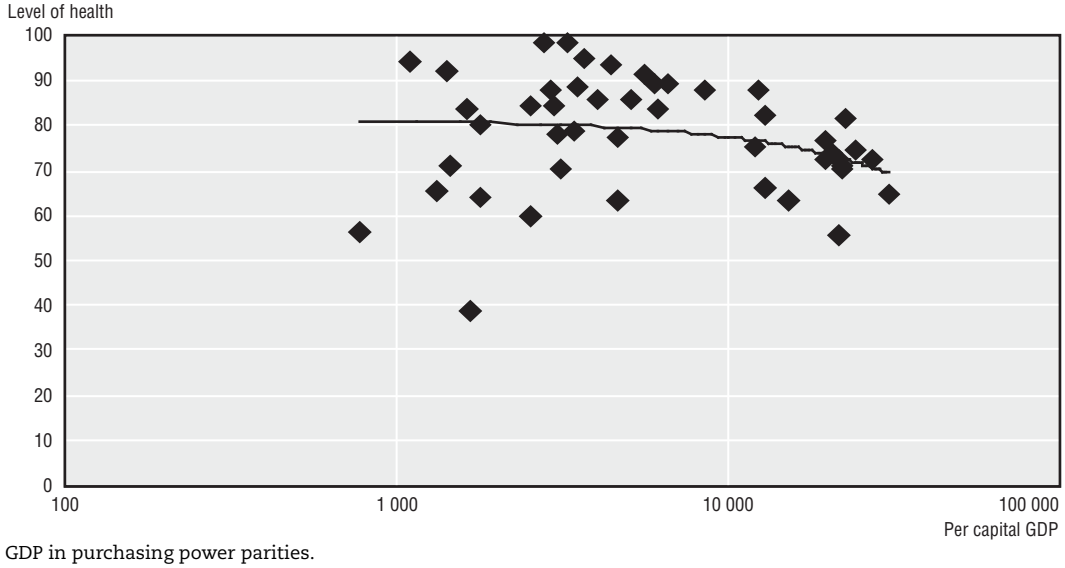
12 European countries



Source: ECHP 1994, EUROSTAT (1997).

Figure 15.2. **Per capita GDP *vs.* self-reported level of health**

65 years and older age group, 46 countries

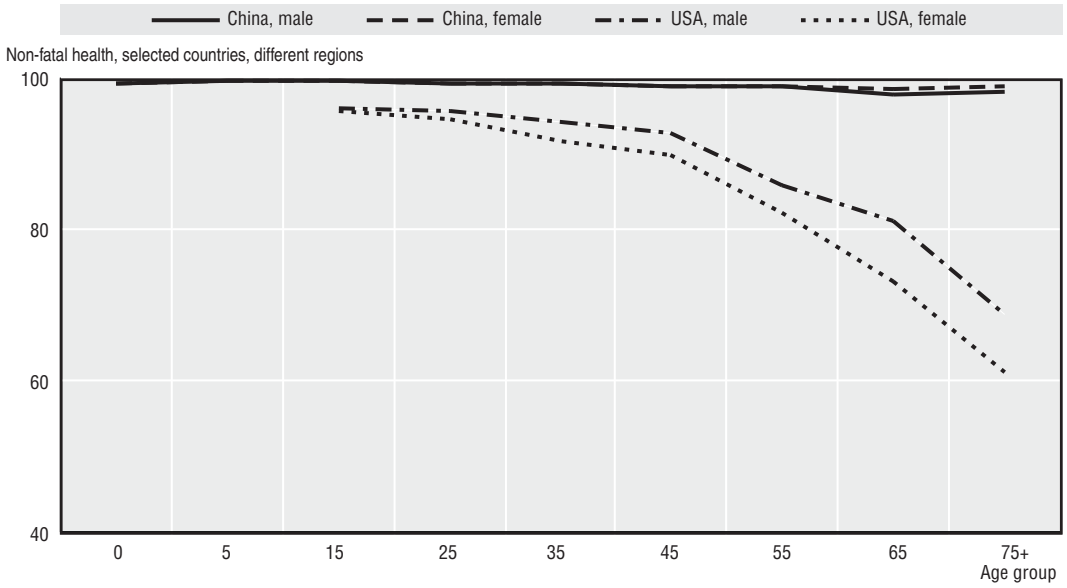


GDP in purchasing power parities.
Source: Sadana *et al.* (2002).

as the reverse is expected. Furthermore, many surveys analyzed did not meet even the weakest form of criterion validity, *i.e.*, that: *a)* some decrements from "full health" are noted, and that *b)* self-reported health decreases by age, particularly in the oldest age groups. Figure 15.3 shows data by age groups and sex for China (from the Longitudinal Integrated Household Survey) and the United States (from NHANES III), (with 100 equivalent to full health and 0 equivalent to the worst health state). These differences severely limit the comparability of self-reported responses on levels of health.

Figure 15.3. **Comparison of age groups, selected countries from different regions**

United States and China, males and females



Source: Sadana *et al.* (2002).

Given these problems, WHO has recently undertaken a multi-country survey study in collaboration with member States using a standardised health status survey instrument together with new statistical methods for adjusting biases in self-reported health (Sadana *et al.*, 2001; Ustun *et al.*, 2001). These new data, together with comprehensive analyses of epidemiological data for all regions of the world, and new life tables for all WHO member States, have enabled us to calculate healthy life expectancy for 191 countries for the year 2000 in a way that is comparable across countries. Therefore, WHO has attempted to improve both "top down" and "bottom up" approaches, and combine these in the estimation of health life expectancy (Mathers *et al.*, 2001). This paper will focus on new methods to improve the top down approach to estimate the prevalence of various states of health in a comparable manner across populations.

2. Methods

The WHO constitution notes that health is a multi-dimensional concept. A formal framework for cataloguing the multiple domains of health has been developed by WHO in the International Classification of Functioning, Disability and Health (WHO, 2001b). There are potentially three sets of domains that can be specified in order to describe health and contribute to its operational measurement: *i)* core domains of health that almost all people agree upon; *ii)* additional domains of health that some people consider as core domains; and *iii)* other domains that indirectly describe health status and serve as good proximate measures of the experience of health, such as performance in usual activities. Based on reviews, technical discussions and linkage with the International Classification of Functioning, Disability and Health, six core domains were selected that almost all people agree upon for inclusion across all survey modes with the WHO Multi-Country Survey on Health and Responsiveness 2000-2001. These include affect, cognition, mobility, pain, self-care and usual activities. The first four are direct measures of health, while the latter two

provide proximate measures of health. Together, these domains provide a generic approach to assess self-reported health status.

Data from 63 surveys in 55 countries from the WHO Multi-Country Survey study (Ustun *et al.*, 2001) were used to estimate the true prevalence of different states of health by age and sex as an input to the HALE estimates reported here. The sampled populations were adults aged 18 years and over. Just over one half (34) of the surveys were household interview surveys, two were telephone surveys, and the remainder postal surveys. Thirty five of the surveys were carried out in 31 European countries, 22 surveys in 19 developing countries, and the remainder in Australia, Canada, New Zealand and United States. Thirty-four surveys were carried out in 28 of the 30 OECD countries (in all OECD countries except Japan and Norway). Surveys in the European countries were carried out as part of the Eurobarometer survey program and a postal survey was carried out in Australia under the auspices of the Commonwealth Department of Health and Human Services. Just under one half of the surveys in OECD countries were household interview surveys, two were telephone surveys, and the remainder postal surveys. Postal surveys as well as household surveys were carried out in five OECD countries (Czechoslovakia, Finland, France, Netherlands, Turkey) and postal plus telephone surveys in one OECD country (Canada) in order to allow different survey modes to be compared.

Strategies to enhance the cross population comparability of responses were included in order to improve the validity of the data collected (*i.e.,* same level of health provides the same measurement result irrespective of social norms, age, sex, education or expectations for health). Besides ensuring the similar content of questions by using clearly worded questions and translation protocols, novel techniques to calibrate responses across different sub-populations and countries were tested. These included short descriptions ("vignettes") that mark fixed levels of ability and some measured tests for selected health domains. Table 15.1 lists the vignettes developed for the domain of "mobility"; it is important to note that the vignettes span a range of levels. Each respondent was asked to rate the vignettes for a health domain using the same question and response categories as for their self-report on their own level of health. We consider vignettes as fixing the level of ability so that variations in categorical responses are attributable to variations in response category cut-points. Then, the introduction of exogenous information in the form of ratings of vignettes allows us to identify the effects of different covariates (*e.g.,* age, sex, education, country) on both the level of the underlying latent variable as well as on the cut-points for each health domain separately (Sadana *et al.*, 2001; Murray *et al.*, 2002).

Table 15.1. **Mobility vignettes within the WHO multi-country survey study**

Paul: active athlete who runs long distance races of 20 kilometres.
Mary: has no problems with moving around or using her hands, arms and legs. She jogs 4 km twice a week.
Rob.: is able to walk distances of up to 200 metres without any problems but feels breathless after walking 1 km.
Margaret: feels chest pain and gets breathless after walking distances of up to 200 metres, but is able to do so without assistance. Bending and lifting objects such as groceries produces pain.
Louis: is able to move his arms and legs, but requires assistance in standing up from a chair or walking around the house. Any bending is painful and lifting is impossible.
David: paralysed from the neck down; is confined to bed and must be fed and bathed by somebody else.
Overall in the last 30 days, how much difficulty did (each person named) have with moving around? None, mild, moderate, severe, or extreme?

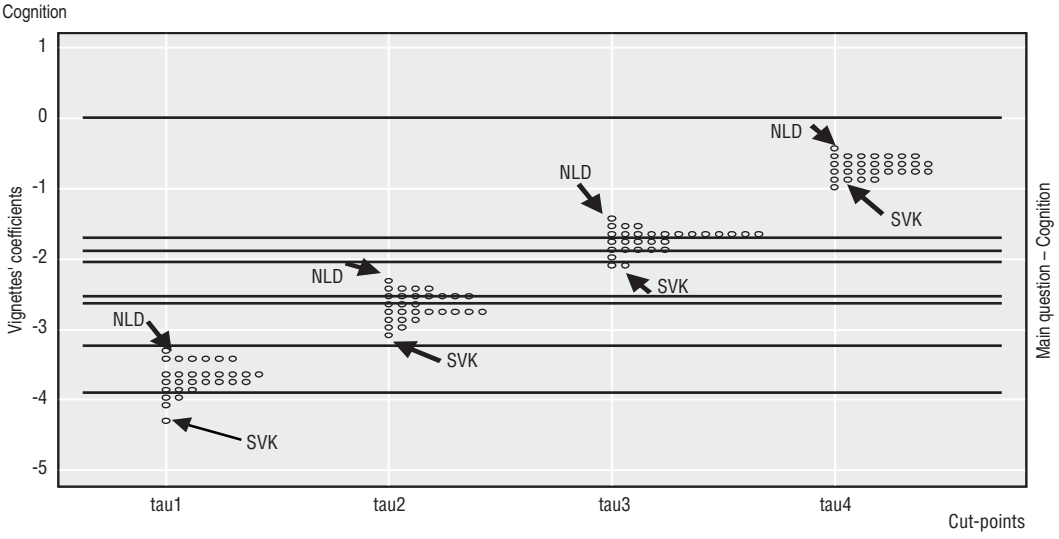
Source: Üstün *et al.* (2001).

The cutpoints for individuals, and their level on the underlying latent variable for each domain, were estimated using the hierarchical ordered probit (HOPIT) model, a variant of the standard ordered probit model. The key innovations in the HOPIT model are that: *a)* cut-points are allowed to be functions of explanatory variables; *b)* vignettes are used to estimate cut-points across different populations; and *c)* interval regression is applied to self-reported questions in order to estimate cross-population comparable levels of ability on any given domain (Tandon *et al.*, 2001). The HOPIT model is estimated using maximum likelihood techniques. In brief, there are several components to the likelihood function. The first component utilizes information from responses to vignettes. In this component of the likelihood function, the model assumes there is an underlying latent variable for the set of vignettes, addressing a particular domain of health, Y^*. Each vignette $v = 1,\ldots, V$ represents a fixed level on this latent variable, *i.e.,* mobility, affect, pain, etc. This latent variable is not observed. What are observed are categorical responses for each of the vignettes Y^v. The mapping from the latent variable to the observed categorical responses is defined by a series of cut-points which are allowed to differ by socio-demographic characteristics of the individual (*e.g.,* age, sex, years of education, and survey population). These categorical responses are the left-hand side variable in the first component of the HOPIT model (each vignette response being a separate observation). On the right-hand side are dummies for each of $V - 1$ vignettes, with the first vignette (describing the best ability level) being set to be the absorbed category and therefore equivalent to 0. In essence, the model fixes the level of ability on the underlying latent variable (*i.e.,* each domain of health) scale such that any differences in response categories are attributed to cut-point shifts. The coefficients on these for each of $V - 1$ vignettes dummy variables are the fixed levels on the underlying latent variable.

Figure 15.4 shows the distribution of mean cut-points for "cognition" for the 34 surveys conducted in 28 OECD countries. Tau 1 to Tau 4 denote the four cut points

Figure 15.4. **Distribution of mean cut-points for "cognition"**

34 surveys in 28 OECD countries

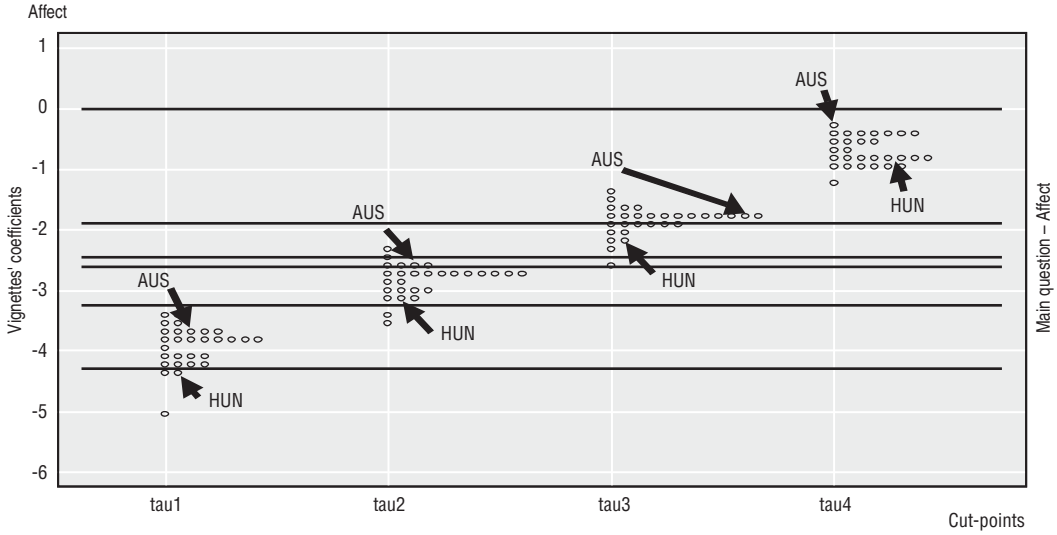


Note: Mean cut-points for Netherlands (NLD) and Slovakia (SVK) are identified to illustrate magnitude of cut-point shifts across OECD countries. The horizontal lines denote the values of the latent variable for each of the eight cognition vignettes.

Source: Sadana *et al.* (2001).

Figure 15.5. **Distribution of mean cut-points for "affect"**

34 surveys in 28 OECD countries



Note: Mean cut-points for Australia (AUS) and Hungary (HUN) are identified to illustrate magnitude of cut-point shifts across OECD countries. The horizontal lines denote the values of the latent variable for the six affect vignettes.
Source: Sadana *et al.* (2001).

between the five response categories. The small circles show the distribution of the mean cut-point values for each survey and country on the latent variable scale for cognition. Mean cut-points for Netherlands (NLD) and Slovakia (SVK) are identified to illustrate the magnitude and in many cases, systematic cut-point shifts across OECD countries. The horizontal lines denote the values of the latent variable for the cognition vignettes based on the HOPIT model results. Thus it can be seen that the second worst vignette lies close to the average cut-point between the severe and extreme category in the Netherlands, but the same vignette falls close to the cut-point between moderate and severe in Slovakia. Figure 15.5 shows the similar systematic differences in the rating of vignettes for "affect" between Australia (AUS) and Hungary (HUN).

The second component of the likelihood function utilizes information from self-reported rating of health on each domain. Cut-points are estimated from the vignettes section of the likelihood to calibrate the self-report responses so as to make these cross-population comparable. In this sense, there is parametric dependence between these two different components of the likelihood function. The mean of the latent variable now refers to the individual's latent variable and this is assumed to be a function of socio-demographic characteristics of the individual. Using the predicted level of health for each domain Y^* from the HOPIT model, we estimate the level of health for each individual, for each domain separately. Across all domains, the estimated level of health Y^* decreases for each age group, increases with years of education, and on average is higher for males than for females. The results for each of the six domains are then combined using a health state valuation function (Salomon and Murray, 2002).

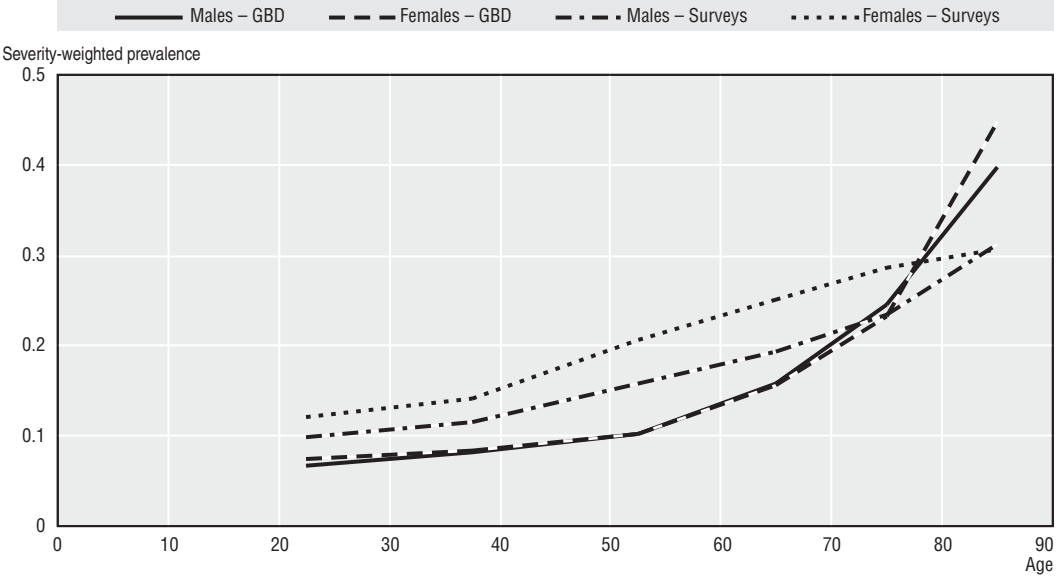
The health state valuations used in HALE calculations represent average population assessments of the overall health levels associated with different states. They range from 0 representing a state of good or ideal health to 1 representing states equivalent to being dead. In the WHO Multi-Country Survey study, all individuals were asked provide descriptions for a series of hypothetical health states described in terms of the six core

domains of health, followed by valuations of these states using a simple thermometer-type (visual analog) scale (VAS). The valuations were converted to interval-scaled valuations for use in the calculation of HALE using results from more detailed surveys among sub-samples of respondents using other approaches to value health states (*e.g.,* standard gamble, time trade-off and person trade-off) (Krabbe *et al*., 1996; Salomon and Murray, 2002).

After application of the valuation function, we are then able to compare and combine average severity-weighted prevalence of non-fatal health estimated from surveys and from the burden of disease work discussed elsewhere (Mathers *et al*., 2003). Figure 15.6 compares the average Global Burden of Disease-2000 based prevalences ("bottom up") and the survey prevalences ("top down") for all OECD countries combined. On average, females and to a lesser extent males, have worse non-fatal health based on the surveys than from GBD-2000 based estimates. The two approaches were combined giving more weight to the GBD-2000 based prevalences. Countries that did not have surveys, such as Norway and Japan, were also adjusted based on the relationship found between these two approaches among countries that did have a survey. These combined and adjusted prevalences of non-fatal health are referred to as the posterior severity-weighted prevalences.

Figure 15.6. **Comparison of average severity-weighted prevalence for surveys (arithmetic mean of mean values for all surveys in OECD countries) with average severity-weighted prevalences for OECD countries derived from GBD 2000 study**

By age group and sex



Source: Mathers *et al*. (2003).

These new data on prevalences of non-fatal health were combined with new life tables and detailed cause of death distributions, taking into account uncertainty (Salomon *et al*., 2001). HALE was calculated using Sullivan's method (Sullivan, 1971) based on abridged country life tables and the posterior severity-weighted prevalences with 95% uncertainty levels, described elsewhere (Mathers *et al*., 2003).

3. Results

Japan leads the OECD group of countries with an estimated average healthy life expectancy of 73.8 years at birth in 2000 (Table 15.2). Female healthy life expectancy in Japan was 76.3 years compared with 71.2 years for males, a difference of 5.1 years. This male-female gap in HALE is narrower than that for total life expectancy at birth (7.2 years). After Japan, in second and third places, are Switzerland (72.1 years) and Australia (71.5 years), followed by a number of other high income European countries. Canada is in 13th place (70.0 years) with an uncertainty range of 6-19 in ranking and the United States in 22th place (67.2 years with a ranking range of 21-24). Note that there is a considerable range of uncertainty in the ranks for many OECD countries, with typical 95% uncertainty ranges for HALE of around three years for developed countries. Healthy life expectancy is lower in the Eastern European OECD countries than in those of Western Europe (Table 15.2) reflecting both lower life expectancies and worse health status. Adult mortality, particularly for men, has increased during the 1990s in many of the former socialist economies of Eastern Europe. In addition, survey data for these countries gave high severity-weighted prevalences of health states less than full health, higher than

Table 15.2. **Healthy life expectancy and total life expectancy at birth, by sex, OECD member countries, 2000**

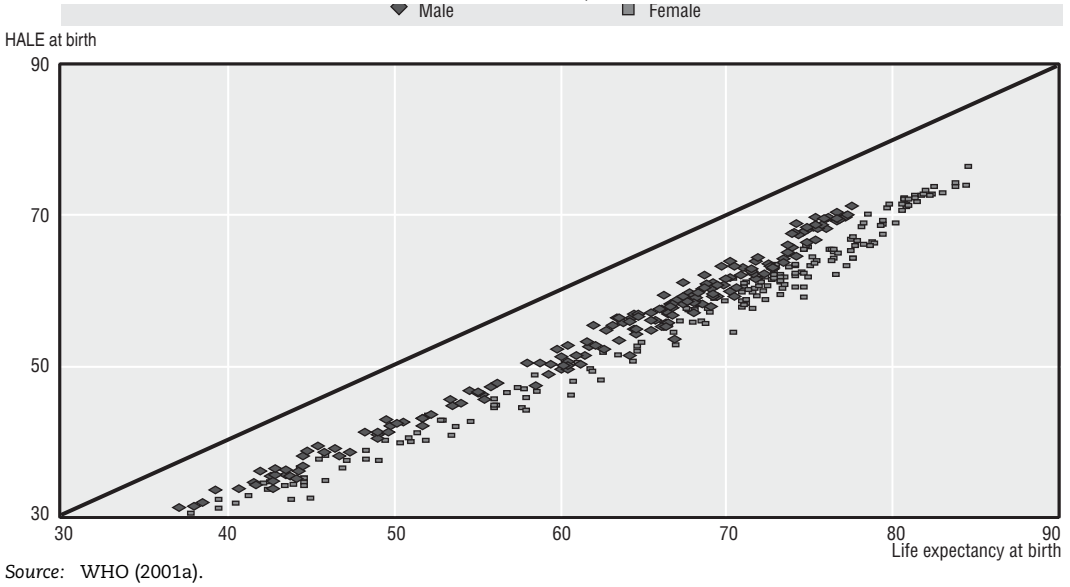
Rank	95% range	OECD country	Healthy life expectancy (HALE) at birth			Life expectancy at birth	
			Persons	Males	Females	Males	Females
1	1-2	Japan	73.8	71.2 (69.9, 72.5)	76.3 (74.6, 77.8)	77.5 (77.4, 77.7)	84.7 (84.4, 85.1)
2	2-8	Switzerland	72.1	70.4 (68.7, 72.1)	73.7 (71.3, 75.7)	76.7 (76.3, 77.0)	82.5 (82.1, 82.9)
3	2-15	Australia	71.5	69.6 (67.8, 71.5)	73.3 (69.8, 75.4)	76.6 (76.3, 77.1)	82.1 (81.7, 82.5)
4	2-13	Sweden	71.4	70.1 (68.7, 71.6)	72.7 (70.6, 74.6)	77.3 (77.0, 77.6)	82.0 (81.7, 82.4)
5	2-14	Iceland	71.2	69.8 (68.1, 71.5)	72.6 (70.3, 74.9)	77.1 (75.7, 78.6)	81.8 (80.5, 83.9)
6	2-13	Italy	71.2	69.5 (68.4, 70.8)	72.8 (70.5, 74.5)	76.0 (75.6, 76.3)	82.4 (82.0, 82.7)
7	2-14	Greece	71.0	69.7 (68.5, 70.8)	72.3 (69.9, 74.0)	75.4 (75.0, 75.7)	80.8 (80.1, 81.5)
8	3-18	New Zealand	70.8	69.5 (68.0, 71.0)	72.1 (69.8, 74.0)	75.9 (75.2, 76.7)	80.9 (79.8, 81.9)
9	4-14	France	70.7	68.5 (67.4, 69.5)	72.9 (71.4, 74.5)	75.2 (74.8, 75.5)	83.1 (82.5, 83.8)
10	3-17	Spain	70.6	68.7 (67.3, 70.3)	72.5 (70.3, 74.2)	75.4 (74.7, 75.8)	82.3 (82.0, 82.6)
11	4-17	Norway	70.5	68.8 (67.0, 70.5)	72.3 (70.2, 74.6)	75.7 (75.5, 76.0)	81.4 (80.9, 82.0)
12	4-19	Austria	70.3	68.1 (66.9, 69.4)	72.5 (70.3, 74.3)	74.9 (74.4, 75.4)	81.4 (81.0, 81.8)
13	6-19	Canada	70.0	68.3 (66.9, 69.7)	71.7 (70.0, 73.5)	76.0 (75.6, 76.5)	81.5 (81.1, 81.9)
14	7-21	United Kingdom	69.9	68.3 (66.8, 69.7)	71.4 (69.2, 73.1)	74.8 (74.6, 75.0)	79.9 (79.7, 80.2)
15	6-21	Luxembourg	69.8	67.6 (66.2, 69.2)	72.0 (69.5, 74.0)	73.9 (73.0, 74.8)	80.8 (79.8, 82.1)
16	9-20	Netherlands	69.7	68.2 (67.1, 69.3)	71.2 (69.7, 72.7)	75.4 (74.9, 76.0)	81.0 (80.4, 81.5)
17	11-21	Denmark	69.5	68.9 (67.5, 70.3)	70.1 (68.2, 72.0)	74.2 (73.8, 74.5)	78.5 (78.2, 79.0)
18	10-21	Germany	69.4	67.4 (66.0, 68.7)	71.5 (69.4, 73.3)	74.3 (74.0, 74.8)	80.6 (80.3, 80.9)
19	10-21	Belgium	69.4	67.7 (66.2, 69.2)	71.0 (69.0, 73.0)	74.6 (74.2, 75.0)	80.9 (80.5, 81.3)
20	12-21	Ireland	69.3	67.8 (66.3, 69.1)	70.9 (68.6, 72.7)	74.1 (73.6, 74.5)	79.7 (79.3, 80.0)
21	16-21	Finland	68.8	66.1 (64.9, 67.2)	71.5 (69.9, 73.0)	73.7 (73.5, 74.0)	80.9 (80.5, 81.3)
22	21-24	USA	67.2	65.7 (63.8, 67.5)	68.8 (66.5, 71.0)	73.9 (73.7, 74.2)	79.5 (79.3, 79.6)
23	22-26	Portugal	66.3	63.9 (62.5, 65.4)	68.6 (66.2, 70.5)	71.7 (71.4, 72.0)	79.3 (78.8, 79.8)
24	22-26	Republic of Korea	66.0	63.2 (60.8, 65.3)	68.8 (64.0, 71.4)	70.5 (69.1, 72.2)	78.3 (76.8, 79.8)
25	23-26	Czech Republic	65.6	62.9 (61.3, 64.4)	68.3 (65.7, 70.5)	71.5 (71.3, 71.7)	78.2 (78.0, 78.6)
26	24-27	Mexico	64.2	63.1 (60.8, 65.2)	65.3 (61.5, 68.1)	71.0 (70.4, 72.0)	76.2 (75.7, 76.8)
27	26-28	Slovakia	62.4	59.6 (58.1, 60.9)	65.2 (62.3, 67.5)	69.2 (68.8, 69.6)	77.5 (77.2, 77.9)
28	27-29	Poland	61.8	59.3 (57.9, 60.5)	64.3 (61.2, 66.7)	69.2 (68.9, 69.5)	77.7 (77.2, 78.2)
29	28-30	Hungary	59.9	55.3 (53.7, 56.9)	64.5 (61.8, 66.7)	66.3 (66.1, 66.5)	75.2 (74.9, 75.5)
30	29-30	Turkey	58.7	56.8 (55.4, 58.2)	60.5 (57.4, 63.2)	66.8 (66.6, 68.0)	72.5 (71.9, 74.0)
		OECD average	**67.9**	**66.0**	**69.9**	**73.5**	**79.9**

Source: WHO (2001a).

prevalences for some developing regions. These high prevalences are influenced by high levels of anxiety and depression, particularly for men, even after adjustment for cross-population differences in the use of response categories.

Figure 16 is a scatter plot of life expectancy at birth and HALE at birth, by sex, for all 191 countries analysed. The difference between HALE and total life expectancy is LHE ("lost" healthy life expectancy). The equivalent "lost" healthy years range from around 7 years in Japan to 11 years in the OECD countries with lowest life expectancies at birth, such as Hungary or Turkey.

Figure 16. **Healthy life expectancy (HALE) *vs.* life expectancy at birth, 191 countries, 2000**



Source: WHO (2001a).

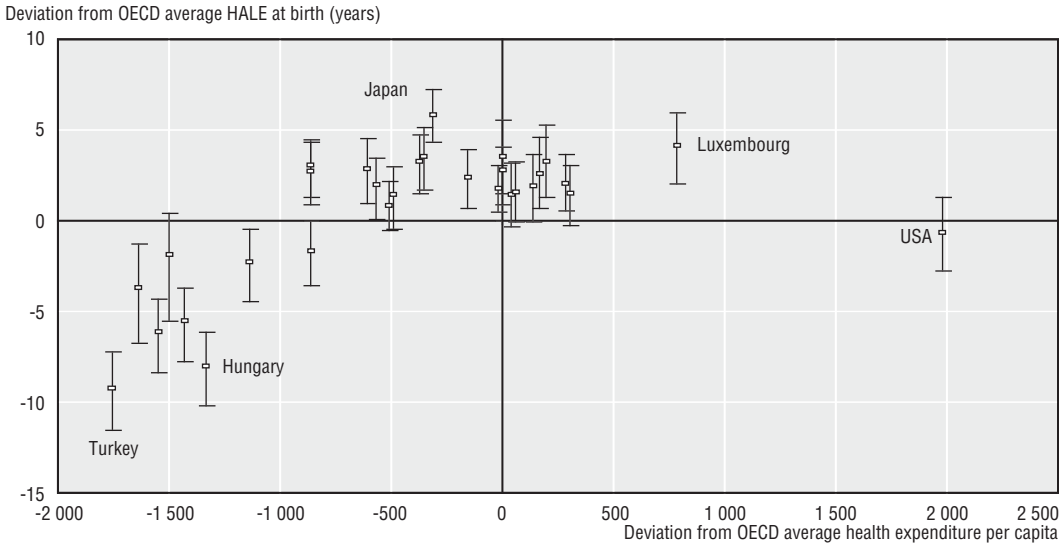
Figure 15.1 shows deviations in average healthy life expectancy at birth from the OECD average (with 95% uncertainty intervals), plotted against deviations from the OECD average health expenditure per capita (Gross Domestic Product measured in international dollars using purchasing power parity conversion rates). Full details of these estimates for OECD and other countries are provided in the annex tables to the *World Health Report 2001* (WHO, 2001). The USA has the highest per capita health expenditure of OECD countries, but this is associated with a HALE at birth 0.7 years below the OECD average. Japan is also an exception, with the highest HALE of all OECD countries, but per capita health expenditure below the OECD average. Taking into account the uncertainty in HALE for each observation, and excluding the USA, there is a positive correlation between per capita health expenditure and HALE at birth for OECD countries, with an estimated slope of 0.44 years per US$100 additional per capita health expenditure and a 95% confidence interval for this slope of (0.37, 0.50). This correlation does not, however, take into account other variables that may be associated.

4. Concluding points

This paper provides a brief overview of approaches WHO is developing to estimate population health, that are comparable. Some key points include that:

- There have been substantial improvements in data available for mortality and life expectancy estimates (not presented in detail).

Figure 15.1. **Healthy life expectancy (HALE) at birth and per capita health expenditure in international dollars (purchasing power parity conversion), deviations from OECD averages, OECD countries, 2000**



Source: WHO (2001a).

- The new methods used in the WHO Multi-country Household Survey Study have increased the comparability of self-reported data across countries. We consider these results as a major step forward in the use of self-reported data on health. Building on this experience, WHO is developing improved health status measurement techniques for a World Health Survey to be carried out in 2002-2003.
- In conjunction with collaborators, progress is being made on new instruments and analytical methods to improve cross-population and within-population comparability. In addition, we are working on improvements to combine the "top down" and "bottom up" approaches to estimate severity-weighted prevalences of non-fatal health states.
- Healthy life expectancy estimates for the year 2000 reported here are not directly comparable with previously published healthy life expectancies for 1999 (WHO 2000; Mathers *et al*. 2001) as the latest estimates incorporate new epidemiological information, new data from health surveys, and new information on mortality rates, as well as improvements in methods to enhance cross-population comparability of self-reported data and also use population-based measured health state valuations.

The regular assessment of levels of population health is a key input to the public policy process. It enables analysis of variations in levels of health across populations, variations in health within populations, changes in levels of health over time for populations and by age and sex, and whether health levels are improving. Without being able to measure and summarize population health using measures comparable across populations, it is difficult to evaluate the success of health policies – if levels of health are improving and inequalities are being reduced. Use of summary measures such as HALE for these purposes does not prevent policy-makers from considering the components separately – the fatal and non-fatal health outcomes, and the morbidity associated with different disease and injury causes.

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PART V

Chapter 16

Progressing the Collection of Information on Health Outcomes: A Perspective from the Ageing-Related Diseases Study*

by
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Abstract. *Health outcomes are changes in health status resulting from health interventions; that is, the impact of the health system. Monitoring health outcomes is essential for assessing the effectiveness of health systems. This paper outlines progress made in collecting health outcome information in the three disease studies that formed the OECD Ageing-Related Diseases (ARD) project. It includes a framework for international health outcome information, broad examples of results from the ARD study, a discussion of the underlying causes of variations, and an assessment of specific areas for improvement in health outcomes data in the future.*

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Introduction

The primary goal of health systems is to improve the health of the population within available resources. Therefore, information on "health outcomes" – changes in health status resulting from health interventions – is essential for assessing the effectiveness of health systems. In other words, the focus of this paper is what we get for our money.

This paper outlines progress made in collecting health outcome information in the three disease studies[1] that formed the Ageing-Related Diseases (ARD) project (see summaries of the three studies contained in Part I of this volume). The focus of the ARD study is to examine variations between countries in treatments, outcomes and costs.

It was apparent that collecting comparable health outcome information would be one of the more challenging parts of the study, as it is a component of health information that is still under development in most OECD countries. The health outcome information that we have been able to collect provides a starting point for comparing health outcome between countries, and for developing further data collections in the future. However, a number of limitations in the currently available data make it difficult to draw firm conclusions regarding the reasons for variations in health outcomes.

This paper provides a basis for developing population health outcome information in relation to disease analyses, particularly from the perspective of international studies (Section 1). It then provides details on how the health outcome information collected as part of the ARD study fits into this framework (Section 2). Section 3 includes a broad discussion of some of the main patterns in the health outcome results in the ARD study, followed by an outline of some likely drivers for this variation (Section 4). Finally, specific limitations in the current data are discussed, with a view to progressing the development of health outcome data in the future (Section 5).

1. Background

1.1. Health outcomes

Health outcomes can be defined as "those changes in health status strictly attributable to the activities of the health system" (Hurst, 2002). However, available data can rarely disentangle the health system effects from other effects (such as those related to the natural course of the disease, and socioeconomic or environmental factors for example). The main focus in this paper is on outcomes that may be to some degree attributable to health care interventions and the quality of those interventions, or the lack of them.

Outcomes are measured in terms of a variety of indicators, including those covering mortality, morbidity, other physiological measures of health and function, and more subjective patient-based assessment of health. The choice of indicator is an important decision in ensuring that the information is relevant and reliable. In practice, availability of data makes indicator selection pragmatic, rather than ideal. Gaps remain, with available health outcome information often restricted to only a component of the required

information, and often not widely available on a country basis. The main outcome measures available for the ARD study relate to death rates, leaving substantial gaps in the areas of morbidity and disability outcome measures.

Two key uses of health outcome information were identified by Jee and Or (1999). Firstly, health outcome information can be used to monitor current trends and forecast future needs within the health system. Secondly, they can be used to measure and evaluate the performance and effectiveness of various health policies and health interventions. These two primary uses result in health outcome information being important for planning and monitoring within countries, for benchmarking between countries, and for research aiming to increase our knowledge of what works.

1.2. Continuum of care

As this paper primarily concentrates on the effect of health interventions, it is useful to examine health outcomes in the context of the continuum of care. With our disease-based approach, we focus on the following four components of the care continuum: prevention, acute care, rehabilitation and ongoing care. The descriptions below are based on definitions from a number of sources (AIHW and CDHF, 1997; CIHI, 2002; NHDC, 2001).

- *Prevention* encompasses a wide range of interventions undertaken prior to diagnosis of the disease, with the ultimate aim to reduce the occurrence of new cases, decrease the risk of the disease, delay onset, or limit progression of the disease. Screening for the disease is also included here.
- The intention of *acute care* is to cure, relieve symptoms, reduce severity, prevent recurrence, prevent complications, and perform surgery or diagnostic procedures. For the three diseases included in the ARD study, acute care is largely provided in the hospital setting.
- *Rehabilitation* aims to improve the functioning of a patient with an activity or participation restriction. It may be provided in a residential or non-residential setting, with care often provided by a multidisciplinary team.
- *Ongoing care* is supportive and after-care services provided on a long-term basis to individuals with continuing impairment. It may be provided in an ambulatory or residential setting, and can include supportive, educational, or pharmacological therapies.

While the continuum of health care can be thought of as broadly following these phases, in practice the boundaries between these phases may not be distinct, with some overlap and interactions likely. In addition, passage through these phases may not be sequential, nor is it always the case that patients receive care in all of these phases. To illustrate how this model is viewed in the ARD study, a brief description of how care for the three diseases may fit into this model follows.

For *ischaemic heart disease* examples of preventative activities include population-based measures to reduce the risk of developing the disease, such as promoting a healthy diet and exercise, as well preventative treatments provided to individuals to modify physiological risks such as high cholesterol or hypertension. Acute care is often a major component of Ischaemic Heart Disease (IHD) care, and includes hospital treatment for acute myocardial infarction (AMI, a "heart attack"), diagnostic tests, and surgery such as a coronary artery bypass graft. Rehabilitation may occur following the acute treatment for AMI. Ongoing care would include long-term drug treatment and monitoring.

Stroke treatment is likely to involve all phases in the care continuum. Preventative care could include programs aiming to assist individuals to stop smoking, and drug treatment provided to control hypertension. Acute care is focussed on care of patients following a stroke event, including diagnostic tests, drug treatment, and early therapies to improve functioning. Surgical treatment is also sometimes a component of acute care related to stroke. Many patients experiencing a stroke will receive rehabilitation and ongoing care.

Breast cancer provides a different perspective on the care continuum compared to IHD and stroke care. In this case, screening is an important component of "prevention", aiming for early detection of cancers to improve the potential outcomes for patients. Acute care may involve surgery, radiotherapy and drug treatment. Rehabilitation and ongoing care may include reconstructive surgery and ongoing monitoring to determine the presence or otherwise of the cancer.

1.3. *Framework*

Table 16.1 provides a framework for examining health outcomes over the continuum of care as a tool to bring these concepts together. The rows represent four key aims of health interventions applicable to our disease-based approach to studying different health systems. The first set of columns give examples of outcome measures against each of these aims, split into two groups: direct measures, and proxy measures. The final set of columns places the four aims of health interventions into the context of the phases of the care continuum. The components of this framework are described in more detail below.

Four high-level aims of health interventions are included in the rows of this framework. The first aim is to reduce the risk of the disease, which also includes reducing the risk that comes from not detecting the disease in its early stages (such as through appropriate screening). The second aim is to reduce the number of deaths from the

Table 16.1. **Matrix for a disease perspective on health outcome measures**

Aim of health intervention	Examples of potential outcome measures		Treatment type/phase (✓ = significant aim)			
	Direct measures (health status)	Proxy and process measures	Prevention	Acute care	Rehab.	On-going care
Reduce risk of disease	Incidence rates Percentage of the population who are smokers	Proportion of population having blood pressure taken in last 5 years Participation rates in breast cancer screening	✓ (key phase)			
Reduce deaths	Population mortality rates Hospital fatality rates (hospital treatment) Case fatality rates (hospital and community treatment)	Proportion of stroke patients receiving care in a stroke unit Proportion of AMI patients receiving thrombolytics	✓	✓ (key phase)		✓
Reduce complications	Specific complication rates Unplanned readmissions	Proportion of ischaemic stroke patients receiving aspirin		✓ (key phase)	✓	✓
Improve functioning and wellbeing	Levels of impairment, activity and participation	Proportion of patients receiving specialised rehabilitation care Proportion of patients returning to original accommodation (home, nursing home)		✓	✓ (key phase)	✓

Source: Author.

disease. The third is to reduce complications, including recurrences of the disease. The final aim of health interventions specified here is to improve functioning and wellbeing.

The examples[2] of outcomes measures provided in the Table 16.1 have been split into two groups, displayed in columns two and three in the matrix. The first are the more direct measures, which are mostly measures of health status – the primary focus of health outcome measures. These include measures of incidence, mortality and disability, and are the preferred measures to use where possible. The second are more indirect or proxy measures, often measures based on aspects of the process of care which have been shown to be directly related to health outcomes. For example, for stroke patients it has been shown that care in stroke units tends to be beneficial for outcomes, both by reducing deaths and improving functioning (*Cochrane Review*, 2002; Stroke Unit Trialists' Collaboration, 1997). Therefore, measuring the proportion of patients cared for in a stroke unit indirectly indicate the likely impact on health outcomes.

The last four columns identify where the four aims fit in relation to the continuum of care. The phases of the care continuum most relevant to each aim are identified with a tick. In addition, for each of the four aims the "key phase" is also identified.

Ideally, it would be preferable to be able to measure health outcomes that reflect all the key aims of health interventions, and all the phases of the care continuum. Preference would be given to using direct measures where possible, rather than proxy or process measures. Although this ideal cannot be fully attained, particularly when adding the dimension of international comparisons, this framework provides a basis for assessing the coverage of available information on health outcomes.

2. Health outcome measures in the ARD study

2.1. Summary

The health outcome measures collected as part of the ARD study are summarised in Table 16.2. For stroke and IHD, information was collected to some degree for all the four aims of health interventions included in the framework developed for this study (see Table 16.1). For breast cancer, information primarily focuses on the first two aims.

The measures chosen for the ARD study were based on a population perspective – one that provides a broad view that is also appropriate for international comparisons. This population focus is in contrast to clinical or patients' perspectives, which more directly reflect the goals and interests of clinicians and patients.[3] Thus the measures included in the ARD study are not directly based on clinical assessment, but use available population

Table 16.2. **Health outcome measures in the ARD study**

Aim of health intervention	Disease included in the ARD study		
	Stroke	Ischaemic heart disease	Breast cancer
Reduce risk	Incidence Information on risk factors	Incidence Information on risk factors	Incidence
Reduce deaths	Mortality rate *In-hospital and case fatality rates*	Mortality rate *In-hospital and case fatality rates*	*Mortality rate* *Relative survival rates*
Reduce complications	Use of stroke units	*Readmission rates*	
Improve functioning and wellbeing	Use of stroke units and specialised rehabilitation	*Readmission rates*	

Source: Author.

level information such as disease registers and hospital administrative data to construct the outcome measures.

The information discussed in this paper does not cover all the measures in Table 16.2, but is limited to the health outcome measures identified in italics. Specifically, the health outcome measures included here are those that measure outcomes for a group of people with the disease rather than for the whole population (for example, case fatality rates rather than population mortality rates).[4] Therefore, differences in the levels of disease between countries is largely controlled for, removing one of the key reasons for variations in health outcomes in international comparisons. This subgroup of measures are all direct health status measures rather than process measures.

2.2. Definition of health outcome measures

Fatality rates (IHD, stroke)

- Hospital fatality rates: measure the percentage of patients admitted during a specified period (for example 1998) with the disease, who died in hospital. The measures may be further refined to only include deaths occurring during a specified time following admission (for example deaths in the first seven days of hospitalisation).
- Case fatality rates: measure the percentage of cases admitted during a specified period who die within a specified time (such as 30 days, one year). In this study, cases are usually defined as those admitted to hospital during a one-year period (for example during 1998). Case fatality rates can only be constructed when a group of patients can be tracked over time, including after discharge from hospital, to determine the proportion that die.

Relative survival rates (breast cancer)

Survival rates measure the percentage of cases surviving for a specified time (such as for five years). Cases are usually defined as those newly diagnosed during a specified period (for example 1994).

Relative survival rates are survival rates adjusted to account for the difference between the risk of death from the disease, and the risk of death from other causes. That is, they indicate how much more likely someone is to die if they have the disease compared to those who do not. The relative survival rates discussed here indicate the number of women with breast cancer who survived for a given time as a percentage of the number expected to survive for that time in the general population. For example, a five year relative survival rate of 80% means that 20% of cases died from breast cancer within five years that were not expected to die from other causes during that time.

Mortality rates (breast cancer)

The mortality rate included here measures the number of deaths from breast cancer per 100 000 women.

Readmission rates (IHD)

Readmission rates measure the percentage of patients in the defined group who are readmitted for a related (and specified) condition during a certain time following the initial admission. Elective admissions are not counted as readmissions. Readmission rates can only be calculated when the admission history for individual patients can be tracked over time.

More precise definitions for the health outcome measures included in this paper are shown in Table 16.3.

Table 16.3. **Definitions of selected health outcome measures**

Health outcome	Disease	Period[1]	Definition
Hospital fatality rates			
a) In-hospital fatality rate	IHD	One year	$\frac{\text{No. cases who died in hospital}}{\text{No. cases}} * 100$
b) 7-day hospital fatality rate	Stroke	One year	$\frac{\text{No. cases who died in the first 7 days in hospital}}{\text{No. cases}} * 100$
c) 30-day hospital fatality rate	Stroke	One year	$\frac{\text{No. cases who died in the first 30 days in hospital}}{\text{No. cases}} * 100$
Case fatality rates			
a) 30-day case fatality rate	Stroke, IHD	One year	$\frac{\text{No. cases who died in the 30 days after acute event}}{\text{No. cases}} * 100$
b) 90-day case fatality rate	IHD	One year	$\frac{\text{No. cases who died in the 90 days after acute event}}{\text{No. cases}} * 100$
c) One-year case fatality rate	Stroke, IHD	One year	$\frac{\text{No. cases who died in the year after acute event}}{\text{No. cases}} * 100$
Survival rates			
5-year relative survival rate	Breast cancer	Varies[2]	$\frac{\text{Proportion of cases who survived for 5 years}}{\text{Proportion of general population surviving for 5 years}} * 100$
Mortality rates			
Mortality rate	Breast cancer	One year	$\frac{\text{Number of female deaths from breast cancer}}{\text{Number of females in population}} * 100\,000$
Readmission rates			
One-year readmission rate	IHD	One year	$\frac{\text{No. cases readmitted[3] in year after initial admission}}{\text{No. cases}} * 100$

1. The period used to define the case group. For example, all admissions occurring during a calendar year would define the patient group for in-hospital fatality rates.
2. For most countries, cases were defined as cases admitted during a one-year period. For some countries, a longer period was used.
3. With specified diagnosis.

Source: Author.

3. General patterns in the ARD results

This section provides a brief look at illustrative results obtained in the ARD study based on health outcome information. As outlined earlier, health outcome information is often not available even within a country. Added difficulty comes when aiming to collect comparable health outcome information from a number of countries. Therefore, considerable is needed when making comparisons using currently available health outcome information. Nevertheless, some general observations based on the data obtained in the ARD study can be made.

3.1. *Health outcomes vary across countries*

Selected results using cross-sectional information obtained in the ARD study are included in Hughes (see Part I in this volume), Moïse (Part I in this volume) and Moon (Part I in this volume). The common theme is that variation in these health outcomes does exist between those countries with available data. This section is descriptive only: reasons for differences are discussed in Section 4.

- *Fatality rates for ischaemic stroke*. The 7-day hospital and one-year case fatality rates for ischaemic stroke display a fair degree of variation. Although the variation between the countries is less for case fatality rates than for the hospital fatality rates, this has occurred with a smaller group of countries. The results from the same subset of

countries do not display a large degree of variation between them (see Moon, Part I in this volume, Figures 3.5 and 3.6).

- *Fatality rates for AMI.* One-year case fatality rates for AMI in four countries and three regions within other countries shows substantial variation (see Moïse, Part I in this volume, Table 2.5).
- *Outcome measures for breast cancer.* The outcome information for breast cancer is particularly difficult to compare. Here we have referenced two outcome measures collected as part of the study: five-year relative survival rates, and age-standardised mortality rates. There are a number of limitations with these data when examined in isolation. The relative survival rates do not account for differences in the stage at which the cancer is detected, and can be affected by biases (such as lead-time and length biases). The mortality rates do not account for differences in the level of the disease between countries nor other influences outside the health system. The reader is encouraged to consult a more detailed discussion of the data issues relevant to these measures in Hughes (Part I in this volume, Table 2.5 and Figure 2.3) and Hughes and Jacobzone (2002).
- *Readmission rates for AMI.* Readmission rates for AMI patients during the 12 months following initial admission for an AMI also exhibit variation, particular for readmissions for ischaemic heart disease (see Moïse, Part I in this volume, Table 2.6).

3.2. Health outcomes vary over time

In general, changes over time in the health outcome information collected as part of the ARD study are not substantial for the period for which data are most widely available. Although the health outcome measures discussed here do not include all the data supplied as part of the study, they allow the main patterns in the data to be illustrated.

- *7-day hospital fatality rates for ischaemic stroke:* for males, these fatality rates have been decreasing in nearly all countries with data available. The results for women are slightly more mixed (see Moon *et al.*, 2003).
- *In-hospital fatality rates for AMI:* for the countries with available data, in-hospital fatality rates and one-year case fatality rates have decreased fairly rapidly during the 1990s (see Moïse and Jacobzone, 2003).
- *5-year relative survival rates for breast cancer:* for all the countries with trend data available for this study, increases in relative survival rates were strong over the 1980s and 1990s indicating improved outcomes. However, particularly for this measure, these improvements may be strongly influenced by changes in the composition of "cases", due to improved detection of early and less severe cancers. This aspect is discussed in more detail in the next section (see also Hughes and Jacobzone, 2003).

4. What is driving the variations?

This section provides a brief discussion of possible influences on health outcomes in order to highlight the complexities involved in making comparisons based on the currently available data. There are a number of limitations with the health outcome data available as part of the ARD study that restricts the analysis of the data beyond that of general comparisons. These limitations are also discussed here.

4.1. *Definitional and data limitations*

Health outcome information collected as part of the ARD study is not comparable or comprehensive enough to permit conclusions to be drawn on the impact of differing treatment patterns on health outcomes. The main limitations of the health outcome data fall into four groups: variations in ability to supply data based on the project specifications, differences in underlying case definitions, differences in "coding" cases to various diagnostic groups in health information systems, and variation in severity of cases.

Difficulties in supplying information to specifications

There are limitations in comparability due to difficulties in supplying information that precisely follows the project specifications. For example, not all countries that supplied some data were able to provide it for the same years. Thus, at times, it has been necessary for results to be presented drawn from different years. While it is likely that limitations of this sort are to some degree an inevitable difficulty when making international comparisons drawn from routinely collected data, it is still important to be aware of these limitations.

Coding differences

It is likely that some variation exists between countries in coding practices: that is, how diagnostic and treatment information is transferred into health information systems using a classification system. For example, in the ARD study diagnostic and treatment information has largely been defined based on the International Classification of Diseases (ICD), and related classifications of procedures. Local guidelines that specify what is the "main" diagnosis, or what diagnostic procedures should be recorded in each particular case, may affect the comparability of the health outcome information.

Variation in case definition

More specifically for our analysis, differences are apparent in the definition of "cases". An example of this is when cases are defined as "individuals admitted to hospital with a diagnosis of ischaemic stroke". In this case, differences may exist between countries in admission practices, with potentially all stroke patients being admitted in some countries, whereas in others only a proportion of patients are admitted to hospitals (some may remain in long-term care institutions for example).

A second example of variation in case definition is particularly relevant to the breast cancer study. It is likely that the severity of detected breast cancer cases have differed over time and between countries due to improvements in identifying smaller, and less severe, cancers. This increase in the proportion of cases with less advanced cancers makes comparisons of outcome measures that are not able to control for this problematic. Further, differing participation rates in screening may also result in variation in the case distribution, both between countries and over time within a country.

Underlying differences in severity

Comparisons of health outcomes is always going to be complicated when differences in severity of cases cannot be controlled for. It is possible that at least part of the explanation for some countries having worse health outcomes than others is because they are treating more severe cases of the disease. Although this may be partly due to variation in case definition as described above, it can also be more than that. It is possible that in some populations the underlying distribution of cases by severity is significantly different

than in other populations. Information available to us as part of this study was not able to directly control for differences in severity. To minimise this problem, precise definitions based on specific ICD codes were selected in conjunction with the expert networks advising the disease studies, in order to provide information on a fairly homogenous group of patients.

4.2. Other causes of variations

The limitations outlined in Section 4.1 above demonstrate that, at this stage, it is not possible to draw conclusions based on comparisons of available health outcome information. Nevertheless, it is useful to discuss the potential impacts of particular interest to this study. Ideally in the longer term, it would be useful to examine the impact on health outcomes of: treatment differences at various stages of the continuum of care, differing approaches to the organisation and co-ordination of the care continuum, and the effect of influences outside the health system.

Treatment variations across the continuum of care

In the longer term, we would like to examine the effect on health outcomes of treatment variations within the different phases of the care continuum, preferably using direct health outcome measures rather than proxy measures. This would provide the best chance of assessing links between treatment variations and health outcomes. Currently, most of the health outcome information available relates primarily to acute care, focussing largely on mortality-based measures rather than disability-based measures.

Organisation and co-ordination of care continuum

As well as examining differences within the phases of the care continuum, it is also important to look at any differences between these phases. For example, some health systems may be better at co-ordinating across the care continuum, potentially resulting in a more holistic approach to care. Any such differences could potentially have an effect on health outcomes.

Influences outside the health system

It is widely acknowledged that there are many influences on health outcomes from outside the health system. Although the central aim in examining health outcomes as discussed here is to look at the effect of health interventions, it is inevitable that not all of any observed effects result from these interventions alone. Health outcomes are also likely to be affected by socioeconomic factors (including those at the aggregate national level, and those of individuals within countries), and environmental factors (such as housing and air quality for example).

5. Next steps

The ARD study has shown that collecting internationally comparable data to allow assessment of the effect on health outcomes of different treatments (at the health system level) remains challenging. Data limitations remain that preclude conclusions to be drawn from comparisons of health outcome measures. However, this paper has been able to provide a framework for international health outcome information, broad examples of results from the ARD study, and a discussion of the underlying causes of variations (including both data limitations and other potential causes).

From this assessment, a number of specific shortcomings in health outcomes data were identified as part of the ARD study:

- Countries differ in their progress in developing health outcomes information. Even for much of the core health outcomes information, data were only available for a subset of countries.
- The majority of health outcome information available for this study were related to deaths from the disease. There is an obvious need to develop health outcome information that also reflects disability and morbidity resulting from the disease.
- While hospital administrative data collections provide a valuable, though often underused, source for health outcome information, countries differed in the benefit that could be gained from analysing the health outcome data. Importantly, it was found that hospital information systems that could track a patient over a number of hospital admissions (patient-based systems) provided more valuable health outcome information compared to systems that could only provide untracked information (event-based systems).
- Not all health information systems allowed linking of patient information from hospital data systems and disease registers with death information. For countries unable to currently undertake this linkage, this is an obvious area for potential improvement that would result in large improvements in health outcome information.
- The conclusions able to be drawn from the health outcome information collected as part of the ARD study were particularly limited due to the inability to control for the severity of the disease. While this was less of a problem for stroke and IHD due to the definition of cases based on specific ICD codes in hospital data collections, it was much more of a problem for breast cancer. This was due to comparable information on the stage of the disease not being available, thus variations in early detection both within and between countries affected the data to an extent that made comparisons and subsequent interpretation very difficult. Internationally agreed and implemented classifications for severity on disease registers would make it possible to reduce the effect of this limitation.
- Only a small number of countries were able to supply comprehensive health outcome information at a national level. A number of other countries were able to supply some information on a region or provincial (in the case of Canada) level. Nationally representative information would obviously be desirable for international comparisons.

If at least some of these shortcoming could be addressed, significant improvements could be made in the availability of health outcome information. In particular, improvements made to facilitate the tracking of patients, both within hospital data systems, and between these systems and other health information systems, would provide significant gains in the health outcomes information able to be derived. More generally, any improvements along the lines discussed above would be useful both within countries, as well as for international comparisons like this study.

Using health outcome information to assess the effect of variations in treatments is an important component of health system performance assessment. Further it provides the basis for understanding the effect of different health policy choices. Although this paper has indicated the difficulty in drawing conclusions from the health outcome information collected as part of the ARD study, it is important to remember that this is one of the first attempts to collect such information from this many countries for more than one disease. It is hoped that the lessons learnt from this exercise will be valuable for any future collections of health outcome information.

Notes

1. The substantial input made by the three disease expert networks in contributing country specific information is gratefully acknowledged.
2. The aim here is to provide general examples of health measures, rather than a comprehensive list. These examples are intended to be descriptive only, and hence the measures have not been defined in detail.
3. For a more detailed discussion of these three perspectives, see for example the reports from National Centre for Health Outcomes Development (for example, Rudd *et al.*, 1999).
4. The exception to this is for mortality rates for breast cancer, which has been included for extra information due to potential biases inherent in the measure of relative survival rate. Also, for some measures the patient group is defined as all cases treated in hospital, rather than all cases in the community.

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PART VI

Policy Implications

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What is Best and at What Cost?
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PART VI

Chapter 17

Understanding the Performance of Health Systems:
The Ageing-Related Diseases Perspective*

by
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Abstract. *This paper presents an overview of performance assessment in the ARD study. The paper summarises the links between demand- and supply-side incentives and treament patterns. While the study established a limited role for demand-side incentives, a stronger role was found for supply-side provider incentives. In addition, specific features of health care systems impact on the mix of treatments, and on the balance between prevention and cure. The study found some links between medical interventions and outcomes across diseases, albeit with decreasing marginal returns and no clear patterns. These results illustrate the various perspectives on performance, between the macro approach, often relevant for policy-makers, with aggregate indicators, and the micro approach, based on treatment of individual patients.*

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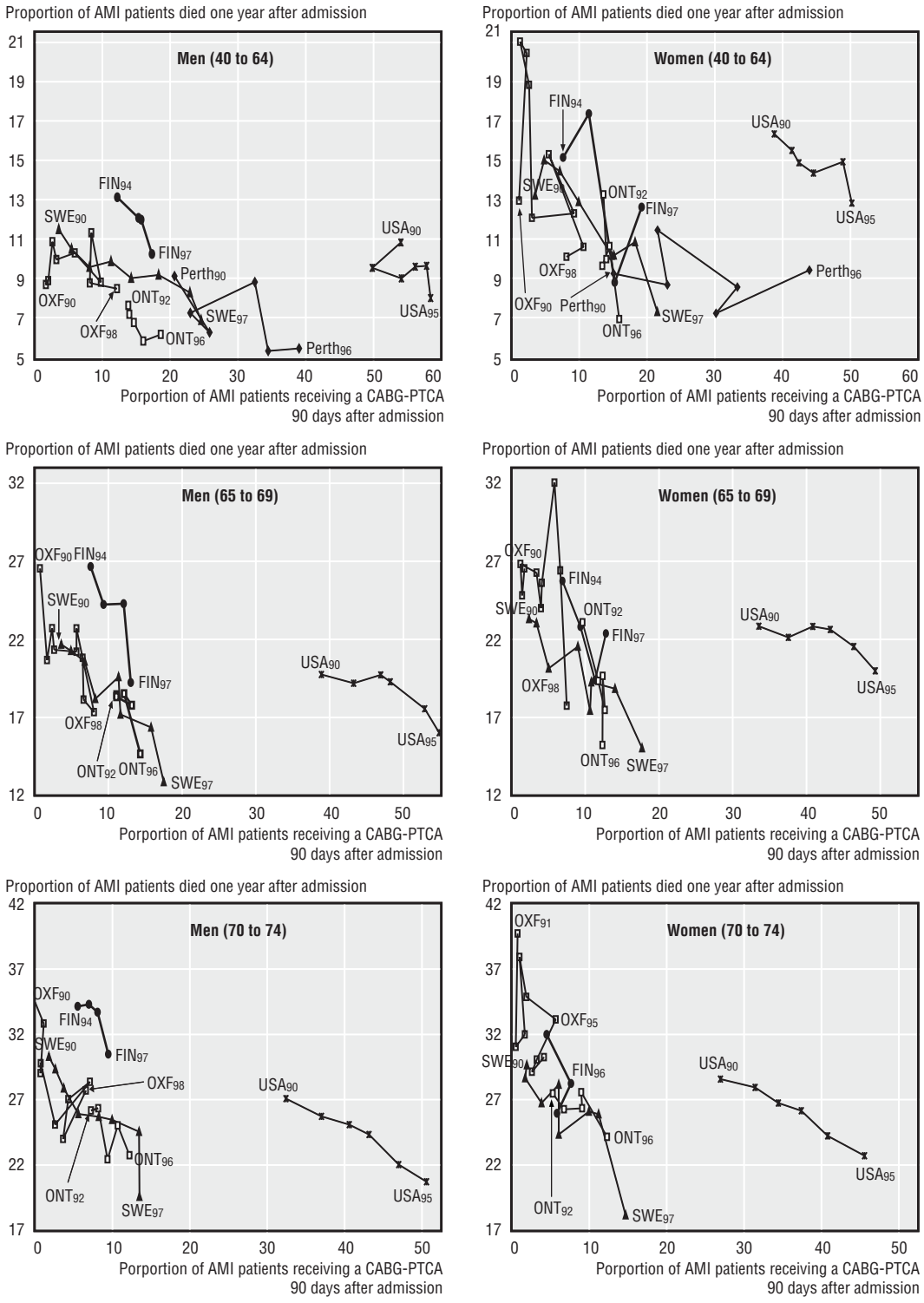
Introduction

The Ageing-Related Diseases project used a disease-based approach to understand the performance of health care systems. This approach was designed to provide an analytical framework for research in the fields of health and ageing from a cross-national perspective. The general framework is described in Jacobzone *et al.* (2002). It is intended to assess the social welfare and the individual utility that can be derived from the improved health, as a result of interventions from the health care system over the continuum of care, in the light of the resources which have been invested to produce these health outcomes (Figure 17.1). Resources include prevention, treatment, and possibly rehabilitative care. The disease approach involves understanding the non-medical determinants of the disease, the symptoms and incidence of the disease itself, with the resulting impact in terms of outcomes. This longitudinal framework tends to follow the patients' itinerary within the health system, against the general health policy approach, which often tends to be based on institutions and financing mechanisms. The financing mechanisms are analysed here only insofar as they influence the way patients are being treated. The study specifically focused on older persons, reflecting the priorities and trends affecting health care systems in industrialised countries, where a very large share of the resources is devoted to older persons.

In this study, specific attention was paid to medical technology as a key factor in understanding differences in resource use and in performance across countries (Moïse, Part IV in this volume). The supply-side issues of medical research and development (R&D) are generally geared towards finding more effective medical treatments, which are not necessarily the least expensive ones. This presents policy-makers with serious challenges, as to the right level and mix of technology that they can afford in their system.

This paper summarises the main findings of the study, first in terms of the links between the demand- and supply-side incentives and the actual patterns of treatments received by patients. The study generally found a limited role for demand-side incentives, together with a stronger role for supply-side, provider incentives. In addition, specific features of health care systems can have a significant impact on the mix of treatment received by patients, and the balance between prevention and cure. The study also assessed the utilisation of resources, in terms of the expenditure per given set of treatments and the use of inpatient facilities. The differences in resource use per intervention may compound, and often reinforce, some of the differences observed across countries. The second part of the paper discusses health outcomes in relation to resource utilisation. The study found some evidence of a link between the use of certain medical procedures and differences in outcomes across countries, even if the causality cannot be fully ascertained at this stage. However, the study also revealed patterns of decreasing marginal returns, in terms of the relative effectiveness of certain health interventions in relation to their frequency. The case of breast cancer also illustrates the need for a balance between a preventive approach and a treatment approach. A final discussion illustrates the

Figure 17.1. **One-year case fatality rates and use of revascularisation for 90-day episode of care**



Note: Perth (1990-1995); Ontario (1992-1996); Sweden (1990-1997); US (1990-1995).
Source: Moïse and Jacobzone (2003).

conflicting perspectives investigated in the study. In reconciliating a macro approach, with broad aggregate indicators reflecting systems' performance, with a micro approach, based on patients' interventions and treatments, the study also reveals the different perspectives of various stakeholders in the performance of health care systems. The policy-makers often tend to be focused on the macro-approach, while patients are concerned with individual interventions, and clinicians with the clinical dimension. This multifaceted perspective is at the core of health policy making, and underlies the public debate in many industrialised countries. With the current study, a body of empirical evidence can be brought to initiate a dialogue between these perspectives and maybe offer the possibility of building a better consensus for the future, and ways in which the performance of health care systems can be further improved.

1. Understanding the drivers of resource utilisation

1.1. Technology, economic incentives and the use of medical interventions

In the policy debate, many analysts tend to attribute the rapid growth in health expenditures to ageing, whereas, in fact, this growth mainly results from the diffusion of new technologies (Weisbrod, 1991). This phenomenon has been discussed in this publication (Moïse and Jacobzone, Part III in this volume) and is mainly due to the fact that it is not ageing itself as a demographic phenomenon which drives the expenditure trends, but the combination of ageing and the relative diffusion of technology across various age groups. Invention of new technologies is affected by policies which foster relationships between academia, government financed-research, and property rights legislation. The United States health care system gives very generous incentives for the invention of new technologies. However, the types of incentives prevalent in the United States system tend to favour cost-increasing technologies rather than cost-saving ones. Once technologies are established, the patterns of diffusion within countries are subject to economic incentives inherent in their health care systems.

The diffusion of health technology is a key factor driving health expenditure growth, and as such is of particular concern to health policy makers, since the production of health care often involves decreasing marginal returns from technology use. Technologies are often assessed under well-defined circumstances in medical trials, with limited population samples. Their use might be extended beyond the intended target group to patients whose characteristics are dissimilar to those of the initial patient group. This raises the issue of "Whether certain technologies have 'gone bad'" (Phelps 1997). The marginal cost-effectiveness of medical interventions varies in different groups of the population. The widespread use of technologies may translate into reduced effectiveness: the more we use the technologies, the less effective they may become. This may not harm patients, and may even produce marginal health benefits in terms of quality of life but it has certain financial consequences for individuals, insurers and governments.

1.2. Quantities and prices

Diffusion of technology results in an increase in treatment quantities. Each of these treatments requires that a given amount be spent, described as a unit expenditure. The total expenditure results from multiplying the quantities by the unit expenditure. This concept of unit expenditure is therefore important if we want to disentangle the factors

contributing to the growth in health expenditure. Unit expenditures reflects various factors:

- Input prices for supplies (imported technologies, goods and services, drugs):
  - The costs of stents or imaging technology, which are often imported in many OECD countries or the price of drugs administered in hospital. Some supplies are produced by local manufacturers (gowns, gloves, masks, beds, etc.).
- Technical and allocative efficiency in producing health care:
  - The technical and allocative efficiency is the professional time required for each intervention, and the relative use of hospital resources, reflected in the length of stay and the use of diagnostic tests. Additional amenities (TV, single rooms) related to patient satisfaction can be counted as volume of care, as it contributes to quality.
- Level of wages of health professionals, mainly physicians and nurses:
  - Labour costs represent more than two thirds of total expenditure. The relative compensation levels awarded to health professionals, in particular to physicians and nurses, have implications for the relative cost of production of a given treatment.

The growth in health expenditure is often assessed as a share of GDP, in order to obtain international comparisons and benchmarks. The unit expenditure per treatment can be divided by the GDP per capita. As a result, if we were able to multiply the number of treatments by the unit expenditure of each of these treatments expressed as a percentage of GDP per capita, we would obtain the overall share of GDP devoted to health care. Therefore, in this study, we divided the unit expenditure by GDP per capita, in order to obtain comparable indicators of resource use across countries, levelling off the impact of exchange rates and standards of living. The analysis of the share of health in GDP could therefore be divided into two parts:

- First, the drivers of quantities through factors affecting the diffusion of treatments in the population.
- Second, the unit health expenditure devoted to these treatments, expressed as a percentage of GDP per capita.

These two indicators of resource use will be discussed in the following sections. The incentives underlying technology diffusion will be discussed first, before discussing the issues related to the measurement and understanding of unit health expenditure.

1.3. Demand- and supply-led economic incentives

The incentives influencing the consumption of health care can be analysed either on the demand side or the supply side. This can be related to the hypotheses of the factors driving the decision to consume care: when the patient initiates and makes the decision, the relative price that he will face, either monetary or non-monetary, will influence the demand. However, the economics of health care also underlines the role of the provider's side in the patterns of treatments received by patients (Ellis and McGuire, 1993). Health care systems involve a complex interaction of the demand-side and supply-side economic incentives. Demand-side incentives include co-payments, listing and prescription policies for ambulatory care drugs. Demand-side incentives can be expected to play a much stronger role for those treatments where the price elasticity of demand is high, such as ambulatory care drugs, as against inpatient care, where the price elasticity of demand is very low. Supply-side incentives include planning and regulating special care facilities,

assessing health technologies and paying providers. How the various demand- and supply-side components interact is linked to the structure of a given health care system.

There is a broad distinction between two families of health systems: the integrated public model and the insurance system (Hurst, 1991). These broad categories were found to have a strong influence on patterns of care and performance achievements:

- The integrated public model primarily includes public hospitals for the delivery of acute care. In this case there is strict planning of facilities and generally a use of global budgets to reimburse hospitals and other providers of acute care. This system is generally found in the United Kingdom, in Nordic countries, and in some Mediterranean countries such as Italy and Spain.
- The insurance model is another type of system, which includes both social or private insurance models. In these systems, a certain amount of hospital care is reimbursed either through fee-for-service or through case-based payment systems, such as Diagnosis-Related Groups. These systems generally rely less on planning and overall regulation, and more on reimbursement systems for patients and providers. These systems exist under the form of a social insurance system for the elderly in the United States and for the general population in continental Europe, in countries such as Belgium, France, Germany, and the Netherlands. In other cases, such as for the working-age population in the United States, or in Switzerland for the general population, a market-based insurance system is used with some regulation.

The trends in quantities of treatment, and, more generally, resource use, can be measured through a variety of indicators, presented in Table 17.1. This table groups the indicators in four columns: admissions, facilities, staffing and treatment. The last column

Table 17.1. **Trends in resource use observed through the indicators collected for the study**

The trends refer to the mid- and late-1990s

Disease	Admissions	Facilities	Staffing	Treatment
Breast cancer	Slightly increasing, with rising incidence following better screening and diagnosis	Cross-section indicators: mammography machines and radiotherapy. Quality and age of machines unknown.	Oncologists, medical oncologists for a few countries, radiologists for more countries.	Surgical interventions: breast conserving surgery and mastectomy. Radiotherapy, but no information on chemotherapy and follow up treatment.
Ischaemic heart disease	Stable or declining trends, lower in Japan, higher in Norway and the United States.	Cross-section indicators, catheterisation laboratories and cardiac surgery facilities.	Few indicators available. Comparability of medical specialties; cardiologists and cardiovascular surgeons.	Trends in PTCA, CABG. Pharmaceuticals: DDD/capita, some MONICA data at patient level.
Stroke	Stable or slightly decreasing hospitalisation rates in the high incidence countries, stable or very slight increase in the group with lower incidence.	Cross-section indicators, CT scans and MRI.	Data on neurologists and neurosurgeons for a significant group of countries.	Use of CT scan and MRI but difficulty in tracking the intervention. Cross-section information on use of carotid endarterectomy, trends for US/Canada and a few other countries. Pharmaceutical use in DDD/Capita at population level.

Source: Moïse and Jacobzone (2003); Hughes and Jacobzone (2003); Moon *et al.* (2003).

presents treatments, which have been generally measured as specific acute-care interventions in the acute phase of the diseases. As this was not sufficient to fully understand the resource use, other indicators have also been collected: staffing, for labour inputs, and facilities, as a proxy for capital inputs. In addition, admissions have been collected, as they are the most commonly-used indicator. More detailed descriptions of each of the trends can be found in the disease summaries in this publication, and also in the technical reports from the study available on the website (Moïse and Jacobzone, 2003; Hughes and Jacobzone, 2003; Moon *et al*., 2003).

Admissions were generally relatively stable over time, reflecting the overall level of resources in the hospital system. This indicator appears to be partly linked with general trends in incidence, which tend to be rising for cancer, and decreasing for heart disease and stroke. However, these indicators often masked the deeper and faster trends in treatment patterns and hospital activity over time: a rapid increase in revascularisation procedures such as PTCA or Bypass is not reflected in a stable rate of admission. The second type of indicators related to dedicated capital stock and qualified labour resources. The capital stock indicators were strictly defined in relation to technology, and not, as is often the case in the economic analysis of acute care, in terms of beds only. Significant differences were found across countries, which generally corresponded to the type of regulation that was imposed, or not, for these facilities. Identifying qualified medical resources as a relevant indicator for the level of health system inputs was a very challenging task, as medical specialties often differ across countries, as does the type of tasks that can be allotted to various types of specialists.

The last type of indicators examined was treatments. This project has been quite successful in tracking aggregate treatment trends for major interventions, such as PTCA, CABG, mastectomy or radiotherapy. Significant data could also be collected for some diagnostic interventions, such as mammography screening, and MRI and CT scan for stroke. Data on drug medication at the patient level remained very scarce, but was more widely available in terms of DDD/Capita (Daily Defined Doses) at the population level. For cancer also, the registry data did not allow wide analysis of the rates of chemotherapy across countries.

As a result, the study allows a deeper understanding of health care systems but with significant limitations. In spite of these limitations, the findings help to understand the links between demand- and supply-side incentives and treatment patterns.

A limited role for demand-side incentives

Demand constraints generally play a small role in the acute phase of ischaemic heart disease, breast cancer or stroke. Generally, the acute-care interventions involve limited demand side management, particularly those delivered as part of an emergency (Moïse and Jacobzone, 2003). However, for more elective procedures, patients may face constraints related to insurance status, as is the case in the United States for the uninsured.

In other countries, universal coverage does not necessarily ensure equal access. This can be due, for example, to the fact that a signficant level of cost-sharing can affect access for certain citizens. For stroke, citizens in Korea face cost-sharing in relation to access to MRI and ultrasonography diagnostic procedures. This is also true in other countries where availability is limited in the public sector for those individuals without private health insurance. However, this can be mediated through more indirect factors: even in countries

with universal insurance such as Canada, if socio-economic status does not influence the use of medication or acute care such as carotid endarterectomy, it can still play a role influencing access to rehabilitative care: Kapral *et al*. (2002) show that an increase in median neighbourhood income in Canada can be associated with an increase in the probability of receipt of in-hospital physiotherapy and occupational therapy. It is possible similar results might be obtained in other countries with universal health systems, such as European countries, if the data permitted such analysis. In these systems the specific role of private health insurance, which facilitates access and is often restricted to part of the population, would deserve further analysis. However, consistent evidence allowing for understanding the role of socio-economic status, in the context of weak demand constraints still would need to be assembled.

The area where demand factors may play a significant role is access to preventive care, as demonstrated by some of the breast cancer work. In the United States, there is evidence of an impact of lack of coverage on access to screening by middle-aged uninsured women (Decker and Rappaport, 2002). The US data shows that this results in initial diagnosis taking place at more severe stages for the uninsured (Osteen *et al*., 1991). However, once diagnosed, the uninsured receive about the same proportion of care as the better insured patients, which reflects the absence of demand-side incentives in the acute phase of treatment, even in the United States. The poor outcomes observed for the uninsured are the result of the lack of a proactive preventive approach for these groups within a fragmented system. However, the differential impact of socio-economic differences in relation to screening has also been observed in other countries where opportunistic screening prevails. In France, the more qualified socio-professional groups have higher screening rates than less qualified socio-economic groups.[1] Some UK studies also reported that lower socio-economic status can also result in a lower rate of breast-conserving surgery (Albain *et al*., 1996). Therefore, it can be hypothesised that these socio-economic differentials also exist in other countries beyond the US, even when universal coverage exists. In addition, the impact of restricted coverage in the US for IHD, cancer and stroke related health care is limited because the bulk of health care for IHD is delivered to older persons, for whom there is near universal coverage through Medicare and Medicaid.

Even where universal coverage exists, it often goes with some restriction, depending on the country. For some countries, coverage will be limited to providers employed by or contracted to the public system, thus limiting choice of provider. The option to choose a private provider is thus available to those who can afford the option by paying out-of-pocket, or, as is more common, through private or supplemental health insurance. The potential impact is greatest in countries such as Greece and the United Kingdom where longer waiting times for invasive interventions in the public sector can be eased by choosing a private provider with shorter waiting times. However, the relative availability of private providers was for example greater in Greece for revascularisation procedures, leading to a higher level of diffusion of those procedures than in the United Kingdom overall.

Demand-side incentives are more important with respect to prescription drugs delivered outside the acute-care hospital setting, since health insurance generally covers drugs within hospitals. Our analysis of drug consumption refers primarily to the consumption of drugs in the ambulatory care sector: the data collected on drug consumption concern the consumption of ambulatory drugs related mostly to primary and

secondary preventive care of IHD. However, we note from our results that the countries with lower levels of drug consumption have generally universal coverage, while countries with non-universal coverage, or coverage limited through co-payments, experience higher rates of consumption. The role of prescription patterns, and possibly the budgeting of physician prescriptions in some countries (Jacobzone, 2000), may play a greater role in overall levels of consumption, suggesting that variations across countries in patterns of drug consumption may result from a mix of demand- and supply-side constraints.

In addition to the monetary incentives introduced by cost-sharing and insurance coverage, gatekeeping can also be used to monitor demand. Some countries such as the UK and Italy, and also managed care settings such as Health Maintenance Organisations in the United States were found to rely on strong gatekeeping mechanisms. Another group of countries relied on gatekeeping, but to a lesser extent. The countries which do not rely on gatekeeping are generally the social insurance countries in Europe, but also Japan and Korea in Asia. The private insurers in Switzerland and also the traditionnal fee-for-service insurers in the United States did not rely on formal gatekeeping mechanisms. Generally gatekeeping can impact access to the specialist, who is required for specific care related to IHD, breast cancer and stroke. In several countries relying on gatekeeping, delays to obtain a referral were mentioned as a specific policy concern.

Finally, we can conclude that the countries with an insurance system and the countries with an integrated public model were not as dissimilar as expected in the extent to which they were using demand-side incentives. Significant cost-sharing, or the need for private health insurance, can influence access to certain services in the private sector in the integrated public model countries, while co-payments on drugs also existed in all countries, at least when they were not reimbursed through additional supplemental insurance. However, countries where insurance is not universal, such as the United States or Mexico, seem to have relatively strong demand-side constraints for certain groups (Tables 17.2 and 17.3).

A stronger role for supply-side incentives and the organisation of care

Overall, supply-side constraints were found to exert a strong influence on treatment patterns. Supply-side constraints reflect a complex interaction between payment methods, availability and constraints on technology that determine utilisation levels. Overall, these constraints can operate via various channels:

- economic incentives through payment mechanisms;
- direct constraints on quantity of care.

These supply-side constraints can in turn have an impact on

- the quantity of care provided by the system;
- the type or mix of interventions delivered to cure the disease;
- the overall balance between preventive and curative services offered.

Quantities can be directly affected both by quantitative constraints and economic incentives. However, reducing or increasing quantities can either affect the population as a whole, or have a more pronounced impact on certain categories of patients, such as older patients or patients for whom the cost-effectiveness of the treatment is judged to be too low compared with the level of resources.

The key potential supply-side constraints affecting treatment for the diseases in our study are outlined in Table 17.4A. This table underlines the general dichotomy between the

Table 17.2. **Potential demand-side constraints impacting IHD, breast cancer and stroke treatment**

Constraints	Strong	Medium	Low
Health insurance coverage	United States: 14% of population without health insurance Groups in Mexico also	Groups with supplemental insurance; Australia, Canada (drugs), United Kingdom, United States Choice of provider: Australia, Denmark, Germany, Greece, Italy, Spain, Sweden, UK, United States (FFS plan)	Most countries have at a minimum universal public health insurance covering most acute and ambulatory care treatment Care delivered in public hospitals
Cost-sharing	Korea	Access to outpatient drugs: Australia, Canada, Denmark, Germany, Netherlands Norway, Spain, UK, US Access to some private care services: Australia, France, Greece, Hungary, Mexico, UK, US Japan (some inpatient and outpatient care)	Non-existent or modest for physician and public inpatient services in most countries
Gatekeeping	Italy, UK, US (managed care)	Australia, Canada, Finland, Hungary, Mexico, Norway, Spain, Sweden	Belgium, Finland, France, Germany, Korea, Japan, Switzerland, US (traditionnal FFS insurance)

Note: Countries can be included under more than one column. For example, in Denmark there is no cost-sharing for physician services and they, like most countries would be included in the Low column. However, there is cost-sharing for outpatient drugs in Denmark, hence the inclusion in the Medium column. Most countries are in the Low column, unless otherwise stated.
Source: Moïse and Jacobzone (2003); Hughes and Jacobzone (2003); Moon *et al*. (2003).

Table 17.3. **A synopsis view of the key features of demand-side incentives**

Disease	Demand-side incentives
Breast cancer	Modest impact of access to mammographic screening outside organised programmes or when they don't exist. Access to specialist care. Access to services in the private system, radiation therapy and some chemotherapy drugs when these are not covered by insurance.
Ischaemic heart disease	Some impact on the demand side for drugs (co-payments). limited impact for acute care interventions.
Stroke	Some impact on the demand side for drugs (co-payments). Very limited impact for acute care interventions.

Source: Moïse and Jacobzone (2003); Hughes and Jacobzone (2003); Moon *et al*. (2003).

Table 17.4A. **Potential supply-side constraints affecting IHD, breast cancer and stroke treatment**

Constraints	Strong	Medium	Low
Hospital payments	*Mainly global budgets* Canada, Denmark, Netherlands, Sweden, UK *Public hospitals:* France, Greece, Mexico, Spain	*Mixed financing or DRG* Australia (varies by state), Finland, Hungary, Italy, Norway, Switzerland (some cantons 50% block grants), US (DRGs, HMOs)	*Mainly FFS* Belgium, Germany, Japan; *Private hospitals:* Australia, France, Greece, Italy, Korea, Mexico, Spain, Switzerland, US
Physician payments	*Mainly salary* Denmark, Finland, Hungary, Italy, Japan, Norway, Spain, Sweden, UK *Public hospitals,* France, Switzerland, Greece, Korea, Mexico, Australia	*Mainly FFS with fixed fees or mixed payment* Australia, Canada, Germany, Greece, US (Managed Care, Medicare)	*Mainly FFS with open-ended financing* Belgium, Korea, Netherlands, Switzerland, US *Private hospitals:* France, Spain, Mexico

Note: For physician payments, this mainly refers to physician services delivered in hospital. This table reflects the period for which data were collected, mainly the mid-1980s to mid-1990s.
Source: Moïse and Jacobzone (2003); Hughes and Jacobzone (2003); Moon *et al*. (2003).

integrated public model countries, and the insurance countries. The public integrated model countries mainly have global budgets to reimburse their hospitals, even if in some cases these budgets can be partly adjusted using some DRG-related scales. In addition, physicians are mainly salaried in these countries. This provides strong incentives in relation to limiting the volume of care that will be provided. At the other end of the spectrum, the pure insurance countries have very low constraints on financing, and use fee-for-service arrangements to pay their hospitals and also their physicians. This is true in the Bismarckian social insurance countries, such as Belgium, Germany and Japan for hospital payments, and Belgium, Korea, the Netherlands, Switzerland and the United States for physician payments. Some countries have dual systems. In France, Greece, Mexico and Spain, the public hospitals are mainly funded through global budgets, which involve strong constraints, while the private hospitals in those countries are funded through fee-for-service arrangements, either paid by the social insurance, such as in France, or through private insurance in the other countries.

The dichotomy also involves some more ambiguous cases, such as mixed financing, or DRG-related payments, which involves a mix of cost-sharing with providers: this cost sharing means, in fact, a mix of cost-plus and fixed payment incentives (McClellan, 1997). These payment systems are now used in the US by Medicare and some HMOs, and also in other countries, such as Australia, Finland, Hungary, Italy, Norway and Switzerland. However, except for the United States, these payments are also generally used in conjunction with a general financing constraint, when made by public authorities.

In addition to payment mechanisms, the two groups of countries also differ in the extent to which they use direct potential supply-side constraints, in terms of regulating the availability of dedicated high technology facilities that are involved in these diseases. The public integrated countries often used these constraints to a large extent, either through explicit and targeted funding (for Canada, Denmark, Norway and the United Kingdom), or through formal acquisition policies. The insurance countries on the other hand, such as in Belgium, Germany, Japan, Korea, Switzerland and the United States, often have no specific quantitative constraints on the supply side. The Netherlands had no constraints in relation to stroke care facilities. However, some insurance countries, such as Greece and Australia, still had some targeted funding in relation to IHD care or stroke. In France, specific constraints apply to radiotherapy machines, and in Australia for the purchase of capital equipment for the public sector. Again, in Belgium and the United Sates, no specific restrictions existed in relation to machines (Table 17.4B).

These two different incentive structures of health care systems were found to have profound implications for the aggregate quantities of care that could be provided. For example, for PTCA in the case of ischaemic heart disease, 87% of the variance could be explained through hospital and facility constraints (Moïse, Part IV in this volume). Similarly, these constraints explained a large share of the variance for bypass (CABG), even if, in the case of bypass, need-related indicators were also found to play a role. Ischaemic heart disease seems to be a very good marker of health expenditure, as the number of dedicated facilities seem generally to be linked to health expenditure levels.

The number of facilities is often correlated to the number of treatments. However, we found that the insurance countries, or countries with less financing constraints, had a slightly higher number of procedures compared with the available number of facilities. In the sense of the underlying production function, they seemed to achieve a higher

Table 17.4B. **Potential supply-side constraints affecting IHD, breast cancer and stroke treatment, macro-regulation of facilities**

	Explicit and targeted funding	Explicit constraints or targeted funding	No constraints
IHD	Canada, Denmark, Norway, UK	Australia, Finland, Greece, Italy, Sweden	Belgium, Germany, Greece (private hospitals), Hungary, Japan, Korea, Switzerland, US
Stroke	Canada, Denmark, Hungary, UK	Australia, Greece, Italy, Korea, Sweden	Switzerland, Japan, Netherlands, United States
Breast cancer	*Formal acquisition policies for Mammography and radiotherapy machines:* Canada, Norway, UK *Radiotherapy only:*France	*Purchase of capital equipment for the public sector at local/provincial level:* Australia, Italy, Sweden Formal plans to invest in the machines: Mexico Hungary	*No specific restrictions:* Belgium, Japan, United States, France (mammography)

Note: The dedicated facilities are catheterisation laboratories and cardiac surgery facilities for ischaemic heart disease, CT scanners and Magnetic Resonnance Imaging facilities for stroke, and radiotherapy and mammography machines for breast cancer.
Source: Moïse and Jacobzone (2003); Hughes and Jacobzone (2003); Moon *et al*. (2003).

efficiency in the use of these inputs. Production levels for bypass in Denmark, Italy and Sweden were slightly below what could be expected, while they were slightly above for Germany, Australia and Canada (Ontario). Similar results were found for PTCA, with Finland, Denmark and Sweden having relatively lower rates than expected, while Norway, Australia and the United States encountered higher rates. Norway also recently modified its payment system, to introduce stronger links between activity rates and payment levels, with a DRG-like mechanism.

The impact of the supply-side incentives also exists on breast cancer treatment, but they are less straightforward overall. The link with actual treatment and diagnostic rates was less evident. In terms of screening, available data show a weak link between the number of women undergoing a mammography and the availability of mammography machines (Hughes and Jacobzone, 2003). Here, some countries with public integrated systems, such as the Nordic countries, achieve a fairly high rate of screening, although they have fewer machines than insurance countries such as France or the United States. These findings are consistent with the overall epidemiological trends and the high incidence observed in those countries.

The organisation of care can explain much of the difference. The integrated public systems in those countries have extensive and universal screening programs for women in the target age groups, whereas in the insurance countries, opportunistic screening tends to distribute the screening unevenly. As a result, the second group of countries does not necessarily use the available technology in the most cost-effective manner. In terms of treatment, aggregate supply-side constraints appear to be important in determining levels of radiotherapy for older people. However, this could also be linked to guidelines in relation to treatment patterns. In some European countries, economic incentives were found to clearly impact radiotherapy patterns (Lievens *et al*., 2000; Tonnaire *et al*., 2000) Finally, lack of qualified personnel was also identified as a constraint in some countries, for example the United Kingdom.

The variations are more difficult to ascertain in relation to stroke care (Moon *et al*., 2003). Countries with higher TIA hospitalisations (TIA is a milder form of stroke), are also those with less constraints on hospital financing. The variations in utilisation of

technology such as CT scans and MRI were more difficult to ascertain. The use of CT scan was high in public integrated systems, such as in Sweden and Spain, and appeared to also be high in Australia and Ontario, while the data showed relatively low use in Italy and the US. MRI was generally less used than CT scan, as it is a more recent and costly technology, and was generally more used in the younger age groups.

The patterns in stroke treatment also underline the importance of the organisation of care: a striking additional feature in relation to stroke care is the existence and role of stroke units. Stroke units include multidisciplinary staffing, access to technology and organised care, including acute and rehabilitation care with dedicated staff. These units seem to play a greater role in certain integrated public countries such as Sweden and Denmark, but also in the Netherlands (Moon, Part I in this volume), and much less of a role in the United Kingdom, and could not be identified in Italy or other countries.

If stroke units are as efficient as studies seem to show, why then are they not a part of the regular organisation of hospitals in all countries? A first issue is that a standard definition across studies has not yet emerged and that extreme caution is needed here before any further interpretation. The lack of definition also complicates the planning process for creating stroke units. A second issue is that the concept of a stroke unit is still at an early stage of evolution. In the 1970s it was recognised that organised stroke care, from acute care to rehabilitation, could result in beneficial outcomes for stroke patients (Indredavik *et al.*, 1999). It is only within the last few years, as more evidence supporting the efficacy of stroke units was gathered, that we have witnessed significant growth, particularly in the Nordic countries. A third possible explanation as to why stroke units apparently are not part of the regular organisation of hospitals is the lack of an established evidence base in countries beyond the Nordic countries, which hampers their adoption (Wolfe, 2001). If the proliferation of stroke units in the UK has been retarded by a lack of trial evidence, then this may explain the lack of stroke units.

Stroke units appear to have primarily developed in the Nordic countries, where long-term care is fully funded from the public purse (public funding accounts for as much as 3% of GDP against 1% or less in other European or OECD countries (Jacobzone, 1999), and also in the Netherlands, which is one of the insurance countries with a high level of financing for long-term care. Therefore, care was organised differently when long-term care was of a higher priority, perhaps due to the resultant incentives provided to develop cost-effective care, aimed at reducing disability, compared to other countries which rely more on informal care (Table 17.5).

Qualitative trends and treatment mix

The analysis can be pursued beyond the aggregate treatment and diagnostic trends in order to understand the treatment mix. The results would generally tend to support the view that this mix can be influenced both by medical knowledge, as would be expected, but also by overall institutional aspects, including supply-side constraints and organisation of care. This was generally true when analysing partly substitutable treatments, such as mastectomy and breast conserving surgery, or PTCA *versus* bypass (CABG). Some of these treatments are more invasive than others, but they can also have implication for patients' quality of life, such as is the case for breast conserving surgery. The other factor is that medical knowledge itself is an evolving field, continually modified following scientific advancements. For example, the evidence for use of PTCA grew stronger over time as the

Table 17.5. **The impact of supply-side incentives and the organisation of care**

Disease	Role of the level of supply	Role of the payment incentives and organisation of care
Breast cancer	Strong impact of the regulation of facilities on the availability of mammography and radiotherapy machines). However, mammography facilities not directly linked to screening rates.	Countries with strong organised programmes tend to achieve higher screening rates with lower utilisation of resources. Likely impact on radiotherapy treatment of payment systems in some countries.
Ischaemic heart disease	Significant link between availability of the technology and number of procedures (PTCA/Bypass).	Additional impact of payment incentives on treatment trends (insurance countries, fee-for-service financing tends to intensify utilisation with a fixed number of facilities).
Stroke	Difficulties in interpreting variation. Impact of regulation on the availability of technology (MRI).	Availability of stroke units. Appears to be higher in Nordic countries (in spite of measurement difficulties). Strong role for organisation of care and stroke unit.

Source: Moïse and Jacobzone (2003); Hughes and Jacobzone (2003); Moon *et al.* (2003).

advent of stents reinforced the long-term outcomes and reduced the risk for further interventions and restenosis.

In this context, certain institutional factors were found to either limit or favour the diffusion of less invasive care procedures, as was the case for breast cancer. For example, the rate of mastectomy was found to be relatively low in Norway, linked with lower levels of payment (Norum *et al.*, 1997) which hampered the use of breast conserving surgery followed by radiotherapy. In the Japanese data, the use of mastectomy was forced, in sub-parts of the sample, due to the lack of radiotherapy equipment to perform the conserving procedure. Otherwise, the results were generally consistent with medical knowledge, with a greater proportion of breast conserving surgery among the younger groups, and more mastectomies among older groups, as is often recommended in medical guidelines.

The relative use of more invasive procedures was also evident in the case of heart disease. Besides the technology dimension, the payment mechanisms can also influence the mix of care, in this case the proportion of CABG in the total number of revascularisations. This is due to an even faster rate of use of PTCA, as the rate of CABG use has been further increasing over the period of the study. The insurance countries (Belgium, Germany) rely far less on CABG as a means of revascularisation than PTCA. In an environment where both hospitals and physicians are paid fee-for-service, PTCA may appear as a more attractive alternative, with less fixed-capital costs. The use of CABG is higher in countries with public integrated systems, such as Finland, Sweden, Denmark. However, the results should not be over-interpreted either, as in the United Kingdom, a very low number of procedures is also accompanied by a large share of PTCA. Bypass use also remains relatively high in the United States, which could also be linked to the intricacies of the DRG payment systems, and the relative payments awarded for PTCA and CABG.

The case of stroke reveals some puzzling results concerning carotid endarterectomy: a heavy and invasive procedure, not frequently performed, and performed only in the case of severe stenosis. This seems to be higher in a cluster of three countries, the United States, Australia and Canada. Its use is generally more moderate in the Nordic countries, Japan, Italy and the United Kingdom. The trends over time are generally consistent with the diffusion of medical knowledge, with a fall from 1984 to 1989 in US and Canadian regions

after the publication of studies demonstrating high risk of complication (Tu *et al*., 1998). However, rates started to increase again following clinical trials in the 1990s, which underlined the benefits of carotid endarterectomy. The rates since the mid-1990s seem to have been rather stable for those countries where data could be collected.

Finally, the organisation of stroke care also reveals a greater utilisation of rehabilitative care in Nordic countries, which can be linked to organisation of care, and to the health and long-term care interface. This is also consistent with the information on stroke units (Table 17.6).

Table 17.6. **Understanding qualitative trends and the mix of invasive/less invasive treatments**

Disease	Role of medical knowledge	Overall institutional aspects
Breast cancer	Strong role for guidelines in influencing diffusion of breast conserving surgery. Role of guidelines in utilisation of mastectomy by age.	Relative utilisation of mastectomy high in some countries: link with payment systems, or lack of radiation therapy. Higher rate of mastectomy in Japan, Norway, lower in France, UK, Canada.
Ischaemic heart disease	Diffusion of PTCA following trials on the effectiveness of the procedure. Recent reinforcement with the advent of stents. Role of clinical trials for trends in pharmaceutical utilisation (calcium channel blockers, aspirin).	Utilisation of bypass higher in countries with integrated public systems. Insurance countries generally rely less on CABG. PTCA more attractive under FFS.
Stroke	Utilisation of carotid endarterectomy following clinical trials over time (US/Canada) (in an older period) but discretionary element appears in recent data across countries.	Less relevant. Overall transfers to rehabilitation higher in Norway, Sweden, Ontario. (organisation or care and Health care/LTC interface)

Source: Moïse and Jacobzone (2003); Hughes and Jacobzone (2003); Moon *et al*. (2003).

1.4. *Understanding the use of resources per intervention*

The second dimension to be explored is costs and expenditure. A first issue is to try to understand the production function of the health care system, as different systems seem to exhibit very different production functions. The study was able to build on some of the cost by disease studies, to offer an order of magnitude of the direct costs attributable to the disease studied as a percentage of health expenditure. These studies result from different methodologies and the results have to be interpreted with caution. The main impression is that the share of direct health expenditure attributable to the various diseases studied was relatively comparable across countries. For cardiovascular disease, the share was comparable in Australia, Canada and the United States, given the measurement uncertainty. For heart disease, the share was slightly higher in the United States than in the other three countries for which data was available. Breast cancer seems to represent about 0.5% of total health expenditure, while stroke care is generally close to 3% of health expenditure (Table 17.7).

Length of stay

The results in length of stay are generally consistent across countries, as a decline is observed for most diseases and most countries. However, the patterns across countries are not necessarily straightforward. Incentives for early discharge after breast cancer tend to exist in countries with public integrated systems, such as the Nordic countries, whereas some of the insurance countries tend to experience longer stays, particularly those countries with less constraining economic incentives and fee-for-service arrangements

Table 17.7. **Direct health care costs associated with the three diseases as a percentage of health expenditure**

	Direct costs as a percentage of total health expenditure				
	IHD	CVD (cardiovascular disease)	Cancer	Breast cancer	Stroke
Australia	2.7	11.3	6	0.6	2
Canada	2.9	10.2			3.3
France				0.7	
Netherlands					3
United Kingdom	3.1	7.1	4	0.5	
United States	5.1	10.0	5.2/5.7		2.8

Note: The studies for Australia, Canada and the US use a similar methodology which is different from that used for the UK study for IHD. The figure for IHD-UK are based on 1996 data and the figure for CVD-UK are based on 1995 data.
Source: "Health system costs of cardiovascular diseases and diabetes in Australia 1993-94" (Australia); "Economic Burden of Illness in Canada, 1993" (Canada); "Coronary heart disease statistics: Economics Supplement", British Heart Foundation Health (UK-IHD); OECD Health Database 2000 (UK-CVD); "2001 Heart and Stroke Statistical Update" American Heart Association (US).

(Belgium, Switzerland, Germany). In some countries with public hospitals, such as Italy, or France, the stays were also slightly longer. Generally, the United States has the shortest stays. For ischaemic heart disease, the countries with higher initial length of stay experienced the steepest decline. Finally, stays were generally longer in relation to stroke care in Norway, Sweden and Australia, and also in the Netherlands. In some of these countries, this may be related to rehabilitative care provided as part of the hospital stay. Finally, Japan is an outlier, with generally very long stays, particularly for the above quartile of stays. For this above quartile, the production of care in Japan refers less to health care *per se*, but is more related to long-term care, as hospitals play a *de facto* role (Table 17.8).

These results lead to formulate the hypothesis that all OECD countries tend to evolve along some underlying international production function, which is spread through the diffusion of medical knowledge, and also the influence of US patterns of care on other

Table 17.8. **Trends in length of stay**
The trends refer to the mid- and late-1990s

Disease	General trend	Variance across countries
Breast cancer	General decline for breast cancer: spread of less invasive forms and shorter interventions, but also shorter stays by types of intervention (mastectomy). Reaching the limit for BCS and ambulatory care threshold.	BCS: Shortest in Sweden, Norway, Canada. Higher in France, Hungary, Belgium. Mastectomy: shorter in Canada, Mexico, Norway, higher in Hungary, Italy, Belgium. US data hypothesised to be the shortest.
Ischaemic heart disease	General decline, more pronounced in countries with higher initial length of stay.	Germany, Finland, Switzerland, Hungary, Spain, Belgium above 10 days. Shorter stays in the United States, Norway, Sweden, Australia, Greece, Denmark and Canada. Longer stays in Japan: upper quartile at 40 days.
Stroke	General reduction in most countries. Stable or slight decrease in Netherlands, UK, Italy, Greece.	Higher in UK, Netherlands, Norway, Sweden, Australia. Lower in US, Denmark. Very high length of stay in Japan (over 100 days, MHLW, over 40 days in recent year for VHJ hospitals. Median slightly over 20 days above other OECD countries.

Source: Moïse and Jacobzone (2003); Hughes and Jacobzone (2003); Moon *et al.* (2003).

countries. There is a potential for economic incentives to influence this general convergence and reduction, either in a positive or negative way. Here again, the incentives towards efficient utilisation of hospital resources can be obtained in various health care systems, either through fixed global budgets or fixed payments, as long as the payments involve high-powered incentives towards the reduction of stays. However, the length of stay itself remains an imperfect indicator of resource use, as it does not tell us much about the actual utilisation of medical resources, technology and qualified labour. They usually represent the bulk of the costs, and are often incurred at the beginning of the stay. Therefore, shorter stays will not necessarily result in savings, even if they bring about a better and more efficient utilisation of the infrastructure resources.

Unit costs

A closer look at unit costs per treatment would be more meaningful as an economic analysis of the differences of prices across countries, although health care treatments are not generally traded internationally. Detailed results have been collected for the three diseases. However, these results originate in some cases from detailed costing studies and need to be interpreted with caution. Therefore they cannot be interpreted as pure price signals in the way an economist would hope for. Aggregate costs will also be influenced by the mix of treatment provided. Even if a country has lower costs overall, if the more expensive bundles of treatment are used more frequently (such as CABG against PTCA), then aggregate costs will be higher.

Difficult methodological issues were faced in relation to unit costs. The detailed data are presented in the technical reports. In some cases, as in Canada, or Denmark, these estimates reflect charges that payers pay for IHD treatment. Charges may not necessarily reflect the actual resources used. Estimating actual resources involves estimating the share of the fixed costs involved in the treatment, which implies methodological assumptions as to how these are being divided. Generally, the results tended to support the view that costs for various types of bundles of acute care treatment for ischaemic heart disease were slightly higher in Japan, due to the length of stay, and also in the United States, compared with European countries, Australia and Canada.

The unit expenditure for stroke care related to a stroke admission were relatively comparable for those countries where representative data are available (Canada, Australia, Denmark, Italy, and Norway). The variance was much higher in relation to TIA admissions. However, the exact severity of TIA can also vary across countries. For carotid endarterectomy, very few data were available. Again, it seems that the unit costs are relatively higher in Japan, and also in Korea, which could be attributed to length of stay (Moon *et al.*, 2003).

The results across countries are also qualitatively similar for cancer. The costs of the first six months of treatment were broadly comparable in a number of European countries (France, Belgium, Italy, Norway. This is even more accentuated in Norway by the fact that mastectomy was generally used to a larger extent in this country, in relation to lower costs (Norum *et al.*, 1997). The Australian results were slightly above these, but come from a very small sample with an academic hospital. The US results overall, from various HMOs and Medicare, are above those observed in the European countries.

More detailed insights can be obtained for breast cancer by age groups and severity. Various results by age groups, which were however not fully comparable across countries, show that costs are higher for younger women (France, US, Canada). The costs were also

higher in France for women not followed under the organised screening programmes which results from the severity effect. In most countries, costs for more advanced stages are higher than for earlier stages, which is one of the key findings in cost-effectiveness studies assessing the cost-effectiveness prior to implementation of breast cancer screening programmes (Butler *et al*., 1994). More severe stages involve higher costs, but with different patterns. Again, here more severe stages involve higher relative costs in the United States than in the other countries, such as Australia and France. Some Canadian studies showed less of an increase in spending in Canada for the more severe stages.

From an economic perspective, the interesting finding is the steep increase found across stages in Australia, France and the United States, which are insurance countries. The increase is only very moderate in Canada for the younger age groups, and it disappears for the older age groups. The younger age groups traditionally have higher costs of treatment, as breast conserving surgery plus radiotherapy is slightly more costly in the initial phase. This may receive the following interpretation: it could be hypothesised that women in older age groups and with more advanced stages may be treated less intensively in Canada than other countries. This would be consistent with the patterns of radiotherapy, with significantly less use in some Canadian provinces, particularly among the older age groups. Either due to patient preference or physician recommendation, older women may be opting for mastectomy in order to avoid radiation therapy. There is a sense that the goal may be to maximise cost-effectiveness per treatment in the Canadian health care system, where more expensive procedures of care have to be used with more parsimony than in other health care systems. However, important information on the relative costs of additional chemotherapies, and the decomposition of costs was not available. This represents a severe limitation to the study. Finally, various costing studies in Australia and the United States have reported higher costs for decedents than for survivors, which is generally consistent with the costs of health care in relation of the timing to death (Moïse and Jacobzone, Part III in this volume).

2. Do we get value for money?

Policy-makers are generally interested not only in the relationship between incentives and throughputs, but also in what happens to patients and how much this costs. The discussion of the policy levers which can affect treatment patterns has been conducted in the first part of this paper. The issue of resources per intervention and costs was also investigated, with its limitations. However, if the analysis is to inform performance, the study has to discuss links between actual resources and outcomes. The ARD study collected and analysed disease-related outcomes in a cross-country perspective (Moon, Part I in this volume). In this section, we will further discuss any evidence of a correlation between outcomes and interventions. However, in some cases, the results can be attributed both to prevention and care. Therefore, we also need to give attention to specific aspects of medical prevention, either of the disease itself, or of its disabling consequences. Finally, in order to obtain a full understanding of performance the analysis has to consider all the potential parameters that can influence performance and discuss those that are likely to be amenable to policy interventions.

2.1. Understanding aggregate trends in health outcomes in relation to resource utilisation, the case of IHD and stroke

Macro-level trends

The easiest, and perhaps best, population-based aggregate measure of health outcome trends for IHD and stroke are trends in mortality rates. Since the 1970s, age-standardised mortality rates have been on the decline in the majority of OECD countries, but at different rates (Moïse, Part I in this volume; Moon, Part I in this volume). How great a role has the health care system played in bringing about these reductions? The analysis can be done for two periods: either from 1970 to the mid-1990s or from 1980 to 1995. Given the rapid change in IHD treatment that occurred in the 1990s, the current analysis will focus on the latter period. During this period, the countries that achieved the greatest reductions in IHD mortality included Australia, Canada the United States, Sweden, Denmark and Belgium. Italy also achieved significant reductions, but more for women than men. These countries differ from each other in the mix of health care services used to treat IHD and belong also to the two general categories of health care system identified in the discussion.

Belgium and the United States are using procedures intensively, while Australia, Canada, Italy, Sweden and Denmark are using them in a more moderate way. However, the United Kingdom and Finland, who were among the countries using technologies to a lesser extent, were not in the group. The United Kingdom, Finland, Norway and Switzerland also experienced less of a decline. Switzerland, with a more intensive technology utilisation, achieved only modest reductions in mortality, which was also the case for Germany.[2] Other countries experienced a slight increase, but one which can be attributed to a different phase in the epidemiological transition. For example, Spain experienced a significant increase in the 1970s, and a moderate decrease since then; Greece and Korea are also experiencing an increase, albeit from low initial levels, which can be linked to the general westernisation of lifestyles in these countries.

While health care treatments may certainly explain some of the success in reducing IHD mortality rates, there have to be other contributing factors. As evidence from other studies shows, especially the WHO-MONICA study, the reductions in underlying risk factors have played a significant role. Analysts such as Cutler commonly summarise the situation in saying that around two-thirds of the reduction was due to the decrease in risk factors, and one-third to the impact of medication and treatment. Perhaps the most cited example of this is the change in smoking patterns since the 1970s. For example, Australia, Canada and the United States not only saw the largest reductions in IHD mortality during this period, but they also saw the largest reductions in tobacco consumption. Germany, Sweden and the UK had lower declines in IHD mortality as well as lower declines in tobacco consumption. Conversely, tobacco consumption increased in Denmark, Finland, Italy and Norway at the same time that IHD mortality rates were decreasing.

While the patterns for stroke reveal reductions in general, they are different from those observed for ischaemic heart disease. They are also much more difficult to interpret, since the relative role of risk factors is different. Generally, the countries experiencing a decline in IHD mortality also experienced a decline in stroke mortality, except for the Nordic countries in the stroke sample, Denmark and Sweden. However, these countries initially had low mortality rates and their end-period mortality rates also remain very low. Japan and Hungary are specific cases, due maybe to a different epidemiological transition in Japan, and specific higher morbidity patterns in the former Eastern European countries (Table 17.9).

Table 17.9. **General trends in mortality across countries for IHD (80-95) and stroke (80-97)**

	Countries with a decrease		Countries with an increase or stable rate	
	Starting with higher level	Starting with lower levels	Starting with lower level	Starting with higher level
	Men			
Ischaemic heart disease	**> 450** With significant decrease (> 3%/year) Australia, Canada, United States, Sweden, Denmark, Belgium. Moderate decrease (under 3% a year) Finland, UK, Norway, Switzerland.	**< 450** Germany, Belgium. Italy, Japan, Spain.	**> 450** Greece Korea.	**< 450** Hungary.
Stroke	**> 150** Switzerland, Italy, Australia: strong reduction. Reduction in the UK albeit with higher end levels.	**< 150** Canada, US continuous decrease. Netherlands, decrease with stabilisation as from 1990.	**> 150** Denmark and Sweden, slight increase albeit at low levels, with end results comparable with other countries showing a decrease. Low and stable level in Spain.	**> 150** Specific pattern in Japan: no clear trend. Hungary stable and slightly increasing mortality at very high level.
	Women			
Ischaemic heart disease	**> 350** With significant decrease (> 3%/year) Australia, Canada, United States, Denmark, Moderate decrease (under 3% a year) Denmark, Finland, UK, Norway, Sweden.	**< 350** Germany, Belgium, Italy, Japan, Spain.	**< 350** Germany, Greece, Switzerland Korea (very low level), Spain.	**> 350** Hungary (stable).
Stroke	**> 150** Switzerland, Italy, Netherlands, Australia: strong reduction. Reduction in the UK albeit with higher end levels.	**< 150** Canada, US continuous decrease. Netherlands, decrease with stabilisation as from 1990.	**> 150** Denmark and Sweden, slight increase albeit at low levels, with end results comparable with decreasing ountries . Low level in Spain.	**> 150** Specific pattern in Japan Hungary stable mortality at very high level.

For the US stroke trends relate to 1990-97.
Source: Moïse and Jacobzone (2003); Hughes and Jacobzone (2003); Moon *et al*. (2003).

Without inferring any direct causal interpretation, we observe that at an aggregate level the countries with the highest activity rates, in terms of intensive procedures, do not necessarily achieve the steepest reductions in IHD mortality. However, the analysis would deserve to be conducted at a deeper level. Several factors can drive mortality trends for IHD, such as tobacco, diet, alcohol, but also income, drug consumption, together with access to high-tech acute care. For stroke, the role of certain determinants can only be mentioned, but not discussed at this stage. In addition, the role of high technology for stroke is to provide better diagnoses, but these technologies are not specifically life-saving treatments, as is the case for IHD. Therefore, the discussion for stroke remains open. Further analysis would involve econometric investigation, following the path set up by Or (Or, 2000). Some specific internal results are available for IHD. However, their level of technicality exceeds the limits of the current publication.

Understanding microlevel trends in health outcomes: case fatality

Figure 17.1 shows results collected by the ARD study in collaboration with the TECH research network depicting the correlation between treatment trends in terms of the proportion of AMI patients receiving a revascularisation procedure (CABG + PTCA) within 90-days of initial admission, and outcomes, in terms of the proportion of patients who died within one-year of the initial admission on the y-axis. As these charts are based on patient-linked data, they were derived from a reduced sample of countries (where these data were available).

First, these charts are consistent with the macro-picture. The most obvious depiction from these charts is that they clearly separate those countries with a higher use of revascularisation as a means of treating AMI [the US and to a lesser extent Australia (Perth)], from the countries that rely less on this method [Canada (Ontario), Finland and Sweden]. These charts are also consistent with the diffusion of technological trends analysed in Moïse (Part IV in this volume), with more procedures being administered to broader categories of patients, particularly in older groups for those countries which are adopting technology at a faster pace. We also witness that the increase over time in the proportion of patients receiving revascularisation procedures is accompanied by a decline in case fatality.

A second observation is that there is a need to discuss whether these findings actually reflect any causal implication, or whether this is perhaps due to an artefact, or other unobserved heterogeneity due to non-measured variables. A first observation is that the declines in mortality seem to be relatively fast from year to year, with significant declines observed in Ontario 1995-96, or Sweden/Finland 1996-97. It seems difficult to attribute such modifications to a sudden change in case mix as in theory AMI is a well-defined diagnostic and as changes in case-mix are only occurring very slowly in the population.

A third observation is that modest increases in revascularisation rates in Ontario and Sweden, or Finland for the 65-69 age groups, have been accompanied by significant declines in case fatality for the elderly. The United States experiences higher increases in revascularisation rates, particularly for the elderly, but similar declines in mortality. For younger age groups, the pattern is more mixed, with some declines in case fatality in Finland, Sweden and Ontario, and a mixed picture for the United States.[3] However, for older groups, and for comparable years, the US case-fatality rate was the lowest, though by a modest margin.

From an economic perspective, these charts are also reflective of various production functions across countries. These charts tend to support the view that Ontario, Perth, Finland and Sweden are more or less on the same production function. The United States is either on a different production function, or on the part of the same production function exhibiting decreasing marginal returns to health interventions: the US also experiences reductions in case fatality, but these do not seem to be in line with the additional amount of resources invested.

2.2. The case of breast cancer

Assessing performance is a complex task in the case of breast cancer, which ideally would involve relating resource use to the multivariate analysis of variations in survival and in mortality. However, the survival data cannot be fully analysed because severity cannot be fully controlled for across countries, due to differences in classification. The

available data in terms of aggregate survival offer only mixed evidence. Gatta *et al.* (2000) compare trends in survival between American and European cancer patients: survival rates are higher in the United States than in Europe, particularly for those cancers, such as breast cancer, where treatment and screening can make a difference. However, the conclusions based on cancer-registry data remain very limited, as they cannot adjust for stage and disentangle the relative roles of treatment *versus* screening. Evidence exists that shows that, generally, screening is very intensive in the United States, and that as a result the cases are, on average, less severe.

For breast cancer, the detailed results show that performance, in the sense of a cost-effective use of available resources,seems to be achieved through a mix of rigorously organised population-based breast cancer screening programs, combined with the availability of treatment protocols able to follow the most recent clinical guidelines, and not too constrained by economic considerations (Hughes and Jacobzone, 2003). The insurance countries can also achieve high rates of screening, albeit at a higher cost, as opportunistic screening often involves a much higher number of mammography machines. However, a strategy relying on prevention only, or on treatment only is not sufficient to achieve performance. In addition, further data needs to be developed, to better assess the efficacy of screening programs across countries, and evaluating the severity of stages in a consistent way at the international level.

From our analysis, we can also note that the public integrated systems seem to have been leading the way in implementing the organised screening programmes. However, when these systems suffer severe financial restrictions, they may not be in a position to fully enjoy the benefits of preventive measures. The insurance countries are usually more aggressive with regards to treatment, and may deliver high rates of screening, albeit at a higher cost, through opportunistic screening programmes. However, these systems seem to be addressing performance more on the curing than the prevention side, and when they do not include the prevention dimension, they may also experience difficulties in delivering performance.

2.3. Trends in disability and quality of life

The analysis on performance has only considered the measures that could be collected as part of the study, which is focused on the reduction of death. Other dimensions of health interventions such as the reduction of complications, the improvement in patients' quality of life, in terms of levels of impairment could only be partly investigated. However in the case of stroke, significant data was collected that could show how specific health interventions are designed to improve performance. For the other diseases, this dimension exists but is implicit in the data we have collected.

For breast cancer, due to early screening less severe cases are likely to receive less invasive interventions and to offer better quality of life to patients. In the case of ischaemic heart disease, one of the aspects of acute interventions is to improve quality of life. Some more detailed analysis of the US/Canadian results shows that the type of CABG that is applied to Canadian patients, that the highest differences are for single vessel disease, where no life expectancy gains have been demonstrated from randomised trials, but where surgery can contribute to enhancing quality of life (Tu *et al.,* 1997). Less aggressive strategies with more conservative care were also found to obtain better and lower death rates than an aggressive surgical strategy across European countries (Time Investigators, 2001). Finally, US/Canadian studies have found (Mark *et al.*, 1994), that Americans underwent many more

expensive procedures than Canadian patients. Canadian patients were more likely to have chest pain symptoms and to report limitations in their daily activities, even if this had no impact on work status and subjective ratings of their own health.

The case of stroke was interesting, since data could be collected on specific interventions designed to improve quality of life, such as stroke units. However, data on actual quality of life was not available. These interventions were more frequently available in the Nordic countries, with a greater amount of time spent in rehabilitation. In spite of statistical measurement difficulties, stroke units were also more consistently reported in these countries than others, and seemed, from the fragmented data that could be collected, to be offered to a higher proportion of patients.

A full assessment of the impact of health systems would involve population-based quality of life indicators, over time and across countries, with a possibility of linkage to health interventions. This would be the only possible path to explore the potential causes explaining the reductions in disability which have been observed in a number of countries (Manton and Gux, 2001; Jacobzone *et al*., 2000). The results would also tend to support the view that medical interventions have generally reduced the debilitating symptoms of disease over time for a range of major conditions (McClellan and Yan, 2000), while the potential contribution of other factors, such as education and lifestyles across various age cohorts needs to be acknowledged (Freedman and Martin, 1998 and 1999).

3. Discussion

3.1. *Getting it right: maximising the potential for health interventions*

The results of this study underline the complexity of any research addressing performance at an international level. Improving value for money for a given health care system involves a multidimensional strategy, including:

- delivering the appropriate amount of care in terms of quantity of treatment in a timely manner;
- delivering the appropriate mix of treatment, when various alternatives or substitutes are available;
- targeting treatments to those patients who have the right indications and are the most likely to benefit;
- improving efficiency in the production process, through adequate use of hospital resources;
- improving value for money, through minimising costs, and possibly minimising providers' rents, while preserving quality.

Various health care systems seem to have different strengths. Some health care systems can deliver a large quantity of care overall. Some are far more costly than others. The issue of treatment mix remains open, as it can be subject to economic and institutional incentives. Finally, some health care systems may remain below their frontier production function, as they incur relatively high-production costs or providers operating at less than full capacity.

3.2. Different perspectives on improving performance : from macro system performance to patient's satisfaction and improved quality of life

The study investigated outcomes in relation to treatment trends and other factors. However, this is not a clinical study, and therefore the analysis of medical interventions remains limited from a clinical perspective. Patient's satisfaction, in terms of improved quality of life, could at best be measured in an indirect way. Collecting such data was beyond the scope of the current study, but would certainly represent a good direction for future research. However, this specific dimension is often key to understanding public expectations towards health systems.

When assessing performance, various stakeholders have different parameters in mind that they wish to evaluate. Physicians' focus in terms of the clinical success of health interventions, is likely to remain limited to the inpatient episode of care, or its immediate follow up. Patients tend to assess their satisfaction both in relation to the quality of their stay in acute care, but also to the long-term gains in quality of life, the reductions in pain and disability that they have experienced. In addition, patients often focus on other issues associated with the episode of care: length of waiting time, availability of nurses and support staff and quality of life, including suffering and physical functioning. At the aggregate level, health care system administrators are likely to have more interest in general health system variables: overall activity rates, mortality rates and costs. The ARD project is an attempt at bridging the micro-macro gap in knowledge in understanding the broad effects of health systems, representing an example of how the various stakeholders' perspectives can be reconciled.

One of the strengths of this study is the demonstration of the link between health care system supply-side incentives and the level and diffusion of various key procedures reflecting the use of technology. The study also found that additional life-saving technologies can help to make a difference in terms of outcomes, although they are likely to be costly. The study also found that universal coverage does not necessarily guarantee that utilisation rates for treatments are the same across countries, since OECD countries devote very different levels of resources to health care, each within their own universal system. Conversely, high utilisation rates achieved in some countries do not mean that all needs are appropriately covered, and that the interventions are all conducted to maximise cost-effectiveness. These higher activity rates observed in some countries do not necessarily translate into improvements in outcomes that parallel the investment in resources, as some lower-spending countries are able to achieve similar results. Higher activity rates do exert pressures on the financing side, as evidenced from the higher-spending European countries, and from North America.

Overall, the results of the study tend to show that only a multi-layer approach is best placed to successfully tackle the challenge of performance: significant results can be achieved through a proactive population-based approach, including prevention, screening, and proper follow-up treatments. For example, significant reductions in tobacco consumption together with better dietary patterns can be linked to a significant part of the variance in mortality for heart disease over time and across countries. In breast cancer, organised population-based screening programmes can also make a difference in terms of trends in survival and mortality.

Assessing performance for health treatments is a challenging task, as a given level of health expenditure has to be confronted to a certain production of health, in terms of outcomes. The health expenditure results from quantities, largely influenced by the

technical intensity and technological diffusion, and unit prices. The study found some evidence of a link between treatment intensity and outcomes, but the link remained weak, and associated with decreasing marginal returns to scale. Therefore, additional quantities could be beneficial, if only they could be purchased at a reasonable cost-per-unit. The costs per unit are difficult to compare. However, at an aggregate level, they appeared to be relatively high in the United States, which would impact on the relative performance of this system, in terms of cost-effectiveness. They were also relatively high in Japan, as treatment involved a very long length of stay in this country. However, in certain countries, outcomes seemed to have been affected by too stringent restrictions on resources. Therefore, our results suggest that an effective health care system is one where expenditures are sufficient to avoid excessive resource restrictions, and where these resources are optimised, for example through rational and cost-effective use of modern technologies.

An additional derived output of this study is both to underline the value of information systems. Existing information systems have made significant progress in OECD countries, and allow the measurement of key parameters of performance. However, in a significant number of countries, the existing information could not be fully utilised, as the information remained confined to acute care and possibilities of linkage across datasets remained limited. The issue of the continuum of care is particularly important for older persons with multiple interventions and can only be tackled through longitudinal information. For example, data on ambulatory care and pharmaceutical utilisation remained extremely limited. It would be quite important and cost-effective for OECD economies to further develop their information systems on health, as health currently represents up to 10% of modern economies.

Finally, the focus on older persons underlines the structural transformation that health care systems are facing. Not even mentioning the other challenges due to ageing, such as the ageing of the providers themselves and the shortages of staff faced with increased needs, this study shows the broad impact of population ageing on the ways in which health care is administered, and the values that are associated to health care in a modern society. In a sense, a growing proportion of the population is now surviving acute events that were fatal in the past, but that now leave individuals with more years to live, conditional on adequate follow-up and timely interventions. This is both a reward and a challenge to the future. This growing part of the population is also more likely to continue suffering from various forms of chronic diseases, which have not been addressed in the current study. A challenge for further research would be to investigate the impact of the growing share of chronic disease on health care systems. Only through proactive strategies and a careful and targeted use of resources will health care systems be able to address this second phase challenge.

Given limited resources, health care systems risk facing increasing demands that would result in either a growing share of the population facing difficulties in accessing treatments that would no longer be covered, or having to endure significant waiting times to access the required care. Only an adapted strategy can help monitor those changes in a way that maximises the cost-effectiveness of health care systems across all age groups. This study has shown the potential for international research in a field where comparative international evidence remains at best scanty and where policy-makers are searching for further answers. It is the hope of the authors of the current study that further research will shed more light on these challenges.

Notes

1. From the CANAM data supplied to the study.
2. Although the German case is very specific, as the data include East Germany as of 1990.
3. The US data for the 40-64 age group refer to California only.

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PART VI

Chapter 18

Information Needs and the Implications for Monitoring Health Systems:
The Australian Experience

by
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Abstract. *This paper outlines the information needs underlying the health information system in Australia and the implications these have for the ability to monitor the performance of the health system. We discuss the use of indicators in performance monitoring and the role of information frameworks in providing a basis for their development. The major Australian data sources to support the development of performance indicators are outlined, and their current and likely futures uses for performance monitoring discussed.*

Introduction

The Australian health system is highly complex. It is characterised by differing roles and responsibilities at different levels of government along with a mixture of service providers and types of services. The public sector plays a larger role than in the United States, ensuring universal access to health services under Medicare, while the private sector plays a larger role than in the United Kingdom, allowing greater responsiveness to individual choice of services and providers. Indeed, as Andrew Podger, the former secretary of the Commonwealth Department of Health and Ageing, noted in his address to the 2001 Measuring Up conference (OECD, 2002):

> "*(…) the word 'system' implies an heroic assumption: that there is a total design that someone has prepared and can control. More often we are faced with a wide range of semi-autonomous players and our role – and our power – is limited to shaping and enabling rather than directing and controlling. Governments have various social objectives, including addressing market failures: but the fact that there is a market makes me particularly conscious that the system may have multiple objectives for multiple stakeholders. Moreover, many of those objectives may be significantly influenced by factors outside the system*" (Podger, 2001).

In terms of ageing related health conditions, the "Intergenerational Report" recently released by the Commonwealth Government as part of the 2002-2003 budget papers has focussed attention in Australia on the possible large increases in health spending over time, partly but not primarily associated with the ageing of the population. This will now focus more attention on ageing-related diseases, their risk factors and cost effective treatment (Australia Treasury, 2002).

Given these challenges for the "health system" it is not surprising to see corresponding challenges for "health information systems" (Podger, 2001). This paper will outline the information needs underlying the health information system in Australia and the implications these have for our ability to monitor the performance of the health system.

1. Developing indicators

The aim of monitoring the health system is to provide a way of determining whether or not the system is performing to an "acceptable" standard. This concept of performance monitoring implies an agreed set of objectives against which performance may be judged and an agreed set of indicators for these objectives. It is possible for a nation to agree on an overarching set of health system objectives and to derive an associated parsimonious set of performance indicators. For example, the New Zealand Ministry of Health undertook this process using evidence based criteria and derived a set of 13 priority population health objectives (MOH, 2001). These objectives range from the relatively broad ("to improve nutrition") to the very focussed ("to reduce smoking") but their specific nature means that associated indicators may be readily constructed.

The Australian health system, with its differing levels of government, is somewhat more complex than that of New Zealand. The Commonwealth and State and Territory

governments have agreed on six National Health Priority Areas (NHPA) – cardiovascular health, cancer control, injury prevention and control, mental health, diabetes mellitus and asthma. Together, these account for 70% of the total burden of disease and injury in Australia (Mathers *et al.*, 1999). However, this process of prioritisation has not yet led to the development of overall objectives for the whole health system.

The Australian National Health Performance Committee (NHPC) has developed the following set of criteria for potential performance indicators (NHPC, 2002). Such indicators should:

- be worth measuring;
- be measurable for diverse populations;
- be understood by people who need to act;
- galvanise action;
- be relevant to policy and practice;
- enable measurement over time to reflect the results of actions;
- be feasible to collect and report;
- comply with national processes of data definitions;
- facilitate the use of data at the health industry service unit level for benchmarking purposes; and
- be consistent and use established indicators where possible.

Such a set of criteria may be sufficient to identify potential performance indicators, but they leave open the issue of how large a set of indicators is necessary to adequately monitor the health system. There is a need both for detailed information to support analysis of appropriate interventions, and for more selective higher-level information to allow Ministers to drive priorities and make broad resource allocation decisions. Andrew Podger (2001) noted that the then Australian Health Minister frequently expressed his exasperation with multiple indicators for multiple priorities which he rightly said is a way to avoid rather than support, let alone drive, major priority decisions.

This tension between a small set of broad summary indicators and more detailed data needed to support specific health policy initiatives is not unique to Australia. Clive Smee (2002) argued that in the UK it is proving most useful to focus on a very parsimonious set of key indicators. However, as Wolfson and Alvarez (2002) note, in WHO consultations as well as in Canadian discussions, concerns have been raised about the practical usefulness of such broad summary indicators. In particular, there is a tension between an indicator that is (at least superficially) easy to grasp, and the kinds of measurements that are relevant to decision-makers, and provide the basis for practical decision making. Wolfson and Alvarez refer to this as the need for additional information to "connect the dots". That is, information to bridge impressions given by summary indicators and the more specific policy levers and choices available to governments and other decision-makers.

An example of implementing different indicators for different levels of the health system is given by the BreastScreen Australia program. This is the program for the early detection of breast cancer via mammographic screening. It is jointly funded by the Commonwealth and State and Territory governments and consists of a network of dedicated screening and assessment services throughout metropolitan, rural and remote areas of all Australian States and Territories. Each service is administered locally and co-ordination of service delivery is done by the relevant State or Territory government.

A comprehensive system of accreditation is used to ensure that all BreastScreen Australia services operate under a common set of standards. Each service is assessed on a regular basis by an independent team to ensure that the service provided complies with national standards. This assessment is based on a set of around 60 nationally agreed indicators. Each State or Territory reports on program performance using a smaller set of related indicators. Further, there is a national report on program performance using a nationally agreed set of eight indicators. Finally, the BreastScreen Australia National Advisory Committee is about to be asked, as part of the NHPC process to develop public health performance indicators, to prioritise these eight indicators to allow one to be chosen for inclusion in a set of national key indicators.

In general, the development of national performance indicators within a complex system such as the Australian health system requires some prioritisation of health conditions in order to focus monitoring on the areas of most interest. The Australian federal system also requires indicators of relevance to State or Territory health policy makers as well as indicators to support the broader national policy concerns. Finally the number and detail of the indicators needs to be suitable for the different needs of actors within the health system – ranging from very detailed indicators to support the development of specific local health initiatives to a much smaller number of broader indicators to support State and Territory or national policy development.

2. Information framework

Reports on health system performance in Australia have traditionally focussed on health and health service indicators, with many of the indicators relating to institutional-care and acute-care settings. This is due, at least in part, to the fact that these indicators are relatively easy to define and collect. As part of its terms of reference, the NHPC has developed a broad national health performance framework and used it as the basis for the 2001 National Report on Health Sector Performance Indicators (NHPC, 2001 and 2002; see Figure 18.1).

This framework is a modification of the Canadian Health Information Roadmap framework. Both use the same three basic fields of information:

- health status and outcomes;
- determinants of health; and
- health system performance.

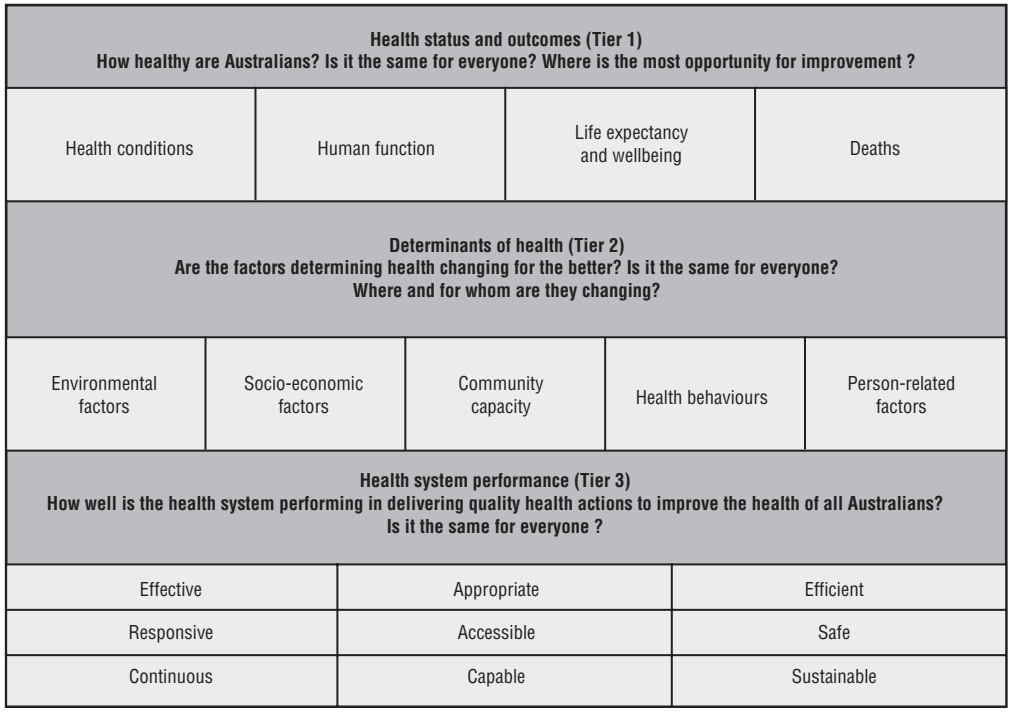
As Andrew Podger (2001) observed:

"*This has the particular advantage of a breadth of coverage, recognising the importance of the determinants of health which are not necessarily managed within health portfolios (…). Canada has a fourth tier on contextual information about Community and Health System Characteristics (the Australian framework has) an additional determinant based on the concept of community capacity. We also include a sustainability dimension within health system performance and have reorganised the content of Canada's acceptability and competence dimensions into dimensions of responsiveness and individual or system capability.*"

Podger also noted that:

"*Equity is integral to the framework. The question, 'Is it the same for everyone?', is posed for each dimension. It is intended that data against the indicators will reflect differentials by age, sex, rurality, Aboriginality, socio-economic status and jurisdiction to provide information about performance in addressing inequities, and to highlight possible scope for improvement. Our aim*

Figure 18.1. **The national health performance framework**



Source: NHPC (2001).

is to apply the framework at all levels and in all sectors of our health system, including at the individual program level and for particular regions. A validated and endorsed structure on how to approach the appraisal of health system performance that supports benchmarking for improvement will minimise the risks of a plethora of conceptual frameworks proliferating, each associated with data collections for which limited comparisons can be made."

The 2001 NHPC Report is the first report on health sector performance based on the new framework. It includes not only indicators relating to health sector performance but also health status and health determinants. It ensures that while the traditional areas of effectiveness, efficiency and quality are included, areas such as the capability and sustainability of health sector performance are not overlooked.

The success of the NHPC hinges largely on its ability to encourage the various jurisdictions and/or sectors of the health industry to work within the parameters of the framework. It is already being applied to the construction of indicator sets for national sub-sector reporting, for instance involving the National Health Priority Areas and Child and Youth Health, and provides a structure for reporting on the health of the nation in our Australia's Health biennial report.

3. Sources of data

Information frameworks and related performance indicators are only as good as the data available to support them. Australia has a well-developed statistical system, and is well served by institutions with a major commitment to national health information. Among these, the Australian Institute of Health and Welfare (AIHW) and the Australian Bureau of Statistics (ABS) play leading roles in the collection and reporting of information on health and wellbeing. These two agencies, together with the Commonwealth, State and

Territory Health departments and the Health Insurance Commission are responsible for implementing the National Health Information Agreement (NHIA). This is the agreement under which health information priorities and directions for development are identified.

A major product of the NHIA is the National Health Data Dictionary (NHDD). The NHDD is the authoritative source of health data definitions used in Australia where national consistency is required. It is updated annually and is designed to improve the comparability of data across the health arena. It is also designed to make data collection activities more efficient by reducing the duplication of effort in the field and more effective by ensuring information to be collected is appropriate to its purpose. In a similar way, a National Community Services Data Dictionary has been developed to improve the comparability of data across the community services arena.

This rest of this section will discuss the major sources of health related data, describing their strengths and weaknesses, giving examples of their use in indicator development and considering future directions in the context of an ageing population. It will also discuss the potential for linkage between different sources of data, which is one major direction for addressing some of the current gaps in health related data.

In general, these sources of data are most relevant to those areas of the framework relating to direct measurement of health and the performance of health services. This reflects both the historical focus of data collection in these areas and the fact that such data continue to be easier to define and collect.

3.1. Survey data

The current situation

The ABS National Health Survey has been run roughly every five years since 1990. Enumeration of the 2001 National Health Survey was conducted from mid-February through to December 2001 with results expected to be released from September 2002. This is a household-based survey with data collected using interviewers. It covered approximately 20 000 households, leading to a sample size of around 34 000 people. The topics covered included:

- demographic, socio-economic and geographic characteristics;
- health status indicators;
- health risk factors; and
- health related actions.

In addition some supplementary women's health topics such as contraceptive use and participation in breast and cervical cancer screening were collected in a separate self-completion form.

The National Health Surveys are designed to support estimates at the national level, and, for more common health characteristics, estimates for individual States and Territories.

A separate survey of Aboriginal and Torres Strait Islander people was conducted during the second half of 2001 (from June to November) in association with the National Health Survey. This provides indicators of the health of Indigenous people, and enables comparisons between the health characteristics of Indigenous and non-Indigenous Australians.

A separate Disability, Ageing and Carers survey is run roughly every five years by the ABS. This focuses on activity limitations and participation restrictions resulting from health conditions, and generates the Australian estimates of disability prevalence, as well as use of formal and informal services.

In addition to this survey program, the ABS has run a number of one-off surveys addressing key aspects of health information, including the National Nutrition Survey, which was run in conjunction with the 1995 NHS, and the National Survey of Mental Health and Wellbeing.

The ABS also has a more general survey program called the General Social Surveys (GSS) program, the first of which is currently in the field. It does not have a specific focus on health, apart from one question on self-assessed health status. However, it does cover a broad range of social issues such as education, income and family issues that are relevant to an appreciation of the population's health. This program also includes an Indigenous Social Surveys (ISS) program focussed on Aboriginal and Torres Strait Islander people, the first of which is scheduled for later this year. The GSS is intended to be run every three to four years, while the ISS is planned to be run at least every six years.

The ABS has been trialing the use of Computer Assisted Personal Interview (CAPI) technology for some time. While the NHS retained the traditional paper based survey forms, the GSS uses CAPI and it is also proposed for the ISS except for some remote area respondents.

There is a separate program of National Drug Strategy Household Surveys now operated by the AIHW, which are designed to collect information on tobacco, alcohol and illicit drug use in the community. The results of the most recent of these, conducted in 2001, have just been released.

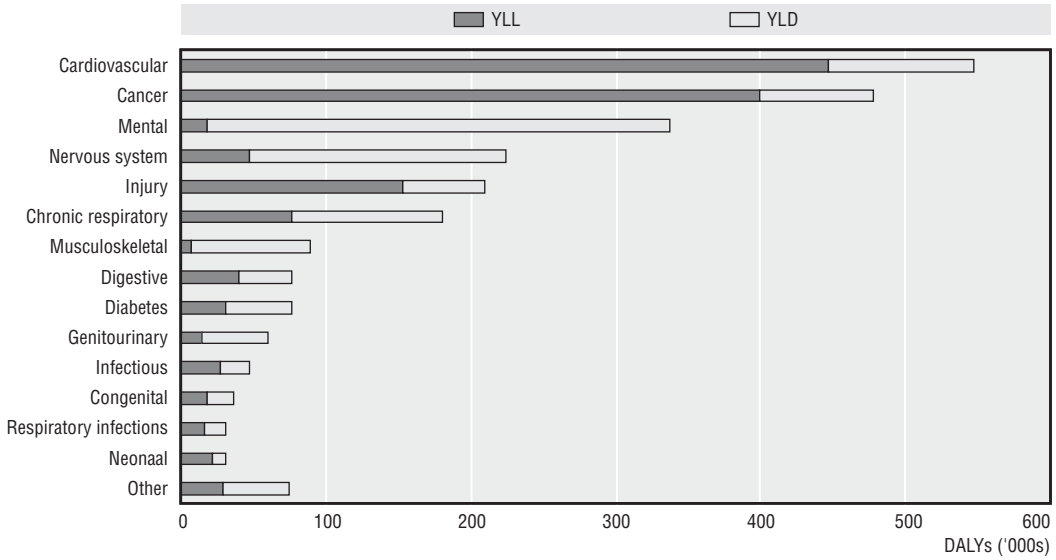
These surveys all share the limitations of self-reported data. That is, the accuracy of the results depends on the reliability of respondents' memory and understanding of their health actions and conditions and their willingness to report accurately on these. Further, because of the limitations of sample size, they are unsuitable for reporting on small geographic areas or small population groups. However, they constitute the only source of data on many aspects of population health such as disease prevalence, risk factor prevalence and health related behaviours. For example, the data underlying Figure 18.2 that show the size of the burden of mental illness relative to other major health conditions in Australia were a major part of raising the profile of mental health among policy-makers. These data depended heavily on prevalence data collected by the National Survey of Mental Health and Wellbeing.

Future directions

Trend analyses. Perhaps the most vital health information need in an ageing world is an answer to questions concerning the likely future health and disability states of future cohorts of older people. With an ageing population, one of the critical information needs in Australia is an indication of disease and disability trends over time. While much information can be gained from our existing cross-sectional analyses, there is a need for longitudinal survey data to further inform this issue. In addition, cohort analyses of existing cross-sectional data provide a potential but under-developed source of information on this topic.

While some other countries have generated longitudinal data on this topic, the quality and quantity of information available is not yet sufficient to provide definitive answers on these questions. The debate as to current and future trends in severe disability prevalence

Figure 18.2. **Burden of disease (YLL, YLD and total DALYs) for major disease groups, Australia, 1996**



DALY: Disability adjusted life-years.
YLL: Years at life lost.
YLO: Years lived with disability.
Source: Mathers *et al.* (1999).

at older ages remains unresolved – and it is severe disability prevalence which is of interest to those responsible for policy development and implementation.

Biological risk factors. A major gap in Australia's population health data is the lack of a data source for population measurement of biological risk factors such as blood pressure and cholesterol levels. A pilot survey is planned for February 2003 for the first Australian Health Measurement Survey (AHMS), which will include a range of physical and biomedical measures including the taking of blood samples from survey respondents. If the pilot is successful, the full national survey is planned to be run in conjunction with the 2004/2005 ABS NHS.

Bridging modules. Information on health status and health systems is not collected without expense, and the resources available are unlikely to expand substantially in years to come. The use of "bridging modules" in surveys (and indeed in administrative by-product collections) provides a little used but relatively simple strategy for maximising the "bang" achieved for the "buck" in the health information arena. Bridging modules (such as a "disability module" in a health survey, or a "health module" in a household expenditure survey) allow analyses from diverse data sources to be drawn together to address problems and topics not readily considered in relation to one survey alone. In an ageing society, the inter-relationship of health, disability, employment, income, family structure and formal services use will become increasingly apparent, and the capacity to link specific surveys (such as disability and expenditure) would prove valuable in informing policy responses.

3.2. Register data

The current situation

Deaths. Australia has virtually complete registration of all deaths. Each State and Territory maintains a jurisdictional register of deaths. The causes of death for these data

are coded according to the ICD-10 coding system and compiled by the AIHW into two national death registers. One of these is a de-identified data set containing demographic characteristics and details of cause of death. This is used for most analyses of mortality. The other, known as the National Death Index, contains identifying information and is used in matching against other data to establish fact and cause of death.

In addition, the AIHW maintains two health registers as a source of data on specific conditions – cancer and diabetes. Their main use is for data on disease incidence and the demographic characteristics of people with the specific condition.

Cancer. Cancer in Australia is a notifiable disease. Notifications of new cases of cancer are collected, mainly via pathology laboratories, and compiled by State and Territory cancer registries. Details of each case covering an agreed minimum data set are compiled by the AIHW into a national cancer statistics database. The AIHW also does a linkage between each of the State and Territory registers to identify and remove duplicate notifications to minimise double counting in reporting national cancer data.

The quality of data on a register is dependent on its sources of data. For example, each year approximately 350 000 new cancer cases are diagnosed in Australia. A large proportion of these, approximately 270 000, are non-melanoma skin cancers (NMSC) which, if treated early, are less life threatening than most other cancers. NMSC are not registrable cancers, so cancer registers do not usually record their details. This is because most are not histologically confirmed, or not reported. These skin cancers are often self-detected and are usually removed in doctors' surgeries. Hence even where there is legislative backing for data collection in the declaration of cancer as a notifiable disease, cancer registers are unable to maintain complete coverage of Australia's most common cancer.

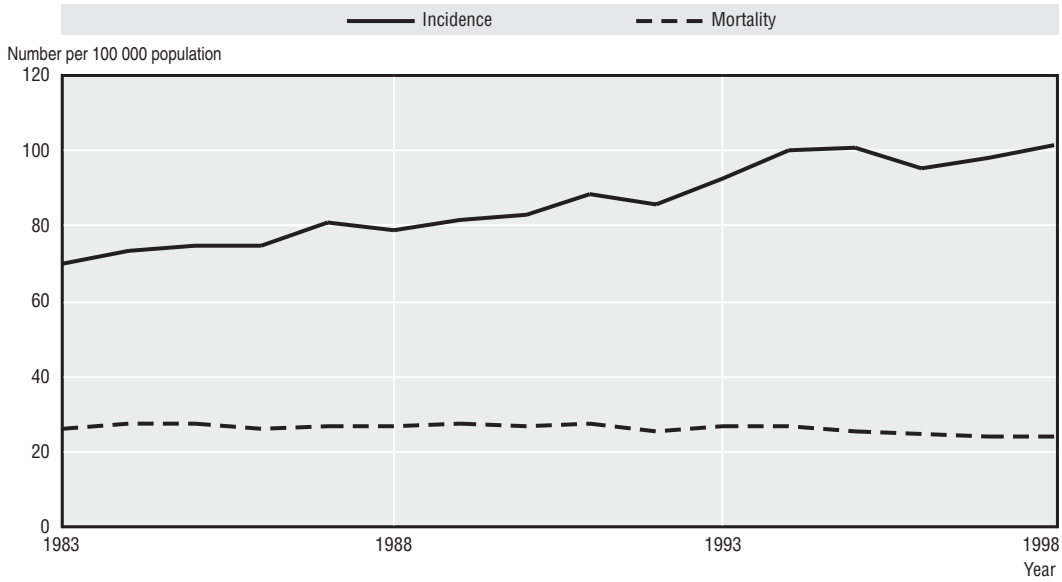
Notwithstanding the inability of the register to cover the most common Australian cancer, it has provided virtually complete data on the incidence and mortality associated with all other cancers including Australia's most common causes of cancer death (lung, colorectal and, among women, breast cancers). These have provided a vital underpinning to our understanding of how to manage and, where possible, prevent these cancers. For example, the incidence and mortality for breast cancer shown in Figure 18.3 are a necessary, though not sufficient, part of monitoring the performance of Australia's breast screening program.

Diabetes. Diabetes is not a notifiable disease in Australia. This means that, while the cancer register can be considered virtually complete for all but NMSC, the diabetes register does not cover all cases of diabetes.

The register focuses on people with insulin-treated diabetes mellitus. There are two main suppliers of data for the Register – the National Diabetic Services Scheme (NDSS) database, a national scheme to subsidise test kits and syringes for people with diabetes, and Australasian Paediatric Endocrine Group (APEG) State-based databases. The NDSS database collects information about people with diabetes in all age groups, whereas the APEG data focus on people with Type 1 diabetes who are under 15 years of age.

Unlike the cancer register, the diabetes register has required written consent from participants before they can be entered onto the register. This is a source of coverage problems for the register. Consent rates for NDSS participants are currently around 72%. However, an initial survey of non-consenting eligible NDSS registrants suggests that further follow-up could substantially increase this consent rate, and new registration arrangements, consistent with Australia's privacy legislation, are now under consideration.

Figure 18.3. **Trends in age-standardised incidence and mortality rates for female breast cancer, Australia, 1983-98**



Source: AIHW and AACR (2001a).

Future directions

Expansion of disease coverage. The disease registers, in combination with the deaths register, provide central information for trend analyses, prevalence and incidence data and mortality rates. Cardio-vascular disease and stroke are two major causes of death for older people that could usefully be informed by register-based data. In an ageing society, more attention is likely to focus on chronic diseases with high levels of morbidity, rather than simply on those which are major causes of mortality. Dementia and arthritis are obvious examples of areas in which disease registers could yield important information.

Development of procedures registers. Increasing technological advances suggest that the development of procedures registers would provide valuable information for health systems management. Currently in Australia there are two such registers, one for angioplasty and one for coronary artery bypass grafts, but they record the total number of such procedures for each hospital rather than the details of each procedure for each patient. There is considerable interest in developing patient-based registers for cardio-vascular procedures, the primary motivation being patient safety and quality of treatment. Should such developments occur, the capacity for data linkage between disease and procedures registers and deaths registers would clearly provide additional benefits.

3.3. Administrative data

There are a number of major health data collections based on administrative data. The Health Insurance Commission maintains a database of medical encounters reimbursed under the Medicare system and a database of prescriptions filled under the Pharmaceutical Benefits Scheme. The AIHW maintains a database of hospital episodes collected from most public and private Australian hospitals. These data provide a rich source of information on the delivery of health services in Australia. However, they suffer from the limitation that the data are collected for the purposes of administering the health service rather than for

the purpose of monitoring the health system. This has two major drawbacks. The first is that the data are not necessarily collected in a form that is useful for health monitoring. Medicare data contain no information on health condition or reason for encounter. The AIHW hospital database has information on each episode of care in participating hospitals. However, it is not possible to link these into a data set of people receiving care. The second major drawback relates to privacy issues. Because the data were not originally provided for monitoring purposes, access for this purpose may be limited.

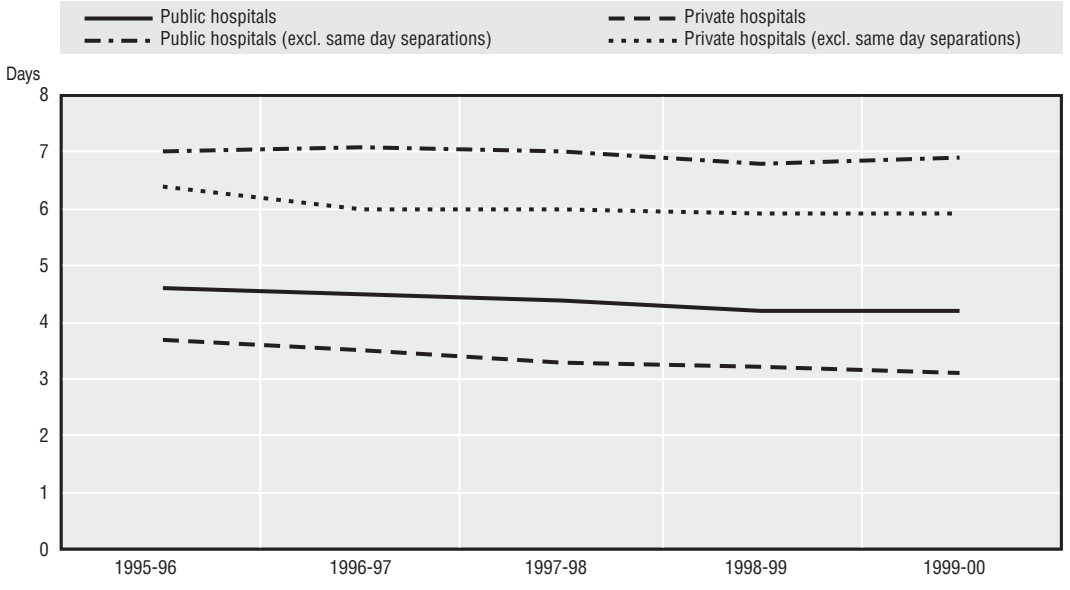
Despite these drawbacks, administrative data collections provide the source for much of the data used in direct measurement of health system performance. For example, Table 18.1 presents data on average length of stay (ALOS) in Australian hospitals for the most common diagnosis related groups by hospital sector and Figure 18.4 presents ALOS by hospital sector

Table 18.1. **Average length of stay (days) for the most common DRGs by hospital sector, Australia, 1999–2000**

Diagnosis related group ranked by highest number of separations, excluding same day separations	Public	Private	Total
Vaginal delivery without complicating diagnosis	3.08	4.80	3.49
Oesophagitis, gastroenteritis and miscellaneous digestive system disorders age > 9 without catastrophic/severe complications and comorbidities	2.63	3.74	2.87
Caesarian delivery without complications and comorbidities	4.90	6.48	5.48
Cholecystectomy without closed common bile duct exploration without catastrophic or severe complications and comorbidities	2.3	2.61	2.47
Chest pain	2.22	2.67	2.30
Tonsillectomy, adenoidectomy	1.22	1.14	1.19
Inguinal and femoral hernia procedures age>0	1.89	2.02	1.96
Hysterectomy for non-malignancy	4.37	5.33	4.80
Bronchitis and asthma age < 50 without complications and comorbidities	2.10	2.68	2.15
Heart failure and shock without catastrophic complications and comorbidities	6.38	8.43	6.85

Source: AIHW (2001a).

Figure 18.4. **Average length of stay for hospital admissions by hospital sector, Australia 1995-96 to 1999-2000**



Source: AIHW (2001a).

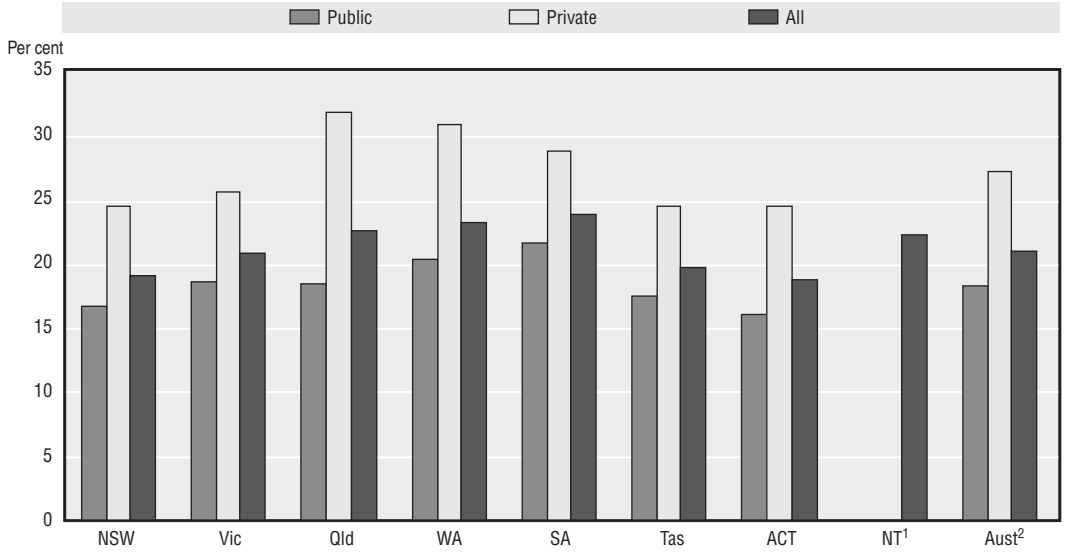
Table 18.2. **Caesarean sections as a proportion of all confinements, Australia, 1990-99**

Percentage

1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
17.5	18.0	18.3	19.0	19.4	19.3	19.5	20.3	21.1	21.9

Source: Nassar *et al.* (2000).

Figure 18.5. **Caesarean sections as a proportion of all confinements by patient accommodation status and jurisdiction, Australia, 1998**



Source: Nassar *et al.* (2000).

for the period 1995–96 to 1999–2000. This was designated by the NHPC as a key efficiency indicator under tier 3 of the framework (NHPC, 2002, p. 51). Table 18.2 presents caesarean sections as a proportion of all confinements in Australia for the period 1990-99 and Figure 18.5 presents caesarean sections as a proportion of all confinements in Australia for 1998 by patient accommodation status. This was designated by the NHPC as a key indicator of appropriate health care under tier 3 of the framework (NHPC, 2002, p. 47).

Future directions

Data linkage. The topic of data linkage is addressed in detail in the next section. However, most data linkage work in the health field in Australia has focussed on clinical record linkage, as is evident in the developmental work on electronic health records, or on linkage between disease registers and the death register. There has been limited linkage of administrative by-product data concerning patterns of service use.

In an ageing society, an increasing proportion of the population will suffer from chronic disease, and from chronic disease interspersed with acute disease episodes. The interfaces between care sectors (residential aged care/hospital/sub-acute care/home-based care) will become increasingly important. Moreover, these interfaces are themselves undergoing substantial change in an environment where both acute and chronic care have been increasingly moved to the community rather than institutional care sector (through

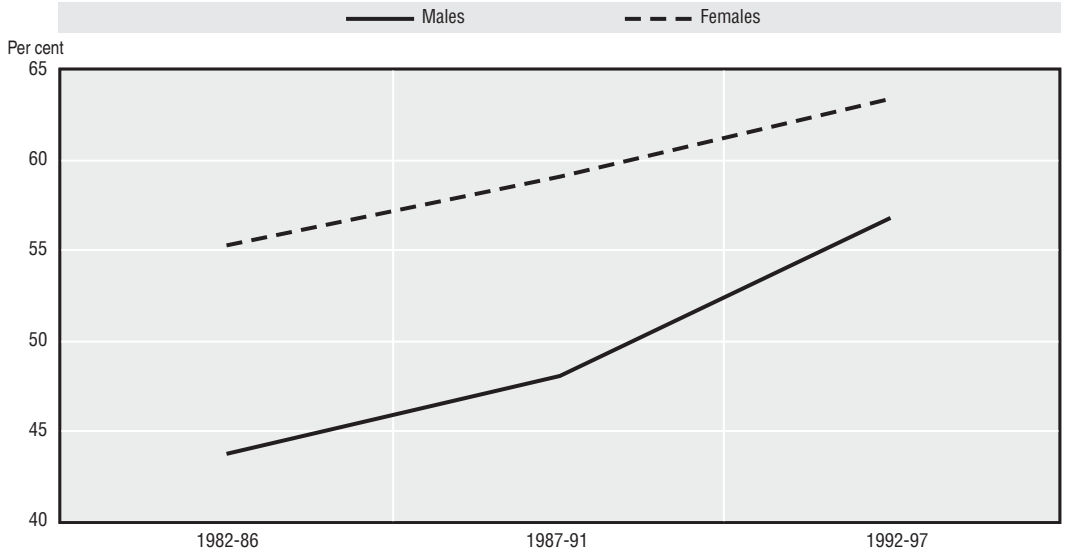
day surgery, shortened length of stay and expanded home care, including hospital in the home programs). Linkage of service use data drawn from administrative by-product information systems provides a valuable and relatively inexpensive way of examining the movement of clients across these interfaces, and through sectors of care, with a view to informing future health care system planning. Statistical linkage keys provide a mechanism for this linkage which protects the privacy of individuals whose records are being linked. The development of such linkage keys that can be used across data collections is thus an important direction for future data development of health systems. The topic of statistical linkage keys is addressed in detail in the next section.

3.4. Data linkage

While it is not currently possible to link health survey data with other data sets, it is possible to link data between health registers and administrative collections. The AIHW has built considerable record linkage experience using its National Death Index and the National Cancer Statistics Clearing House. The primary use for this has been to allow researchers outside the AIHW to link their data with these data sets, under strict confidentiality and ethical conditions, to establish fact and cause of death or to verify cancer diagnosis. The AIHW has also used such linkage to establish survival after cancer diagnosis. A study of national level relative survival after cancer diagnosis has already been published (AIHW, 2000) and a study of survival by State and Territory, broad geographic region and socio-economic status is currently being prepared. Results from this study have been designated as a key effectiveness indicator under tier 3 of the framework (Figure 18.6) (NHPC, 2002).

Several States are establishing linked data sets with matched records from local hospital morbidity, mortality and other records. Western Australia in particular has used health record linkage extensively in health studies.

Figure 18.6. **Five year relative survival proportions for all cancers excluding non-melanoma skin cancer by diagnosis period, Australia, 1982-86 to 1992-97**



Source: AIHW and AACR (2001b).

Data linkage directly confronts major confidentiality issues in its use of identified or identifiable unit record data. These can only be partially addressed by the use of confidentiality guidelines and ethics committee approval. Data linkage methods have been developed using confidentialised linkage keys, which allow the production of de-identified, linked unit record data sets while protecting the confidentiality of those whose records are on the databases. A full description of this methodology is beyond the scope of this paper. However, the AIHW in collaboration with the Commonwealth and Western Australian Health Departments, the University of Western Australia and the Health Insurance Commission has used it to develop a pilot project for linkage of hospital, medical and deaths data for patients with diabetes. This project has been approved by the AIHW Ethics Committee and is intended as a model of "best practice" in the use of administrative data for the production of de-identified linked data files. The project is not yet complete, but the model is already under consideration for other record linkage projects including a linkage between BreastScreen Australia screening participation and outcome data, the AIHW cancer and deaths data bases and the Health Insurance Commission's Medicare database.

The move to more general electronic storage of health records provides an opportunity for extensive health record linkage. In November 1999, Australian Health Ministers established the National Electronic Health Records Taskforce to consider a national approach to electronic health records.

In July 2000, following consideration of the Taskforce Report, Ministers agreed in principle to the development of a voluntary national health information network based on electronic health records, known as HealthConnect, and agreed to the establishment of a HealthConnect Board to develop and test the concept. Under HealthConnect, a person's health-related information would be collected in a standard electronic format at the point of care (such as at a GP's clinic) and stored in a networked storage service. This information would take the form of event summaries, rather than attempting to include all of the notes that a health care provider may choose to keep about a consultation.

With the consumer's consent, data from these summaries could then be retrieved any time they were needed. It would be exchanged via secure network services between only those health care providers authorised by the consumer.

As Andrew Podger notes:

"The benefits of HealthConnect for direct patient care are clearly substantial. However, the secondary uses of the wealth of data that could be collected and stored under HealthConnect also potentially offer great benefits. Such secondary uses of this data could include:

- *assessing the cost-effectiveness of various treatments and interventions;*
- *monitoring disease outbreaks and adverse reactions;*
- *establishing registers for diseases, devices and treatments; and*
- *identifying where quality improvement is most needed and monitor improvements over time.*

A separate but related development involves an electronic medication record. The aim is to improve provider and consumer access to medication information, thereby improving patient safety and health outcomes. Under this initiative, known as the Better Medication Management System (or BMMS), prescriptions written by different doctors or dispensed by different pharmacists will be linked to create individual medication records.

In effect, BMMS will form the medication component of what should evolve into HealthConnect. As with HealthConnect, the data held in the BMMS will be able to be used for research, policy and planning purposes."

To aid in the appropriate management of these resources, an extensive infrastructure of ethics committees is being established, guided by the Australian Health Ethics Committee of the National Health and Medical Research Council. In addition, as part of a number of activities to develop national networks and privacy principles for electronic health records, business rules for linking statistical collections using unique patient identifiers have been developed.

A note of caution is important here. All the electronic health record initiatives now under development depend on explicit client consent. Take-up is therefore not likely to approach full coverage for many years. Traditional statistical collections from various sources will therefore be with us long into the future.

The use of *statistical linkage keys* derived from key elements of client records and used to link administrative by-product records as has been referred to in the preceding section. The Australian Institute of Health and Welfare has included such linkage keys in a number of collections, including the national disability services data collection, the national home-based care data collection and the soon to be implemented national aged-care assessment collection. This same key can be derived from the residential aged-care database, allowing the linkage of client records with an estimated 98-99% accuracy. The Institute has commenced work on analysing the movements of aged-care clients between the home-based care and residential-care sectors.

The Institute has also been engaged over the past 18 months in a project exploring the feasibility of linking residential aged-care and hospital morbidity data using a series of data elements. The feasibility study is now complete, and the findings are promising, suggesting in the vicinity of a 90% accuracy in data linkage. The acute-care/residential-care interface is of particular policy importance in Australia at present, and the linkage project has been of particular interest to health administrators.

3.5. *International data*

There is wide interest internationally in the measurement of health system performance. National level indicator sets have been constructed in many countries, including the United States "Leading health indicators for healthy people 2010" and Canadian health indicators developed under the Health Information Roadmap initiative.

The use of international health information is dependent on the level of international data standards. The Canadian Institute for Health Information proposed to the International Standards Organisation (ISO) in 2000 that it develop and promulgate a standard for health indicator frameworks. It argued that such a framework would provide a shared reference point and enable more comparable and consistent indicator development. The Canadian proposal, based on the Health Information Roadmap framework, has subsequently been considered by the ISO's Health Informatics Committee. Elements of the Australian modification have been debated as part of this process and some, such as the focus on inequalities across the entire indicator framework and the inclusion of genetic health determinants, have been accepted as useful additions.

In addition to the development of frameworks, international health information also requires agreement on appropriate indicators. For example, Australia is a part of the Commonwealth Fund Working Group on Quality of Care Indicators. This project aims to choose indicators of process and outcomes that are closely linked to medical care. Examples of such process indicators include screening rates for cervical and breast cancer

and vaccination rates for influenza for the elderly. Examples of outcome indicators include survival rates after a diagnosis of cancer, acute heart attack or stroke. Work on these indicators has reached data collection stage among the five participant countries (Australia, Canada, New Zealand, the United Kingdom and the United States). Other indicators, which are currently under development, include safety indicators and waiting times. The Nordic countries (Denmark, Iceland, Finland, Norway, and Sweden) have formed a working group and are in the design phase of a similar project.

Even without complete agreement on international data standards, it is possible to use some international comparisons as a measure of the success of Australia's health system. For example, Australia and New Zealand are often compared as countries with a similar cultural background. The New Zealand Ministry of Health is currently preparing estimates of five-year relative survival rates for cancer similar to those published by the AIHW. These estimates are not yet available, but the AIHW has published a comparison of incidence and mortality between the two countries (AIHW and AACR, 2001a). New Zealand males and females have incidence rates for all cancers except NMSC approximately 2% higher than those of Australian males and 5% higher than those of Australian females. Mortality rates in males are 5% higher in New Zealand. However, female mortality rates in New Zealand are 27% higher than those of Australian females (Table 18.3).

Table 18.3. **Cancer incidence and mortality for Australia and New Zealand, 1998**

	Incidence		Mortality	
	Males	Females	Males	Females
	Rate per 100 000 population[1]			
Australia	340.9	268.7	143.5	91.9
New Zealand	346.6	283.3	151.0	117.0

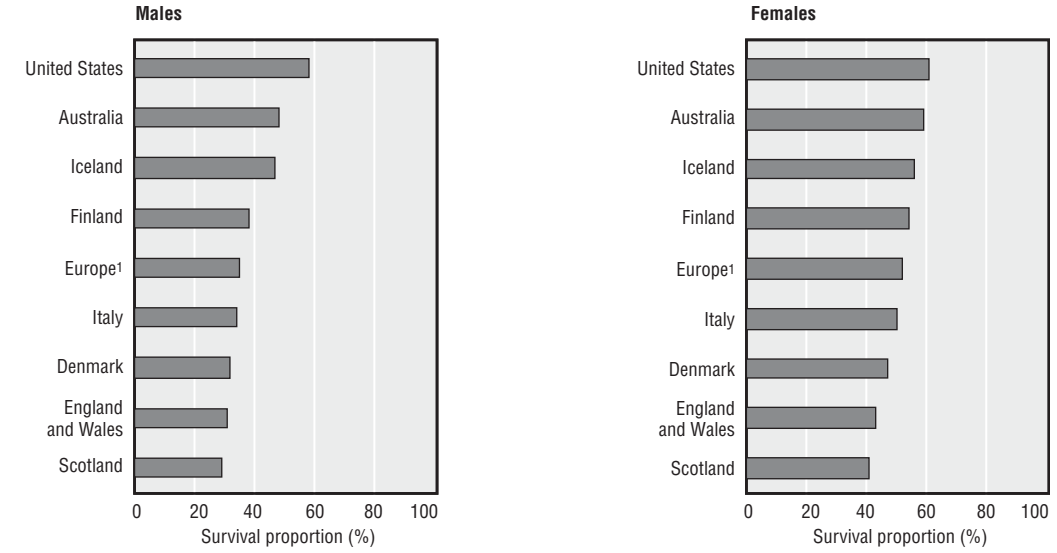
1. All rates age standardised to the World Standard Population.
Source: AIHW and AACR (2001a).

Some other countries have published five-year cancer relative survival rates. Figure 18.7 shows a comparison of these rates between selected countries. These data are not strictly directly comparable, but they are close enough to show that cancer survival in Australia is slightly worse that in the United States, comparable to Iceland and Finland and significantly better than in the United Kingdom and a weighted average across European countries.

To compare the health status of populations across regions, countries and time, a common measure of disability is essential. The previous OECD workshop on this topic in 1999, followed up in Stockholm in 2000, showed the wide difference in measures in use in different countries and surveys and the widely differing estimates that result. Since then, the Washington City group has been established by the United Nations Statistical Commission, with a first meeting in Washington in February this year. The emphasis there is not specifically on aged people, but there was a consensus to work towards common approaches based on limitations of activity and participation for both censuses and surveys. Emphasis will be on severe disability.

In 2001, the World Health Assembly endorsed the International Classification of Functioning, Disability and Health (ICF), the culmination of a long development process through the 1990s. The ICF provided a common language and structure for describing

Figure 18.7. **All cancers five-year relative survival proportions: selected countries**



Note: The survival period varies among countries, but is broadly within the 1987-1991 period.
1. Weighted average.
Source: Berrino *et al.* (1999); Coleman *et al.* (1999); Ries *et al.* (1999) as reported in AIHW and AACR (2001b).

disability, covering body structure and function, activities and participation and environmental factors. It can be hoped that all interested parties will join in the work towards common approaches to disability measurement.

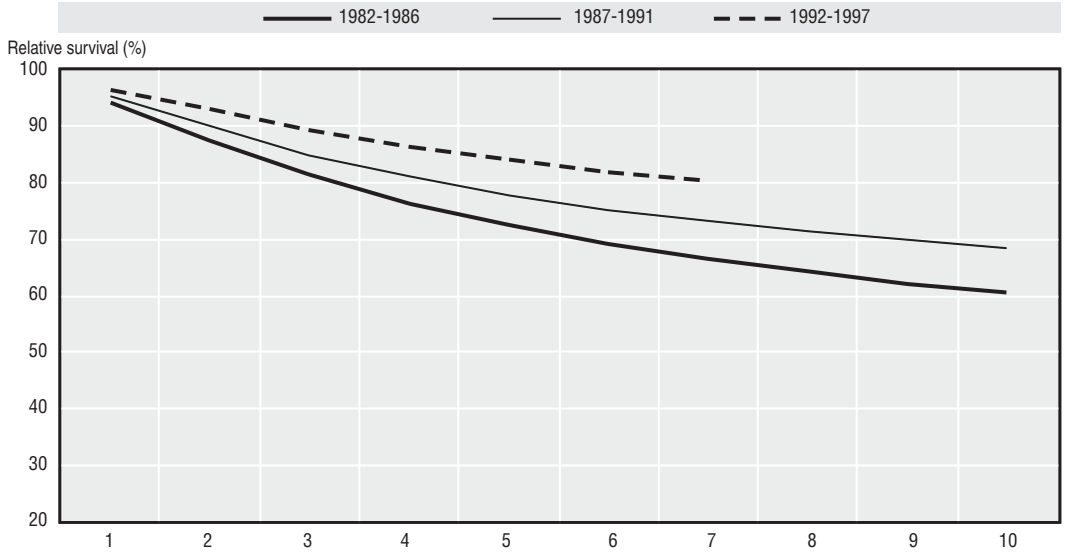
4. Using data for performance monitoring

A key feature of using indicators to monitor the performance of the health system is the ability to attribute movements in the indicator to the operation of specific parts of the health system. Unfortunately it is rarely the case that the outcomes of specific health interventions can be related directly to national indicators.

Again the BreastScreen Australia program illustrates this difficulty. Indicators such as population participation in screening can be used to monitor the effectiveness of delivery of program services but they do not directly measure the program's ultimate outcome – the reduction in breast cancer mortality. Recent publications in the medical literature have questioned the value of mammography screening in reducing mortality (Gotzsche and Olsend, 2000). Breast cancer mortality has declined and patient survival increased as would be expected if the screening program was having an impact (Figures 18.3 and 18.8). However, there are other factors such as changes in cancer treatment and patient management, which may have also had an effect on mortality. The BreastScreen Australia program was first introduced in 1991. Mortality rates for breast cancer were relatively stable from 1983 to 1994 but declined after 1994. Breast cancer incidence rates rose from 1983 to 1998 and there was a concurrent increase in relative survival. While this suggests an effect of other factors besides screening, the indicators themselves cannot answer the issues raised by those questioning the value of mammography. These require appropriate focussed research and evaluation studies. The BreastScreen program is planning to commission just such a study of mortality and its relationship to screening.

Another issue in the development of key summary indicators is the development of suitable health measures to support them. A major part of the use of indicators is in

Figure 18.8. **Relative survival proportions for female breast cancer by period of diagnosis, Australia**



Source: AIHW and AACR (2001b).

comparison between interventions. Such comparisons require health measures which can combine mortality and morbidity measures in a consistent way across disparate disease conditions. The Australian Burden of Disease (BOD) study used the Disability Adjusted Life Year or DALY (Mathers *et al*., 1999). Other studies have used different forms of health or disability adjusted life expectancy. These measures require international acceptance and standardised, validated methods of calculation if they are to be useful in health policy formation.

It is interesting to consider what performance indicators have made a difference in the Australian health system. Indicators which appear to have had little effect include the accreditation status of hospitals and hospital beds per head of population. Blood cholesterol and blood pressure measures have not had the impact they have perhaps deserved because of the difficulty of measuring them on a population basis.

On the other hand, the burden of disease analysis has raised the profile of mental health and some other chronic disorders and the risk factor attribution in the BOD study was an important factor in increasing the focus on physical inactivity and inadequate consumption of fruit and vegetables as health risk factors (Mitchell *et al*., 2002). The move from using hospital waiting lists to hospital waiting times as a measure of hospital performance was helpful as waiting times is a measure which is better defined and less open to manipulation.

The lack of routine data on adverse events provides a good illustration of the difficulties that can then arise. A 1995 study based on retrospective review of hospital records resulted in the publication of estimates of 18 000 deaths annually in Australia and 16.6% of hospital separations associated with an adverse event (Wilson *et al*., 1995). Much alarm resulted, especially when comparisons were made to several US studies. Subsequent re-analyses have shown the position in Australia to be comparable to the US, with some 2.5% of hospital separations associated with a significant adverse event (Runciman *et al.,* 2000). Action is now in hand to achieve more reliable reporting of adverse

events from hospital separation statistics, where estimates to date show 4.5% of hospital separations associated with a significant adverse event.

A discussion of the use of performance indicators raises the question of the appropriate audience for these indicators. Government policy-makers require relatively broad indicators to support policy development. Indicators at a more local level are required to support the implementation of specific health interventions. The audience for these will include clinicians and health service providers as well as policy-makers. Another audience for indicators at all levels will be consumers of health services and the general public. A consequence of this is that publication of indicator data must be done in a way that is sufficiently complex to support their use by health service providers and policy-makers but is also simple enough to be interpreted by consumers and the general public.

5. Future directions

A necessary future direction is the development of common definitions for data items and standards for data collection and coding. Analyses of recent trends in disability provide a clear example of the problems arising from a lack of common definitions. Recent studies from the United States and some European countries have suggested that disability prevalence rates among older people have started to decline and that the improvements have mainly occurred through reduced levels of moderate or mild disability (Cutler, 2001). On the other hand, no evidence of a decline in disability rates has been reported for Australia, the United Kingdom and some other developed countries (Jacobzone *et al.*, 2000; Schoeni *et al.,* 2001; AIHW, 2001b). Many of the apparent trends in disability prevalence can be explained by changes in the way such disability is measured. So there is no clear information on direction of trends in OECD countries because of differences in concepts and definitions.

Standardisation in collection and coding practice can also address some issues of data quality. For example, the Working Party's summary of results from the ischaemic heart disease (IHD) study used an international comparison of deaths rates from IHD to classify countries into those with high demand for IHD health care services and those with low demand. While all the countries under study have mortality data collection systems which should support such a comparison, potential differences in how the deaths data are coded could undermine the use of this comparison. Murray and Lopez (1997) provided convincing evidence that a significant and varying proportion of IHD deaths are coded in many countries to ill-defined codes such as ICD9 code 428 (heart failure).

As noted in Section 3.3, in an ageing society the interfaces between care sectors (residential aged care/hospital/sub-acute care/home-based care) will become increasingly important. So another direction, which is related to the development of data standards and definitions, will be an increasing use of data synthesised from different sources. At the simplest level this could involve the use of bridging modules as described in Section 3.1 to allow analyses from diverse data sources to be drawn together to address problems and topics not readily considered in relation to one survey or administrative collection. At the more complex level, it would involve linkage of records between different collections based on a common linkage key.

Linked data sets allow us to develop longitudinal data, which are critical in assessment of the outcomes of specific interventions – for example in investigating death rates following surgery. In a broader sense linked data allows us to follow people's paths

through the various interfaces between care sectors. This is particularly important in understanding issues around management of disability.

The development of the Australian National Health Data and National Community Services Data Dictionaries is the strategy underpinning the development of data standards in Australia. The AIHW work on these dictionaries recognises the need for common standards to apply across the diversity of data collections at all levels of the Australian Health System. These dictionaries are updated annually and are available from the Institute's website as well as in printed form. In addition, a fundamental part of the development of data, which is both focussed on local needs and centrally accessible, is national agreement on minimum data sets on which to build national data collections. The dictionaries and their associated data standards and definitions are a key support to the development of Australian statistical frameworks and performance indicators in the health and welfare area.

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PART VI

Chapter 19

Ageing and Health Policy: The Value of International Comparisons and the Potential of Surveys to Add a Missing Perspective

by
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Abstract. *Despite the varying nature of their health care systems, there is significant opportunity for developed nations to address and anticipate the health care needs of aging populations by learning from other countries' experiences. Cross-national surveys can provide uniform measures to track change, inform policy debates, and enhance researchers' ability to compare and to identify areas for further inquiry. Surveys can overcome some of the difficulties posed by administrative data, and have the unique potential of assessing and comparing system responsiveness from the perspective of patients and families' care experiences and perceptions. This article uses results from two recent multinational surveys to highlight insights on aging issues and to illustrate the potential of surveys to provide a unique perspective.*

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Introduction

Developed nations share common concerns of how best to address and anticipate the health care needs of aging populations in the 21st century. The fact that we often approach these concerns very differently due to our different delivery and financing systems yields opportunities to gain insight and spark new thinking by looking beyond our borders.

To stimulate new work from an international health policy perspective, the Commonwealth Fund, referred to hereafter as the Fund, a private US foundation, launched its International Program in Health Policy and Practices in 1998. Predicated on the belief that industrialized nations are grappling with many similar problems in the area of health, the Fund's program seeks to open opportunities to learn from common experiences. The program supports an annual multinational survey of five English speaking countries, policy exchange and analysis on international health care topics and includes an annual international symposium. This article draws several recent Fund supported surveys, and Fund supported studies within the US and other cross-national work to address issues of aging, health policy and to illustrate the potential of surveys to provide unique insights and perspectives (Box 19.1).

Issues of the elderly, aging and health policy, in particular, offer opportunities to gain insight to country systems by sharing international perspectives. When it comes to the elderly, the US for once is not an outlier when it comes to coverage thanks to near universal coverage through the Medicare program. The challenge of how to adapt health and social policy for an aging workforce as retirees live longer confronts all industrialized nations.

Box 19.1. **The Commonwealth Fund**

The Commonwealth Fund, located in New York City, is a private United States foundation that supports independent research on health and social issues and makes grants to improve health care practice and policy. The Fund's two national program areas are improving health insurance coverage and access to care and improving the quality of health care services. The Fund's International Program in Health Policy and Practice is designed to stimulate innovative policies and practices in the United States and other industrialized countries by working to build an international network of policy-oriented health care researchers, to support innovative health policy thinking and high level exchanges that benefit the United States and other countries, and to encourage cross-national comparative research and collaboration. The program supports an annual multinational survey of five English-speaking countries – Australia, Canada, New Zealand, the United Kingdom, and the United States – which each year focuses on a different, salient health policy topic. The surveys are limited to these five countries to complement a fellowship program supported by the Fund. The Fund's international program also supports comparative papers and collaborative work across nations to develop common indicators of care and system performance.

As discussed throughout other papers in this conference volume, and indeed a theme of the conference, an international perspective helps underscore a general policy conclusion that demography is not destiny. Comparative international data reveal that there is little link between the share on national income spent on health care and the proportion of the population age 65 or older. Within the United States we know from efforts to estimates long-term health care and social program costs that even very small changes in medical care cost trends or underlying disability rates or economic growth rates dramatically alter future forecasts (Friedland and Summer, 1999). Projections are also likely to be highly sensitive to each nation's success in finding ways to promote healthy aging, improve the quality of care or to reduce or moderate the debilitative effects of chronic disease.

Understanding the elderly's current care experiences can help inform efforts to improve system responsiveness and to anticipate future trends. Country variations in performance in areas of shared concern, in particular, may provide opportunities to learn.

Population surveys have the potential to provide a unique perspective into this process, that of the elderly patient or citizen and their families. Cross-national surveys can provide uniform measures and new information to track change, inform policy debates and enhance policy researchers' ability to compare and identify areas for more in-depth inquiry. Surveys can overcome difficulties posed by different definitions, measures and data systems. They also have the unique potential of assessing and comparing system responsiveness from the perspective of patients and families' care experiences and perceptions.

To highlight the value of international studies and illustrate the potential of surveys to capture the patient perspective to inform policy, this article draws from two recent Fund supported multinational surveys and selected Fund supported studies. Each of the two surveys included adults in Australia, Canada, New Zealand, the United Kingdom and the United States. Although these five countries speak a common language, their health care systems are quite distinct from one another. The appendix at the end of the article describes the surveys and references articles based that provide more detailed descriptions of the country system variations.

The discussion focuses on two diverse issues related to aging and future health policies:

- The potential of surveys to track access and system responsiveness and to provide a patient or family perspective.
- Caregiving for frail elderly: the challenge of mixing formal and informal care and supporting family caregivers.

1. Tracking access and system responsiveness: the potential of surveys to compare and present the patients' perspective

Lack of common definitions and administrative systems producing widely varying health care outcomes measures make it particularly difficult to track and compare different countries' health care systems' performance. Common measures of access and system responsiveness are particularly problematic. Population surveys have the potential to overcome these difficulties by measuring quality from a patient and family perspective and tracking change over time.

1.1. The potential of surveys to assess: access restrictions from undue economic burden

One key aspect of health care quality is access to care and protection from undue economic burden from medical care costs. The Fund 1999 survey of the elderly finds evidence of the substantial efforts in each country to facilitate access to care for the elderly – particularly for those living on limited incomes. The survey found that while 15% to 26% of the elderly in the five countries found it difficult to pay for basic living costs in the past year, less than 6% reported problems paying medical bills (Figure 19.1).

Figure 19.1. **Financial difficulties: the elderly are relatively well-protected from medical costs**

Per cent of the elderly who...	AUS	CAN	NZ	UK	US
Find it extremely or somewhat difficult to meet basic living costs	20%	15%	26%	26%	21%
Had problems paying medical bills in the past year	4%	3%	5%	1%	6%

Source: Schoen *et al.* (2000).

A 2001 survey in the same five countries that included adults of all ages found these five countries have generally been more successful in protecting senior citizens' access to care than access for those under 65. Adults 65 or older were less likely to report difficulties seeing a specialist when needed or to forego care when sick due to costs (Table 19.1). The contrast by age in the US is particularly notable where Medicare provides near universal coverage for those over 65 and other programs to supplement coverage become available for older citizens. Differences by age also emerge in New Zealand and again reflect national policies that provide special supplements to the basic universal coverage benefits for older or low income residents.

Access patterns across countries tend to reflect national policies. Based on responses in the survey, older adults are more likely to report access barriers due to costs for benefits less well covered by national systems, such as drugs and dental care.

1.2. Elderly population vulnerability to cost sharing: evidence from the US

The US is in many ways unique in insurance design efforts to expose patients to out-of-pocket costs as a cost-containment strategy. One result of these policy decisions is that access to care and economic burden vary substantially by income in the US. Patients at the lower end of the economic spectrum often forego care out of a fear of costs or struggle to pay bills when they can no longer wait.

International survey data reveal the extent to which the US departs from other countries efforts to protect citizens against out-of-pocket costs. The 2001 Fund survey finds a stark contrast in out-of-pocket costs in the US compared to the other four countries in the survey. In the US three of ten elderly and one of four adults under 65 said they spent more than US$1 000 in the past year on medical bills. No other country came close. In three of the four other countries, 4% or less of the elderly reported spending this high (Table 19.1). For low income residents, the exposure to patient cost-sharing translates into

Table 19.1. **Access problems due to cost and cost burdens, 2001**

Comparison of elderly and adults under age 65

	Australia		Canada		New Zealand		United Kingdom		United States	
	18-64	65+	18-64	65+	18-64	65+	18-64	65+	18-64	65+
	Percentage									
Did not get needed care due to cost:										
Did not fill a prescription	22	2[1]	15	2[1]	16	5[1]	9	0[1]	28	13[1]
Did not get recommended test, treatment or follow up	17	5[1]	6	3[1]	16	5[1]	3	–	25	4[1]
Had a medical problem but did not visit doctor	12	3[1]	6	1[1]	23	6[1]	4	0[1]	27	6[1]
Needed dental care but did not see a dentist	36	16[1]	28	12[1]	42	12[1]	23	5[1]	39	15[1]
Had problems paying medical bills in past year	12	5[1]	8	3[1]	13	5[1]	3	2	22	10[1]
Out-of-pocket spending on all medical bills in past year:										
$0	3	10[1]	33	43[1]	6	4	37	66[1]	7	6
$1-100	16	23	21	17	32	35	30	16[1]	12	11
$101-500	36	24	26	24	36	27	21	11[1]	30	20
$501-1 000	12	5[1]	8	5	5	3	4	2	16	14
$1 001+	10	2[1]	5	4	11	11	2	–	26	29
Out-of-pocket spending on prescription drugs in past year:										
$0	5	10[1]	19	15	8	7	30	80[1]	10	10
$1-100	32	35	31	29	35	35	43	10[1]	24	14
$101-200	22	11[1]	19	18	19	17	11	2[1]	14	11
$201-500	18	7[1]	13	14	7	8	7	1[1]	22	17
$501-1 000	5	3	8	10	1	2	1	–	10	13
$1 001+	2	–	4	5	8	6	1	0	11	19[1]

1. Significant difference from 18-64 age group at $p < .05$. "–" = Less than 0.5%.

Source: The Commonwealth Fund 2001 International Health Policy Survey.

barriers to access and economic burden. Other analysis based on this survey finds that US adults with below average incomes reported foregone care at twice the rate as those with incomes above average – with inequities on every measure of access in the survey (Blendon *et al.*, 2002)

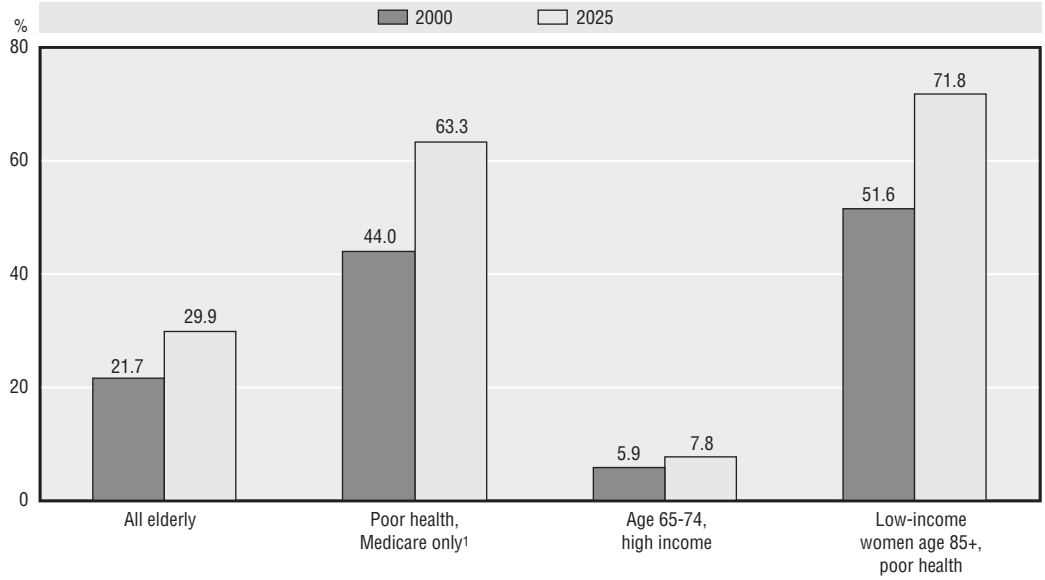
Other Fund supported studies of cost burdens for US elderly patients document the extent to which gaps in coverage expose sicker and lower income beneficiaries to high cost burdens. A recent analysis, for example, estimated that current out-of-pocket costs averaged 51% of the income of older single, low-income women in poor health (Maxwell *et al.*, 2001). This cost burden is projected to rise to 72% given current trends in cost, income and coverage (Figure 19.2).

Based on per capita costs and trends, these gaps in coverage have done little to curb US cost increases. Among industrialized nations, the US stands out in terms of high average expenditures per capita or per adult 65 and older (Figure 19.3).

Cost-sharing can distort care patterns or lead to lack of adherence to recommended care. For example, a new survey supported by the Commonwealth Fund and the Kaiser Family Foundation, which focused on prescription drug use among the elderly, finds that a high proportion of patients without prescription benefits or with limited coverage tried to

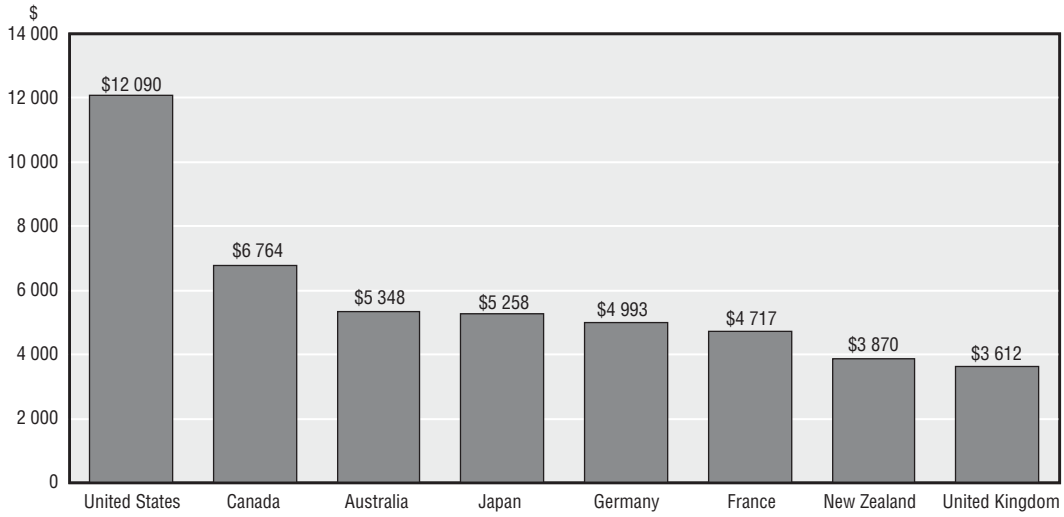
Figure 19.2. **Out-of-pocket health care spending as a share of income for US elderly, 2000 and 2025**

Per cent of income spent on out-of-pocket medical costs



1. No insurance beyond US Medicare basic benefits.
Source: Maxwell *et al.* (2001).

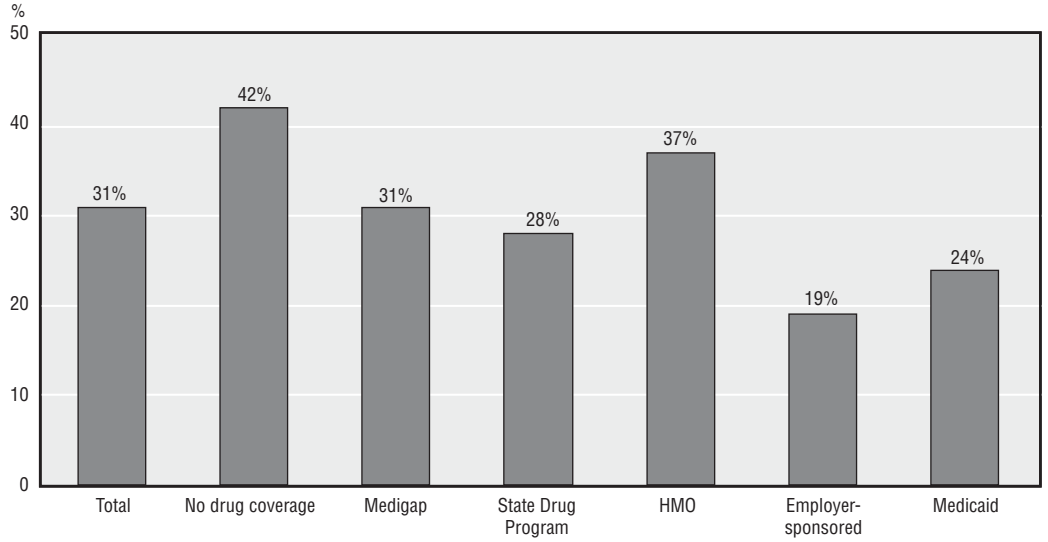
Figure 19.3. **Health expenditures per capita for adults aged 65 and older, 1997**



Source: Anderson and Hussey (1999).

cope with out-of-pocket costs by skipping doses or not filling prescriptions (Safran *et al.*, 2002). Those with chronic disease were at notably high risk of lack of adherence to care regimes due to costs. One-third of seniors with congestive heart failure, diabetes, and hypertension who lacked drug benefits reported skipping doses to make medications last longer due to costs. The survey also found that limits on benefit and cost-sharing for those with prescription drug benefits were associated with widely varying foregone care rates across different types of supplemental coverage (Figure 19.4).

Figure 19.4. **Per cent of seniors in eight states with incomes at or below 200% of poverty who either didn't fill a prescription one or more times or skipped doses of a medicine to make it last longer, by source of drug coverage**



Note: Analysis of seniors in sample with classifiable drug coverage.
Source: Kaiser/Commonwealth/Tufts-New England Medical Center 2001 Survey of Seniors in Eight States.

1.3. The potential of surveys to assess: the patient-provider relationship

A second aspect of quality is the patient's relationship with his or her care provider. When it comes to the elderly, care systems have generally done well in fostering long-term relationships with primary care physicians. The Fund 2001 survey finds that 50 to 60% of the elderly in each of the five countries had been with the same doctor 6 years or more – with nearly half with their doctors for 10 years or more four out of five countries (the US was the exception). In all countries, seniors' length of time with a physician they identified as their main source of care exceeded that reported by younger adults (Table 19.2).

The survey also finds that the elderly in each country were more likely than younger adults to give positive ratings to their physicians as well as hospital and overall quality of care (Tables 19.2 and 19.3). These generally more positive ratings along six dimensions of care likely reflect the benefits of long-term and more personal relationships with physicians.

Health policies that seek to preserve or promote such long-term relationships offer the potential for decreasing care costs as well raising patient care satisfaction. A recent study in the US found that patients with stable patient-physician relationships had a decreased likelihood of hospitalization and lower overall costs compared with those who had short-term relationships (Weiss and Blustein, 1996). This has important consequences for the US, where the survey finding that US patients are less likely to have long-term relationships with their physicians may indicate a potential source of less effective care in the US.

1.4. The potential of surveys to assess: responsiveness and waiting times

To improve the quality and effectiveness of primary care, recent private initiatives as well as public policy in the US has urged system changes to allow same day access when sick. The 2001 survey illustrates the value of surveys to measuring relative success in meeting this goal. The survey finds that responsiveness varies widely across countries. In

Table 19.2. **Physician relationships, ratings and access, 2001**

Comparison of elderly and adults under age 65

	Australia		Canada		New Zealand		United Kingdom		United States	
	18-64	65+	18-64	65+	18-64	65+	18-64	65+	18-64	65+
	Percentage									
Has a regular doctor	81	92[1]	82	96[1]	85	97[1]	76	83[1]	72	93[1]
Been with same doctor:										
No regular doctor	19	7[1]	17	4[1]	15	3[1]	24	17[1]	27	6[1]
1 year or less	11	9	10	10	10	8	8	5	15	14
2-5 years	27	22	25	27	28	29	23	21	28	31
6-9 years	11	10	11	12	13	15	10	10	9	14
10 or more	32	51	34	45	33	47	36	47	19	33
Rates doctor as excellent or very good on:										
Treating you with dignity and respect	78	91[1]	79	82	82	93[1]	70	86[1]	70	80[1]
Listening carefully to your health concerns	71	86[1]	74	76	74	82[1]	64	79[1]	63	77[1]
Providing all the information you want	70	86[1]	68	66	71	81[1]	55	73[1]	61	71[1]
Spending enough time	67	83[1]	62	63	69	82[1]	50	69[1]	56	68[1]
Knowing you and your family situation	62	74[1]	59	62	65	74[1]	47	67[1]	55	68[1]
Being accessible by phone or in person	55	80[1]	53	65[1]	61	78[1]	43	67[1]	50	64[1]
Average of 6 measures	67	83	66	69	70	82	55	74	59	71
How soon are you able to see a doctor when sick?										
Same day	62	67	35	39	68	74	40	53[1]	36	35
1 day	16	13	15	14	18	17	13	14	20	22
2 days	12	8	13	13	7	3[1]	15	12	13	14
3 or more days	9	10	33	31	3	2	29	17	28	23
How difficult is it to see a specialist when needed?										
Very/extremely difficult to see a specialist when needed	14	5[1]	18	10[1]	12	7[1]	13	11	19	5[1]
Somewhat difficult	25	12[1]	30	19[1]	23	21	24	17[1]	24	11[1]
Not very/not at all difficult	57	80[1]	48	65[1]	60	66	50	63[1]	55	78[1]

Note: The survey included 1 400 adults in each country including 200 adults 65 or older.

1. Significant difference from 18-64 age group at $p < .05$

Source: The Commonwealth Fund 2001 International Health Policy Survey.

Australia and New Zealand, two-thirds of elderly and non-elderly adults said they were able to see the doctor the same day compared to 50% of adults in the UK and only one-third in Canada and the United States (Table 19.2).

Such country variations in responsiveness indicate an opportunity for collaborative studies to understand whether or how the apparent high level of responsiveness translates into improved ability to avoid complications, avoid hospitalization or improve effectiveness of care.

Averages tend to hide differences in patient care experiences due to varying income, health, personal resources and family support. Where administrative data systems may be able to control for age and health and selected other demographic characteristics, medical records and claims often miss socio-demographic characteristics that are likely to

Table 19.3. **Overall quality and hospital ratings, 2001**

Comparison of elderly and adults under age 65

	Australia		Canada		New Zealand		United Kingdom		United States	
	18-64	65+	18-64	65+	18-64	65+	18-64	65+	18-64	65+
	Percentage									
Overall ratings of quality of care received:										
Excellent/very good	60	80[1]	53	66[1]	65	81[1]	47	74[1]	55	70[1]
Good	29	15[1]	34	26[1]	24	15[1]	32	18[1]	29	23
Fair/Poor	10	3[1]	12	8	9	2[1]	17	7[1]	15	7[1]
Hospitalized in past two years (respondent):	22	26	14	19	17	25[1]	16	19	18	23
Rating of hospital care:										
Excellent/very good	52	78[1]	48	72[1]	53	76	44	65[1]	47	67[1]
Good	27	13[1]	31	16	23	11[1]	28	20	28	19
Fair or poor	20	9	21	11	23	9	25	13	24	12
Rating of nursing staff adequacy in hospital:										
Excellent/very good	51	80[1]	45	68[1]	53	76	42	61	46	68[1]
Good	22	11	30	23	23	11	25	18	31	22
Fair or poor	27	8[1]	25	7[1]	23	9	30	21	22	10
Any elective surgery in the past two years	28	24	25	19	30	28	25	17[1]	26	28
Among those with elective surgery, waiting time for elective surgery:										
Under one month	51	53	39	34	43	36	36	40	60	75
6 months or more	16	22	18	16	19	20	28	24	2	0

1. Significant difference from 18-64 age group at $p < .05$.

Source: The Commonwealth Fund 2001 International Health Policy Survey.

influence access and care experiences. Even in systems with universal core health insurance coverage, more affluent residents may be able to guard against shortages or overcome access barriers by purchasing additional care outside of national systems or using private health insurance to buy quicker response to care needs. Population surveys have the often unique potential to track and compare experiences by income to provide early warnings and indicators of disparities in experiences by income as well as health (Blendon *et al.*, 2002).

2. Caring for the frail elderly: formal and informal care giving and support of caregivers

Even if disability rates continue to decline, the number of frail elderly with long-term care needs is likely to rise substantially over the coming decades due to the fact that we are living longer. This population will require a diverse range of services with varying needs for public support depending on income and family resources, and how well communities are able to support and encourage healthy aging.

Most people's fears about aging reflect concerns about quality of care, their ability to remain at home or in the community and not becoming a burden to their family. As populations age, long-term care policies across nations have shared a common goal in efforts to care for the frail elderly in communities or at home, rather than in institutions.

International efforts to move care into the community vary and offer unique opportunities to learn from different models. A special journal issue focused on aging policies that grew out of Fund commissioned international work on the elderly identified Denmark as one of the more successful community efforts. Based on recent reports, Denmark reduced nursing home use by the elderly by 27% from 1982 to 1996 through provision of publicly-financed care through local, municipal governments (Merlis, 2000).

The health policy challenge is how to find a mix that accommodates the needs of frail elderly and disabled across an income spectrum and enables a mix of formal and informal care where possible. A key to this success may be how well nations are able to support informal caregivers.

We at times forget that the aging spouse of a person in need of home care often serves as the informal caregiver. In the 1999 Fund survey of the elderly in five nations, one of four seniors said they had been the caregiver of a spouse or family member in the past two years. Burdens on these care-givers can be substantial, leading to deterioration of their own health.

The survey found that the five nations varied in the extent to which these informal caregivers also received paid home health care assistance. Among the elderly with care giving experiences in the past two years, the proportion saying they had relied on paid home health care in additional to informal care range from 44% in Australia to 58% in the US.

The survey also found that children play a substantial care-giving role for their aging parents although direct financial support is rarer. One-fourth to one-third of the elderly in each of the five countries said their children "often" helped out when they or their spouse was sick and another third reported occasional help. In contrast 4% or less said their children often provided financial support for their basic needs (Table 19.4).

Some states within the US, as well as other nations, are instituting new policies that provide respite care to relieve care-givers or cash assistance to family members to compensate them for time off from work. As populations age and the number of children per family dwindle, spouses as well as more extended family members are likely to be key sources of informal support.

The policy challenge is how to find a mix that works across a range of needs and incomes and family structures. In the case of home-based care and concerns about care-giver burden, surveys may be the only tool available to assess the relative effectiveness of new policies and the extent of unmet need and caregiver burden.

3. Summary

In summary, people of all ages as well as the elderly have gained from the commitment of public resources to address the health and social support needs of an aging population. In the 21st century, we face the challenge of how to build on the gains in health and economic security of the past.

The elderly of tomorrow are likely to be better educated and wealthier than the elderly of today yet less likely to be able to rely on their children for supportive care. Developed societies are becoming more and more creative in developing alternative living and housing arrangements for the elderly. And while we don't know yet what the consequences of these will be in terms of health or demands on the care system, the response of public policies will need to be equally creative.

Table 19.4. **Elderly and caregiving: roles, informal care and reports of assistance from their children, 1999**

	Australia	Canada	New Zealand	United Kingdom	United States
	Percentage				
Elderly and caregiving:					
Elderly who are currently caring or have in the past two years cared for someone who is frail, sick, or disabled	21	25	25	19	27
Among elderly caregivers, per cent reporting paid home health care in addition to informal care	44	53	48	46	58
Elderly caregivers who needed home health care assistance for the person they cared for in the past two years and couldn't get it	15	19	20	32	10
Elderly and assistance from children-Base: elderly with children					
Do your children help when you or your spouse are ill?					
Often	31	26	37	30	32
Occasionally	33	29	27	39	28
Never	34	38	33	28	37
Do your children provide you with financial support to pay for basic needs?					
Often	3	4	4	4	3
Occasionally	9	8	10	14	10
Never	88	87	85	81	87
In the past two years, has there been a time when you needed help from your children or their families and didn't get it?					
Yes, needed help but didn't receive it	3	5	4	4	5
No, didn't have problems receiving help	56	62	58	66	65
No, never needed help	41	33	38	29	30

Note: The survey included 700 adults 65 or older in each of the five countries.
Source: The Commonwealth Fund 1999 International Health Policy Survey on the Elderly.

To the extent we can promote more successful aging with opportunities for part time work or activities within communities and opportunities to participate in decisions about their own care, geriatric research indicates nation's have the opportunity to prevent or delay the onset of functional impairment.

Collaborating to learn from the strengths and limits of international variations in care systems and policies offer the potential of sparking innovations. Surveys offer the potential for providing a range of new insights regarding quality of care, the effects of alternative living arrangements and system responsiveness as well as to compare across systems using common definitions and concepts. Fittingly, a new European survey of aging known as SHARE is on the planning agenda for the European community (Santos-Eggiman and Goeffard, Part III in this volume). Shared methods and questions and a common questionnaire used across countries could enhance our ability to learn how to address common concerns within diverse systems.

During of a time of changing policies and shifting demographics, surveys can also help track the impact of new strategies on the elderly and their families and enable nations to assess intended as well as unintended consequences. Surveys may have the unique potential of providing early warning signs of undue economic burden or quality concerns if policies shift in new directions. Surveys could thus supplement and complement other international measures of system performance (including clinical outcomes, expenditures and health status) to enrich our understanding of how policies can make a difference and point to promising areas for further collaborative learning.

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* The Commonwealth Fund sponsored a special issue of *Health Affairs* in May/June 2000 (Vol. 19, No. 3) focused on the elderly in which these articles were featured. Other articles in the special issue also focused on the elderly and aging health policy. Full-text access to these articles is available from *Health Affairs* website at: *www.healthaffairs.org*. Results of the Fund 2001 survey focused on differences by income are also available online from *Health Affairs*

Appendix

Description of Surveys

The Commonwealth Fund 2001 International Health Policy Survey

Included telephone interviews with 1 400 adults in each of five countries: Australia, Canada, New Zealand, the United Kingdom and the United States. Conducted during April and May 2001 by Harris Interactive, the survey explored adults views of their health care system, access, physician care, and other recent care experiences and included questions asked in earlier surveys to examine trends over time.

Initial findings were published in the May/June 2001 issue of *Health Affairs*.

The Commonwealth Fund 1999 International Health Policy Survey of the Elderly

Included interviews with 700 adults age 65 or older in the same five countries. The survey focused on health care experiences, long-term care and roles as caregivers, and related concerns. Harris Interactive, Inc. and their international affiliates conducted the survey from April to June 1999.

Initial findings were published in the May/June 1999 issue of *Health Affairs*.

The Commonwealth Fund and Kaiser Family Foundation 2001 Survey of Seniors in Eight States

Consisted of mail and follow-up phone interviews with 10 927 non-institutionalized seniors in eight geographically diverse states: California, Colorado, Illinois, Michigan, New York, Ohio, Pennsylvania, and Texas. These states account for 42% of US adults age 65 and older and 41% of low-income elderly adults nationwide. The eight states include four states with a pharmacy assistance program that provides direct drug benefits through state coverage programs (IL, MI, NY, and PA) and four states without such programs (CA, CO, OH, and TX).

An article based on the survey was web-published by *Health Affairs* in August 2002 and is available online.

Reports based on the surveys and other Fund Supported International Work can be found at *www.cmwf.org*

PART VII

Roundtable Panel Discussion

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What is Best and at What Cost?
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PART VII

Chapter 20

Summary of Roundtable Panel Discussion

by
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* The views expressed by the panellists were not necessarily those of the organisations they represent.

Introduction

The objective of the roundtable was to place what was learned about the ARD study over the previous day and a half within a health policy context. The panel members were asked to focus their discussion on how they felt research could best serve evidence-based policies addressing the implications of ageing for the health and well-being of populations. Panel members were asked to discuss the following questions:

- How can a disease-based approach contribute to dealing with the issues of ageing and health policy?
- What data collection and measurement activities are needed to implement the disease-based approach to comparing health systems? Are these data already available? If not, are they in the process of being developed?
- What contributions can cross-national analyses of health systems make? Are cross-national benchmarks useful or valid?

1. How can a disease-based approach contribute to dealing with the issues of ageing and health policy?

With regards to the ageing issue, one issue raised by panellists is that a disease-based approach could be used to explore the issue of age discrimination in treatment provision. As evidence accumulates showing that age should be less important than other factors, such as general health status, in determining treatment decisions for major interventions, comparable international data on utilisation trends by age for major interventions could help inform the debate.

While it was recognised that age discrimination is a key issue which a disease-based approach could shed light on, it was stressed that the issue would need to be looked at within the context of reducing inefficient spending on health care. Finance ministers are increasingly demanding that investments in health care be spent efficiently, especially for the elderly for whom health care costs are significant. A disease-based approach could facilitate the calculation of disease-related health spending, which will help finance ministers sort out the contradictions between the forecasts of macro-economists and health policy-makers.

One obvious area where a disease-based approach could be used to contribute to dealing with health policy issues is with disease-specific issues themselves. The information collected and analysed for the ARD study will certainly contribute to a better understanding of health policy issues related to heart disease, breast cancer and stroke. Applying a disease-based approach to other diseases is an important next step in an evolving understanding of health systems from a micro-level. Ideally, these diseases would be chosen to complement the diseases studied under the ARD study. These would include non-fatal chronic diseases such as dementia, cataracts and osteoporosis. The importance of studying these diseases would be to analyse issues of quality of life, well-being and disability.

It was noted that the OECD has already taken a step in the direction of studying other diseases with its study on dementia care, funded by the National Institute on Aging in the United States. This study will examine the issue of well-being in broader scope than the ARD study. It was also noted that the OECD has facilitated the study of disability issues at the international level by sponsoring two conferences, one in Paris in December 1999 and one in Stockholm in May 2000.

Finally, panellists stressed the importance of tracking and evaluating the impact of the disease-based approach. It was felt evaluation of the impact of the ARD study was necessary to help promote the disease-based approach. This would require the dissemination of the work to peer reviewed journals, as general overall descriptions and summary of the findings, as country-specific articles and as disease-specific articles. Publishing to a wider audience would introduce many people to the innovative way in which the ARD study compared health systems.

2. What data collection and measurement activities are needed to implement the disease-based approach to comparing health systems? Are these data already available? If not, are they in the process of being developed?

This issue of data collection generated the greatest interest among the panellists. The panellists focussed their energies on the OECD's role in fostering the collection of internationally comparable data.

The idea that the OECD should facilitate the collection of internationally comparable survey data proved to be problematic. Under this scenario the OECD would facilitate the pooling of nationally representative, longitudinal, shared and publicly available data derived from existing and future surveys. Some panellists felt the OECD's role would be especially important for developing these sources of data in countries where such data are difficult, if not impossible, to obtain. It was noted that earlier presentations of internationally comparable surveys produced valuable results for making international comparisons,* and making these data available to the research world would be a positive development.

An even more problematic suggestion from the panel was for the OECD to assume the role of archiving the survey data described in the previous paragraph, as well as micro-data similar to that collected for the ARD study, and making these available to researchers. However, panellists remarked that this could not be envisaged at this time, in most part due to the existence of several barriers that largely prevented the OECD from taking on this type of activity. The two barriers discussed during the panel session were privacy issues and data ownership.

Probably the greatest barrier is the issue of privacy. It was noted that countries vary widely with respect to how strictly they protect the privacy of health data. The Nordic countries and the United States were cited as examples where data privacy issues were not as restrictive as some European countries. Unimpeded access to data and the possibility of linking data for inappropriate purposes were recognised to be the two main issues that worried data restriction advocates. These issues would have already been discussed in the Nordic countries and the United States, and proper safeguards put in place that allow for

* These would be SHARE, a European Union funded survey, see Santos-Eggimann and Geoffard (Part III in this volume) and the various surveys of the Commonwealth Fund, see Schoen (Part VI in this volume). These surveys are explored in detail in papers included in this volume.

the existence of comprehensive and almost universal databases linked through personal identifiers. Before the OECD could even contemplate exploring the issue, internal discussions surrounding privacy would need to take place in countries where large, linked databases did not exist.

It was noted that data ownership also acts as an impediment on data archiving and sharing. Much of the data used for health services research, such as Medicare data in the US, are routinely collected administrative data. The administrators of these data feel they, as the persons running the administrative systems gathering this information, are the owners of these data. They must be included in any discussions involving increasing access to these data. However, practitioners and patient advocates have equally legitimate claims of ownership to data that contain sensitive personal information. While their concerns are based more on the consequences of deliberate misuse of data, they are valid issues that need to be considered in a discussion of the proper use of data for research purposes.

It was recognised that the OECD, as an international organisation with special relationships with national health ministries, has a comparative advantage in fostering the development of internationally comparable health data. Unfortunately, at this stage data privacy concerns seriously limit the ability of the OECD to take on the role of collector and archivist of the type of micro data used in creating longitudinal databases linked through individual patient identifiers. Nor is it an activity the organisation foresees itself taking on in the near future.

While a comprehensive, internationally comparable, longitudinal and accessible micro-database is not a realisable goal in the near future, the OECD has fostered the development of internationally comparable data through the OECD Health Database. Having recognised the need to achieve better agreement on developing more comparable data on health care, the OECD has embarked on a project that will develop internationally comparable quality indicators on health care, as part of its Health Project.

3. What contributions can cross-national analyses make? Are cross-national benchmarks useful or valid?

Much of this issue was discussed within the context of the complexity of international comparisons. The use of a simple indicator, the percentage of gross domestic product (GDP) devoted to health spending was used to illustrate the point. The message journalists have developed for any country that spends below average is clear: the country needs to increase spending on health, which inevitably means the government should increase spending on health. However, this simple indicator is fraught with issues that confound the message. First, the figure includes private spending, which government has limited control over. If public spending on health, in a country that is below average in terms of total health spending, is closer to the average of other countries than it is for total spending, then a government can point to this to defend its level of spending. Second, other factors such as per capita national income affect aggregate health expenditure. A country that devotes less of its GDP to spending on health may in fact be spending more on health than other countries with similar per capita incomes. This is another argument that a government can use in its defense. Finally, some countries that devote less of their GDP to spending on health still compare favourably with other countries on many aggregate health indicators such as life expectancy and infant mortality. A governement defending its policies could claim it is using its health care resources more efficiently. Even a simple indicator may not deliver a clear message.

Therefore, the obvious first step in making cross-national analyses would be to make certain a clear message is understood. Within the context of a disease-based approach, the use of cross-national benchmarks for sending a clear message would be difficult if these benchmarks were put forth as being clearly defined. The ARD study has shown that countries can still learn a lot about differences in treatments, expenditures, outcomes, health policies and health systems, within the disease-based framework.

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Participating Countries and Organisations

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1. Participated in the breast cancer study.
2. Participated in the ischaemic heart disease study.
3. Participated in the stroke study.

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