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Stroke Care in OECD Countries: A Comparison of Treatment, Costs and Outcomes in 17 Countries

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SUMMARY

The Ageing-Related Diseases study compares health care systems by examining treatment trends and health outcomes on a disease-by-disease basis. Most of the day-to-day decisions that determine health care system performance are made in treating specific diseases. Therefore, the ARD's bottom-up approach to comparing health care system performance at the disease level, rather than the more common top-down approach, goes to the heart of health care system performance. This paper presents such an analysis for stroke.

There is considerable variation in treatment trends for the same diseases across countries and much of this variation can be explained by differences in structural characteristics of health care systems. A disease-level analysis begins with an examination of these characteristics: the economic incentives, policies and regulations that affect individual providers' decisions for treating a specific disease, defining a particular health care system's approach. In order to properly assess health care system performance, this analysis must be accompanied by an examination of the health outcomes emanating from these treatment trends. Finally, analysis of health care system performance is not complete from an economic point of view without an analysis of the cost of the various health systems' approaches to treatment.

This report focuses on stroke. The results show variations in all aspects studied across the 17 countries that participated in this study. Variations in health care were apparent in the prevention of stroke, in the hospitalisation of stroke patients, and in the frequency of use of diagnostic tests. Differences were also observed in health outcomes, with some countries having higher case fatality rates than others. Finally, some countries clearly had higher expenditures on stroke care. These results have clear implications for how health care systems treat stroke, showing that some countries may be treating stroke more efficiently, especially given the fact some countries had both higher expenditures and relatively poor outcomes.

The explanations for these variations are not straight-forward. Further, conclusions about the links between the variations in treatments, costs and outcomes cannot be made without more information about the relative severity of cases being treated. However, the broad patterns found in this study reflect those found in research studies reported in the literature.

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.

RESUME

L'étude sur les maladies liées au vieillissement compare les divers systèmes de santé en examinant les tendances en matière de traitements et de résultats par type de maladie. La plupart des décisions prises quotidiennement et qui déterminent la performance des systèmes de soins de santé le sont au moment du traitement d'une maladie spécifique. Ainsi, lors de la comparaison de la performance des systèmes de soins de santé par maladie, le projet des maladies liées au vieillissement effectue une approche du bas vers le haut plutôt que l'approche plus habituelle, et va ainsi au cœur de la performance des systèmes de soins de santé. Ce document présente une telle analyse en ce qui concerne les accidents cérébrovasculaires.

Les tendances dans les traitements préconisés varient considérablement d'un pays à l'autre pour les mêmes maladies et peuvent s'expliquer par des différences caractéristiques structurelles propre à chaque système de santé. Une analyse par type de maladie commence par l'examen de ces caractéristiques : les incitations économiques, les politiques et les réglementations qui influencent les décisions prises par des fournisseurs individuels dans le traitement d'une maladie spécifique et qui définissent l'approche de chaque système de santé. Afin d'évaluer correctement la performance des systèmes de santé, cette analyse doit s'accompagner d'un examen des conséquences qui résultent de ces tendances dans le domaine des traitements. Pour finir, l'analyse de la performance des systèmes de santé ne sera pas complète d'un point de vue économique sans une analyse du coût des approches des divers systèmes de santé face au traitement de la maladie.

Ce document porte essentiellement sur les accidents cérébrovasculaires. Les résultats montrent des variations dans tous les aspects étudiés parmi les 17 pays qui ont participés à cette étude. Des variations dans les soins de santé étaient évident dans la prévention des accidents cérébrovasculaires, au niveau de l'hospitalisation des patients souffrants d'un accident cérébrovasculaire et dans la fréquence d'utilisation des examens lors de diagnostiques. Des différences ont également été observées en matière de résultats sanitaires, certains pays ayant des taux de décès plus élevés que d'autres. Enfin, de toute évidence certains pays avaient des dépenses plus élevées pour les soins des accidents cérébrovasculaires. Ces résultats ont des implications claires dans la manière dont les accidents cérébrovasculaires sont traités par les différents systèmes de santé démontrant que, pour certains pays les accidents cérébrovasculaires sont traités plus efficacement, étant donné le fait que certains pays avaient des dépenses plus élevées et des résultats sanitaires relativement maigres.

Des explications pour ces différences ne sont pas très évidentes. En outre, on ne peut pas tirer de conclusions en ce qui concerne les liens entre les variations dans les traitements, les coûts et les résultats sans renseignements supplémentaires sur la sévérité des cas traités. Cependant, les grands schémas soulevés par cette étude sont le reflet de ceux trouvés dans les travaux de recherche mentionnés dans la littérature médicale.

Deux implications majeures ont été identifiées. Premièrement, il y aurait un avantage à une approche étendue dans la gestion des accidents cérébrovasculaires qui engloberaient la prévention, les soins intensifs et la réhabilitation. Et deuxièmement, il pourrait y avoir des avantages potentiels spécifiques à tirer de l'utilisation d'unités spécialisées en accidents cérébrovasculaires qui ne figurent pas dans la plupart des pays inclus dans cette étude.

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Country reports:

The following country reports were used as the basis of this synthesis report. Data and other information included in this report come from these reports or associated data submissions unless otherwise noted.

- Alfò A, Di Fiandra T, Giampaoli S, Inzitari D, Palmieri L, Scafato E (2000). OECD study of cross-national differences in treatments, costs and outcomes in stroke: Italy. Country report to the OECD Ageing-Related Diseases study on stroke treatment, costs and outcomes.
- Asplund K and Stegmayr B (2001). OECD study of cross-national differences in treatments, costs and outcomes in stroke: Sweden. Country report to the OECD Ageing-Related Diseases study on stroke treatment, costs and outcomes.
- Australian Institute of Health and Welfare (2000). Australian data for OECD study of cross national differences in stroke. Country report to the OECD Ageing-Related Diseases study on stroke treatment, costs and outcomes.
- Byung-Woo Yoon, Duk SunWoo, Moon-Ku Han, Hyun-Ah Yang (2001). Korean report for the OECD study of Cross-National Differences in Treatment, Costs, and Outcomes in Stroke. Country report to the OECD Ageing-Related Diseases study on stroke treatment, costs and outcomes.
- Christiansen T, Johnsen S and Husted S (2001). Health care in Denmark - with specific emphasis on aspects related to treatment of stroke. Country report to the OECD Ageing-Related Diseases study on stroke treatment, costs and outcomes.
- Cordeiro M (2000). Stroke in Portugal: an approach to health indicators. Country report to the OECD Ageing-Related Diseases study on stroke treatment, costs and outcomes.
- Evers SMAA, Struijs JN, Ament AJHA, van Genugten MLL, Jager JC and van den Bost GAM (2002). The disease impact, health care management, and costs of stroke in the of Netherlands. Country report to the OECD Ageing-Related Diseases study on stroke treatment, costs and outcomes.
- Gabanyi J (2001). OECD study of Cross- National Differences in Treatment, Costs, and Outcomes in Stroke: Hungary. Country report to the OECD Ageing-Related Diseases study on stroke treatment, costs and outcomes.
- Haug C and Indredavik B (2001). OECD study of Cross-National Differences in Treatments, Costs, and Outcomes in Stroke: Norway. Country report to the OECD Ageing-Related Diseases study on stroke treatment, costs and outcomes.

- Kyoto University (2000). Country report for Japan. Country report to the OECD Ageing-Related Diseases study on stroke treatment, costs and outcomes.
- Nagpal S, James A and Fry R (2001). Study of Cross-National Differences in the Treatment of Stroke: Canada. Country report to the OECD Ageing-Related Diseases study on stroke treatment, costs and outcomes.
- Santos-Eggimann B (2001). Data tables for Switzerland. Data submission to the OECD Ageing-Related Diseases study on stroke treatment, costs and outcomes.
- Sarría A, Timoner J and de la Mata I (2001). OECD study of cross-national differences in stroke treatment: Spain. Country report to the OECD Ageing-Related Diseases study on stroke treatment, costs and outcomes.
- Stanford University (2001). Data tables for the United States. Data submission to the OECD Ageing-Related Diseases study on stroke treatment, costs and outcomes.
- Tu J and Gong Y (2000). OECD Study of Cross-National Differences in Treatments, Costs, and Outcomes in Stroke in Ontario, Canada. Report to the OECD Ageing-Related Diseases study on stroke treatment, costs and outcomes.
- University of Alberta (2001). Data tables for Alberta, Canada. Data submission to the OECD Ageing-Related Diseases study on stroke treatment, costs and outcomes.
- University of Athens (2001). Data tables for Greece. Data submission to the OECD Ageing-Related Diseases study on stroke treatment, costs and outcomes.
- University of Oxford (2001). Data tables for Oxford, England. Data submission to the OECD Ageing-Related Diseases study on stroke treatment, costs and outcomes.
- Wolfe C, Rudd A, Coshall C and Irwin P (2001). Country report for England and Wales: Report from the Royal College of Physicians (England) and the South London Stroke Register, King's College, London. Country report to the OECD Ageing-Related Diseases study on stroke treatment, costs and outcomes.

COUNTRY ABBREVIATIONS TABLE

ISO country abbreviations used in this report

AUS	Australia
CAN	Canada
CHE	Switzerland
DNK	Denmark
ESP	Spain
GBR	United Kingdom
GRC	Greece
HUN	Hungary
ITA	Italy
JPN	Japan
KOR	Republic of Korea
MEX	Mexico
NLD	Netherlands
NOR	Norway
PRT	Portugal
SWE	Sweden
USA	United States

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1. INTRODUCTION

1. Health care expenditures among OECD countries continue to grow with little evidence demonstrating the link between the level of spending and health care system performance at a macro-level. Across OECD countries there exists variations in spending levels, treatment trends and health outcomes, which suggests there is room for improving the performance of health care systems. However, informed decisions on health care system performance require information at both the macro and micro-level to assist health analysts and health policy makers answer the crucial question: Do health care systems offer the best value possible given the level of human and financial resources invested?

2. In order to answer this question requires an understanding of the links between the underlying incentives embedded in health care systems and how they affect costs, treatment trends and outcomes. Until now health care system comparisons have largely focused on one of these aspects at a time, or have combined these elements in analysing one specific treatment, or one disease at a sub-national level. To-date a few key studies are known to have taken an approach which links this complex array of information at a cross national level. A study by the McKinsey Global Institute (McKinsey Health Care Practice, 1996) assessed differences in "productivity" at a disease level for three countries (Germany, United Kingdom and United States) by focusing on variations in diagnosis and treatment for four diseases (not including stroke), and relating these to variations in incentives and supply constraints. In the second study, the TECH Research Network also made a link between treatment patterns and health care system characteristics, but they chose to concentrate on one specific disease, acute myocardial infarction, commonly known as heart attacks. The strength of their approach was to analyse individual hospital discharge records using a standardised protocol and methodology to provide a direct link between treatments and outcomes. This report, with an analysis of stroke, builds on aspects from each of these studies and extends the methodology to other facets with a specific emphasis on system-wide policy-related issues.

3. This report is part of a broader project, known as the Ageing-Related Diseases project, which examines various conditions with high prevalence and high cost among older persons. We use a common framework for each disease, with the specifics tailored to each disease. To date, the study has also included breast cancer and ischaemic heart disease (Hughes & Jacobzone, 2002; Moise & Jacobzone, 2002). In particular, this report on stroke brings to the study an analysis of variation in the 'organisation of care', notably with the use of stroke units.

4. This study has four main aims, which are all relevant to each disease study:

- To examine variations in treatment between countries, in the context of differing epidemiological backgrounds
- To examine the relationship of any treatment variations to the relevant health care system, economic incentives and health policies
- To explore the effect of these on costs and health outcomes
- To determine the implications of the study in relation to future health system monitoring.

5. The information collected for this report is based on a series of national reports on stroke epidemiology, treatments and costs prepared by a network of over 50 epidemiologists, physicians and health economists. This information has been supplemented with data collected from existing national and international sources in consultation with participating experts[1]. This represents an effort that has spanned almost three years, beginning with the official launch meeting for the project in spring 1999. Following this meeting the network of experts from participating countries was put in place and a meeting was convened in December 2000 bringing together this multidisciplinary group.

6. This analysis largely focuses on a sub-type of stroke — ischaemic stroke — although other types are discussed in some sections. More detail concerning the definitions used is included in Chapter 3, while a summary of some of the medical aspects is contained in Appendix 1.

7. Chapter 2 of this paper reviews the health care system policies of participating countries related to stroke. In that section we explore the various demand and supply-side issues that have an impact on health care treatments for stroke. The next chapter describes the key epidemiological trends for stroke. Chapter 4 provides a descriptive analysis of treatment trends, making use of a number of data sources, particularly information collected from hospital administrative databases. In Chapter 5 a similar approach is applied to health outcomes. In chapter 6 we discuss some of the issues surrounding spending on health care for stroke, including unit expenditures for several pre-defined treatment bundles. The appendix to the report includes, along with a summary of the relevant medical aspects, and an summary of the recent policy situation for stroke for some of the participating countries (compiled by the relevant member of our network of experts). The more detailed tables and figures for the report are also contained in the appendix.

8. The main chapters of this report (chapter 2–6) are largely descriptive, with links between these chapters being discussed in the final chapter. The discussion chapter draws together the results of the report and highlights a number of issues and their policy implications.

1. All data included is sourced from the country reports prepared by the national experts for this study, unless otherwise noted.

2. HEALTH CARE POLICIES, INCENTIVES AND REGULATIONS

9. Relevant to a discussion of the policy implications from an economics and health policy perspective is the full dimension of treating stroke from primary prevention, to treatment in the acute phase, and also into the rehabilitation and potentially long-term care phase. As outlined in the introduction, the scope of the study is limited to the health system's role in stroke care and treatment, including public health such as prevention, and the treatment and rehabilitation components of the continuum of care. Therefore, this chapter does not examine the various policies in relation to long-term care, even though it is recognised as a very important issue for stroke care.

10. The use of resources involves a complex interaction between the demand and supply parameters that characterise health care systems. Monetary factors invariably play a large role in the demand for health care services. Health insurance reduces prices as perceived by the patients, but cost-sharing will provide them with a non-zero price signal. Non-monetary factors such as gate-keeping systems can also help to structure demand while avoiding the direct intervention of monetary factors, particularly when equity considerations are taken into account. The impact of monetary factors in the demand for health care services is far greater for elective surgery, ambulatory care and other non-emergency situations than it is for emergency acute care services.

11. On the supply side, payment systems and various regulations need to be considered, as they may impact the quantity of supply and the way health care providers are reimbursed. The most important incentives are those involved in various remuneration schemes. However, in some cases, the balance between demand and supply is not achieved through market mechanisms, and may result in queues and waiting lists for treatment.

12. This short schematic presentation provides a rationale for the various policy-related factors we have explored. We have deliberately provided a simplified representation of a complex interactive system in order to make it possible to make international comparisons, otherwise our task would have been immeasurably too complex to accomplish. The following section discusses the impact of various forces on the demand and supply of health care services, using information gathered by the national experts, supplemented by information from published sources.

2.1 The Demand Side: few financial limitations on access

13. The majority of countries in our survey have universal health insurance coverage, meaning few limitations on access to medically necessary health care exist in those countries. Since treatment for the acute phase of stroke usually involves treatment in acute care facilities, the population 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.

14. Demand side constraints are not limited to barriers to initial access to the health care system due to lack of health insurance. In some countries, patient co-payments for inpatient and outpatient services could in theory have a limiting effect on patients' access to services, at least in some private facilities. However, our survey has not produced strong evidence to support the fact that this could lead to a significant deprivation of access for large groups in the population. However, while most patients will not face out-of-pocket payments for pharmaceuticals administered in hospital, this will not be the case in the

ambulatory care setting. Whether this will have a significant effect on the utilisation of drugs in ambulatory care for chronic treatment will need to be investigated.

15. Non-monetary factors may play a role restraining access to technologically advanced diagnostic tests and surgical procedures in several ways. In some countries, gate-keeping mechanisms may restrain access to non-emergency acute care services. Waiting lists have a particular role in restraining access to these procedures. These issues will be discussed in Section 1.3. Table 2.1 summarises the main issues in relation to the potential demand-side constraints.

Table 2.1: Potential demand side constraints impacting stroke treatment

Constraints	Strong	Medium	Low
Health insurance coverage	Some groups in Mexico and the United States	Groups with supplemental insurance; Choice of provider: AUS, DNK, ESP, GBR, GRC, ITA, SWE, USA (FFS plan); CAN (drugs); CHE and NLD private insurance major role but virtually 100% coverage	Most countries have at a minimum universal public health insurance covering most acute and ambulatory care treatment HUN, JPN, KOR
Cost sharing	Korea	Access to outpatient drugs: CAN, DNK, GBR, ESP, NLD, NOR, USA Access to some private care services: AUS, GBR, GRC, HUN, USA JPN (some inpatient and outpatient care)	Non-existent or modest for physician and public inpatient services in most countries

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.

2.1.1. Health Insurance Coverage

Public health insurance

16. This section refers to the various types of public coverage available, whether through universal social insurance or tax-financed systems of health care. Coverage for public health and private health insurance is summarised in appendix Table A2.1.

17. Alone among the countries participating in the stroke part of the ARD project, Mexico and the United States do not have universal health care coverage, at least in practice. In the US approximately 17.5% of the population aged 65 or less is presently uninsured (Institute of Medicine, 2001). These individuals do not have private health insurance and are not eligible for Medicaid, the federal health insurance program for low income earners. In Mexico, in 1994, about 11% of the population did not have access to health care. Unlike the US, this was not a problem of inadequate coverage, since individuals not covered through social security or private insurance are eligible for public health care services, but rather a problem of access. Since 1994 significant government investments in the health care system have provided significant improvements such that most of the population receives at least basic health care (Larre 2001).

18. In Switzerland, universal coverage is achieved through compulsory private health insurance; premiums are not risk-related (WHO Europe 2000). A similar “social insurance” structure exists in the Netherlands: 62.8% of the population are covered by compulsory sickness funds (social insurance), 30.3% are covered through a private insurer and 6.8% are either covered through 3 civil servant health care schemes or do not have any health insurance.

19. By and large citizens of OECD countries, whether through public or private health insurance, are covered for basic health care services related to stroke. The most notable exceptions are for drugs delivered outside of hospitals (Canada, US - Medicare) and MRI and ultrasonography in Korea (Table A2.1 in the appendix). Therefore, access to stroke health care services does not appear to depend on the type of health insurance, but rather on its presence. The lack of health insurance may have adverse affects on the uninsured in the US since they are less likely to undergo expensive, technologically intensive procedures (Wenneker 1990; Hadley 1991; Sada 1998; Canto 2000). In addition, the uninsured are less likely to receive monitoring and treatment in relation to stroke risk factors such as hypertension (IOM 2002).

20. Another factor to consider is that of individuals in the United States who retire before they have reached the age of 65, the age at which eligibility for Medicare begins. Many of these individuals had employer-based health insurance which they were ineligible for following retirement, but cannot afford the high cost of private health insurance, especially since it is risk-based, while they await eligibility for Medicare.

Private health insurance

21. Private health insurance plays a significant role in covering individuals for basic health care services in some countries in our study: Netherlands (30.3%), Switzerland (100%) and the US (2/3 of adults less than 65 years of age). For these countries no stroke health care services are excluded from coverage. To the extent that uninsured individuals are denied access to preventative and health care services for stroke, either through an inability to afford insurance, an unwillingness to purchase or the lack of 'charity' health care, this may have an effect on health outcomes (IOM 2002).

22. For most countries, private health insurance is most often used as supplemental or complementary insurance. Patients in Australia, Greece, Italy, the United Kingdom and - to a limited extent - in Denmark, use private health insurance in order to be treated by the physician of their choice. It is possible that private health insurance in these countries may also be used to avoid queues in the public sector. However, this is likely not to have a major influence for most stroke health care services, though it might be more important for diagnostic procedures such as Magnetic Resonance Imaging (MRI). In Canada, private health insurance is used to cover services not included under the public health insurance scheme; this mainly refers to drugs delivered outside of hospitals. Medicare patients in the US also use private insurance to cover drugs outside hospitals.

23. In general terms, the results of the survey can be summarised as follows:

- Private insurance plays a significant role in providing coverage for basic stroke care services in Mexico, the Netherlands, Switzerland and the United States.

- In countries such as Canada and the United States, private insurance can be bought to cover services left out of the public health insurance programme such as outpatient drugs for stroke patients.

- In Australia, private insurance is used to cover the co-payment required when a person decides to be admitted as a private patient, but will not cover the co-payment for ambulatory or outpatient physician services or for drugs.

- In Japan, private insurance traditionally provides an insured person with an indemnity benefit to compensate for lost income due to hospitalisation. As of 2000, private insurance also provides compensation for co-payments.

- In Australia, Denmark, Greece, Italy and the United Kingdom, patients buy private health insurance in order to access choice of private doctor and treatments provided in private facilities.

- In Hungary, Norway, and Sweden at this time, private health insurance is not widely available. However, Norway reported that there are current efforts to establish private health insurance. In Hungary also, some private companies are starting to operate.

2.1.2. Cost Sharing

24. Since the costs to patients of drugs administered in hospital are invariably lumped together with other cost components of a hospital stay, we will only consider cost sharing for drugs consumed in an ambulatory setting. The only exception is Korea where inpatients may share 20% of the cost of administered drugs (Table A2.3 in the appendix). First we cover some general issues in relation to cost-sharing, then consider cost sharing for non-drug related stroke treatment, and finally discuss cost sharing for drugs consumed outside the hospital setting.

25. Out-of-pocket payments represent a significant proportion of total health care expenditures for OECD countries. In 1998 out-of-pocket payments represented 8.0% of total health care expenditures in the Netherlands, in the same year out-of-pocket payments represented 47.9% of total health care expenditures in Mexico (OECD 2001).

Table 2.2. Out-of-pocket payments per household: 1990 and 1998
(as a percent of Total Health Care Expenditures)

Country	1990	1998
Australia	16.4	16.2
Canada	14.4	16.6
Denmark	16.0	16.6
Hungary	.	17.6
Italy	15.8	24.5
Japan	.	17.0
Korea	53.0	41.6
Mexico	59.2	47.9
Netherlands	.	8.0
Switzerland	32.4	27.6
United Kingdom	10.6	11.1
United States	20.2	15.6

Note: In 1999, official figures from the Ministry of Health in Denmark show the figure to be 18.8%. Data for Switzerland are for 1990 and 1997.
Source: OECD Health Data 2001; Switzerland - Health Care Systems in Transition: Switzerland 2000. Table 3.

26. While the individual burden of cost sharing differs across countries, there are schemes in place that reduce the burden on individuals. These schemes apply equally to non-drug and drug related care for stroke, and apply to public health insurance and publicly delivered health care. The first of these schemes are exemptions. The three most common exemptions in place are for low income persons/families, the elderly and the chronically sick. In Spain there are no exemptions from cost sharing for non-drug related care but there are exemptions for retired persons and the chronically ill. There are no exemptions in Switzerland. There are no explicit exemptions in Korea but co-payments for the elderly are lower.

27. Another scheme to reduce the burden of cost sharing are ceilings, whereby patients share in the costs of treatment up to a yearly, or daily, maximum accumulation of charges. The only country that does not have explicit ceilings on cost sharing is the Netherlands[2], but this only applies to drugs consumed out of hospital. It should be noted that for drug treatment, cost sharing applies to drugs delivered outside hospital only.

Cost sharing for non-drug related care

28. If large enough, co-payments may affect patients' decisions on treatment choice. For the countries in our study, out-of-pocket payments are not regarded as representing an impediment to patients' demand for stroke health care services. Even in Greece, Korea and Switzerland, where out-of-pocket payments are the largest, exemptions and ceilings limit the negative demand impact of out-of-pocket payments (Table A2.2 in the appendix).

29. Cost sharing is less common for inpatient care than it is for ambulatory care. Since inpatient care is typically more expensive than ambulatory based care, this has the potential to burden patients financially. For cost sharing for ambulatory care, the countries in our study are split roughly 50-50 between those that do allow cost sharing and those that do not. In the inpatient setting, Italy specifically exempts diagnostic and pathological services from any cost sharing for stroke patients. For both inpatient and ambulatory care, exemptions and ceilings work to reduce or eliminate any potential financial burden to the patient. However, rehabilitation services offered in an ambulatory care setting provide the potential to place a significant financial burden on stroke patients. Rehabilitation services outside of hospital settings are often not covered by public health insurance, or are not part of the publicly delivered health care system, especially if there is a requirement for long-term rehabilitation. No country in our study indicated a problem with cost sharing for ambulatory rehabilitation services, but it is also difficult to obtain detailed information on rehabilitation services for stroke. This is an area that requires further study.

Cost sharing for drugs in ambulatory care settings

30. Cost sharing for ambulatory care drugs is much more prevalent than for non-drug related treatments for stroke. In fact, apart from exemptions for various identified groups, cost sharing is an integral part of insurance coverage for ambulatory care drugs, be it public or private coverage. 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. Table A2.3 in the appendix provides an outline of some of the issues related to cost sharing policies for ambulatory care drugs.

31. Almost all the countries in our study provide universal coverage for ambulatory care drugs. Only Canada and the United States do not provide universal public coverage for ambulatory care drugs. For these two countries private health insurance plays an important role in providing coverage for ambulatory care drugs. In the United States, in addition to the extensive role private insurance plays for all health care coverage for persons aged less than 65 years, private health insurance is also used to provide coverage for ambulatory care drugs for the elderly since these drugs are not covered under Medicare. In Canada, private health insurance plays a vital role for ambulatory care drugs in provinces that do not provide universal drug coverage. Private insurance can also be used to insure against copayments for public health insurance. Although reinsurance will not completely offset copayments, reinsurance is especially important for Korea where copayments are much higher than other countries[3].

2 . Denmark had no ceiling up until 1 March 2000.

3 . Re-insurance refers to the practice of insuring against the co-payment for treatments already insured.

2.2. The supply side:

32. This subsection will describe how hospitals and other health care facilities, and physicians are remunerated. We will not enter into a discussion of how health care systems are financed since these have no direct bearing on individual decisions regarding treatment choices, which is the essence of this study: to compare health care systems using a bottom-up approach through investigation of the relationship between treatments, costs and outcomes at a micro-level. Nevertheless, while the method of how health care systems are financed and how services in general are delivered may not have a direct impact on treatment decisions, it is important to have an understanding of how health care systems are financed to put into context the interrelationships among the various economic and structural factors. It would not be possible to have an adequate discussion of this matter in a few short paragraphs, however, there is an abundance of literature the reader can refer to for discussions of the various financing arrangements of health care systems and how services are delivered[4].

33. The survey reveals that supply side limitations appear to play a crucial role in differentiating OECD countries in terms of diffusion of technologies within their health care systems. In addition to official restrictions to entry and regulations, payment mechanisms may also influence how providers are able to use these technologies. In most countries, the universality of health care systems allows governments to wield a significant degree of control over health care providers through the exertion of monopsony power. These supply side constraints have tended to be reinforced in periods of slow economic growth and when increases in health care spending were straining public budgets, as was the case at the beginning of the 1980s. Restrictions of hospital and physician payment systems, regulation of the supply of providers and of technology have been the instruments used to constrain supply side behaviour. Table 2.3 offers a general overview of the constraints faced by providers.

Table 2.3. Potential supply side constraints affecting stroke treatment

Constraints	Strong	Medium	Low
Hospital payments	*Mainly global budgets* CAN, DNK, GBR, NLD, NOR, SWE, Public hospitals: ESP, GRC, MEX	*Mixed financing or DRG* AUS (varies by state), CHE (some cantons 50% block grants), HUN, ITA, USA (DRGs - Medicare, HMOs)	*Mainly FFS* CHE, JPN, KOR; Private hospitals: AUS, ESP, GRC, ITA, MEX, USA (priv insurers, Medicaid)
Physician (specialists) payments	*Mainly salary* DNK, ESP, GBR, HUN, ITA, JPN, NOR, SWE Public: CHE, GRC, KOR, MEX	*Mainly FFS with fixed financing or mixed payment* AUS, CAN, GRC (private), USA (Managed Care, Medicare)	*Mainly FFS with open-ended financing* CHE, NLD, USA Private: ESP, KOR, MEX
Technology regulation	*Explicit and targeted funding* CAN, DNK, GBR, HUN,	*Explicit constraints or targeted funding* AUS, GRC, ITA, KOR, SWE	*No constraints* CHE, JPN, NLD, USA

Note: For physician payments, this mainly refers to physician services delivered in hospital. Thus, the focus is on specialists delivering stroke care which generally does not include general practitioners. Refer to Tables A2.4, A2.5 and A2.6 for more details regarding the ranking of constraints. In some countries hospital and physician payments are not separate. This table reflects the period for which data were collected, mainly the mid-1980s to mid-1990s.

4. For example, the OECD study *The Reform of Health Care: A Comparative Analysis of Seven OECD Countries*, provides a thorough discussion on the different methods of financing health care systems and methods of providing services.

2.2.1. Payment methods for hospitals and physicians

Hospitals

34. In terms of financing of hospitals, there exists three main payment methods, although in practice payers tend to use a mixture of these systems (Table A2.4 in the appendix):

- global budgets: hospitals are paid a fixed amount for all services rendered within a given period.
- fee-for-service: hospitals are remunerated per patient, usually on a per diem basis.
- case-mix payment systems or Diagnosis-Related Groups (DRGs): group treatments and diagnostic procedures related to specific diagnoses into payment groups, with weights assigned to payments based on the intensity of the service within the DRG.

35. The three methods of finance have different effects on how treatment decisions are taken. In terms of constraints in providing services, global budgets are the most restrictive and fee-for-service is the least restrictive. The reader should refer to the ARD ischaemic heart disease report for a more detailed discussion regarding how each payment method affects treatment decisions (Moise *et al.* 2002).

36. Historically, global budgets, or block grants, have been the main method through which hospitals are remunerated. Only Canada, the UK and the Nordic countries remunerate hospitals almost exclusively with global budgets. The attraction of global budgets is the ease with which they can be used to put tight restrictions on financing hospitals, but since there is no link between payment and activity there is less financial incentive for hospitals to provide productive and timely health care.

37. On the other end of the constraint spectrum lies fee-for-service, or per diem remuneration. This is the method of remunerating hospitals in Japan, Korea and Switzerland and is how most private hospitals receive payment. From a profit maximising perspective hospitals prefer this method since it is easiest for them to identify marginal revenue and marginal cost. While hospitals may prefer this method, it provides an incentive to increase the number of services, thus potentially making it more expensive for third-party payers, either private insurance or governments. In some cases, for example Japan, governments exert some control over prices through centralised control of fee schedules.

38. The drawbacks of global budgets and fee-for-service have led to the creation of a third method of paying hospitals, case-mix (DRGs). DRGs provide hospitals with greater incentives than global budgets since there is a semi-direct link between payment and treatment, but are not as financially burdensome to third-party payers as fee-for-service since the links are made within a group of services and are attached to specific diagnoses. While DRGs are used as the primary means of paying hospitals in some states in Australia and for Medicare in the United States, most countries that make use of DRGs combine them with global budgets to provide a mix-payment system. Denmark (as of Jan. 2000), Norway and Sweden, countries that in the past relied exclusively on global budgets, have begun experimenting with DRGs by combining them with global budgets.

Remuneration methods for physicians

39. In our study we consider mainly specialists physicians who most often treat stroke; neurologists and neurosurgeons. This was done for practical reasons: other physicians such as general practitioners or internists who may deal with stroke patients treat other patients as well, so data on their numbers will not

accurately reflect stroke related supply. In addition, as will be evident in Section 2.3, other health personnel such as nurses and rehabilitation specialists are important to the treating of stroke patients.

40. Table A2.5 in the appendix shows that fee-for-service is used primarily in remunerating specialists in private practice and salary is the preferred method for public specialists. Furthermore, hospital based physicians tend to be paid salary while fee-for-service is more prevalent for paying ambulatory care specialists.

41. For most countries there exists one dominant form of payment for physicians. Fee for service tends to dominate both the ambulatory and hospital sectors in Australia, Canada, the Netherlands and Switzerland, although payment methods appear to be more diverse for hospital-based specialists[5]. Salary is the preferred method of payment in Denmark, Hungary, Norway, Spain, Sweden and the United Kingdom. For the remaining countries included in our study, there is a mixture between the two payment methods with fee-for-service more prevalent in the ambulatory care sector and salary preferred for remunerating hospital-based specialists[6].

42. The prevailing environment, fee-for-service the dominant form of payment in the private sector and salary the dominant form in the public hospital sector, has led to an interesting development: the ability of public hospital based specialists to practice on private patients. In Australia, Italy, Spain, Switzerland and the UK, specialists are allowed to treat private patients in public hospitals, with varying degrees of constraint. This practice may help salaried specialists supplement their incomes which are usually lower than fee-for-service specialists.

43. Regarding comparisons of specialists' incomes, there is little data available that would allow us to examine the incomes of neurologists and neurosurgeons. What little data there is would force us to be too speculative and therefore we feel it is prudent not to discuss levels of remuneration across countries.

2.2.2. Quantitative regulation of supply

Physician supply

44. There are several means available to limit the supply of physicians. One method would be to place limits on the future supply by limiting medical school enrolments. This was attempted in Canada in the early 1990s (Barer 1991), but has resulted in a shortage of physicians and is no longer considered a viable option. By and large most countries have not used medical school placement as a means of controlling physician supply, any reductions in medical school places are more likely the result of reductions to education funding than an explicit attempt to control physician supply.

45. In several countries, especially those with large swathes of thinly populated areas, an important policy objective is to have an adequate supply of physicians to serve these areas. Therefore, another means of regulating supply is to offer incentives for physicians to set up practice in rural or isolated areas. For neurologists and neurosurgeons however, this is likely to not have a large impact since their numbers are small and they tend to concentrate near urban areas with large tertiary care hospitals.

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5 . Netherlands has a mixed system; the remuneration is different for specialists who work in general hospitals or in university hospitals. Specialists in university hospitals receive more or less a fixed salary. Specialists in general hospitals work mostly on a fee-for-service basis with a maximum level.

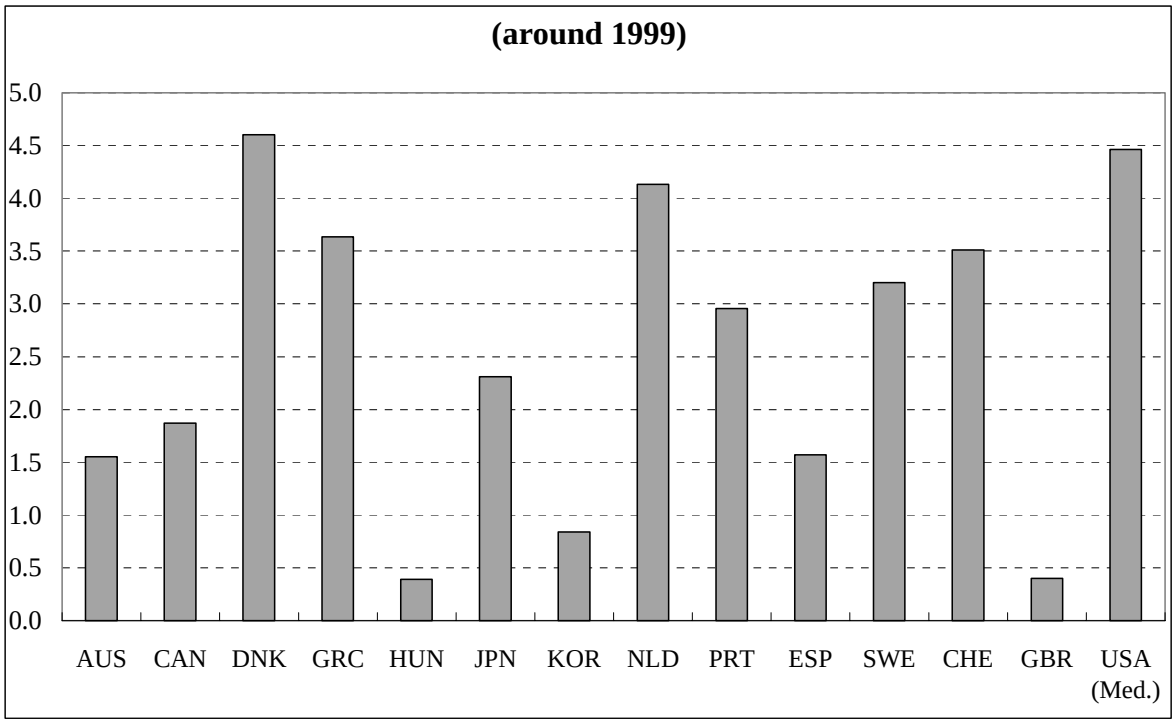
6 . We have not devoted any space to another form of paying physicians, capitation, that is gaining increased use in OECD countries. Under capitation, physicians receive a fixed payment for each patient on their roster. Since capitation is most often used in primary care, it is not as relevant to the present study as the other two methods of remuneration.

46. Another means of regulating supply is to restrain the number of licensed practising physicians, but no country in our study indicated this method has been used to any great degree, though in some cases such as Denmark the number of physicians able to bill for services is heavily regulated. A final means of regulating supply is to recruit foreign physicians to fill in supply shortages. This has been done in the UK where foreign trained physicians have been brought in to fill in supply shortages of specialists; in Australia, Canada and the US, foreign physicians have been brought in to serve in remote areas.

47. For the majority of OECD countries, it seems that the rate of physicians, as well as of specialists, per 100 000 population has been rising over the past 20 years (Figure A2.1 in the appendix), although we cannot discern what differences there are across specialities. The largest increases are to be found in Hungary and Norway while the smallest increases were in Canada and Australia (since 1990). In fact, the largest increases were mainly observed in continental Europe, where physician oversupply has been observed in the past.

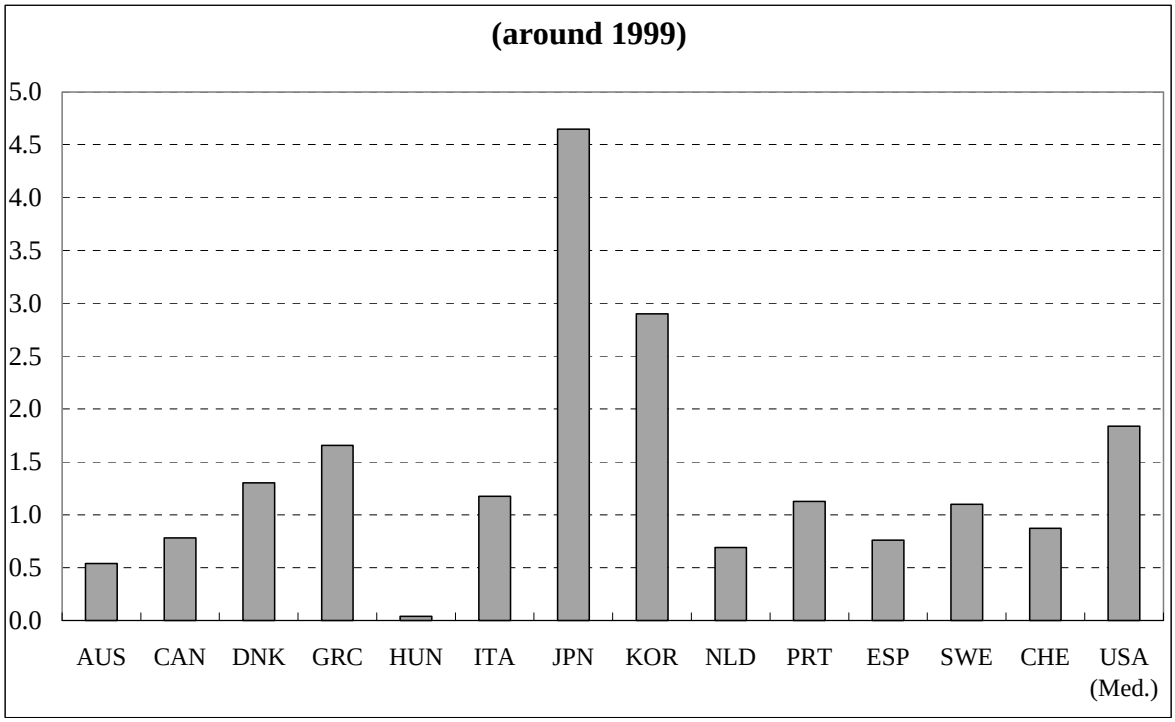
48. In Figures 2.1 and 2.2 we present figures on the number of neurologists and neurosurgeons respectively. Italy has by far the largest number of neurologists with 10.4 per 100 000 population (data not included in Figure 2.1), but these may include many non-practising neurologists who are in reality 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. Japan and Korea are the countries with the largest numbers of neurosurgeons per 100 000 population, 4.6 and 2.9 respectively (Figure 2.2).

Figure 2.1 Number of neurologists per 100 000 population



Source: ARD questionnaire for stroke.
Note: 1995 data for Greece and Spain. In Italy, the number of neurologists per 100 000 population was 10.4 in 1999.

Figure 2.2 Number of neurosurgeons per 100 000 population



Source: ARD questionnaire for stroke.
Note: 1995 data for Greece and Spain.

49. The figures presented above need to be treated with caution since the definitions of neurologists and neurosurgeons vary significantly across countries. It is probable that many of the stroke patients not treated by neurologists are treated by internists, gerontologists or even specialists in circulatory diseases. Furthermore, many neurologists may perform the same surgical procedures for stroke patients as neurosurgeons, although in the present study we only look at carotid endarterectomy. These definitional problems will cloud somewhat the true physician supply picture for treating stroke patients, so caution should be exercised when interpreting the data.

Supply of technologies and facilities

Policies for regulating supply at a macro level

50. Medical technology is recognised as one of the key contributors to rising health expenditures in developed countries. Carotid endarterectomy can be considered the only high technology surgical treatment used for ischaemic stroke. However, technology plays a more important role is in the diagnosis of stroke. The two technologies we focus on diagnosing stroke are computed tomography (CT) and magnetic resonance imaging (MRI).

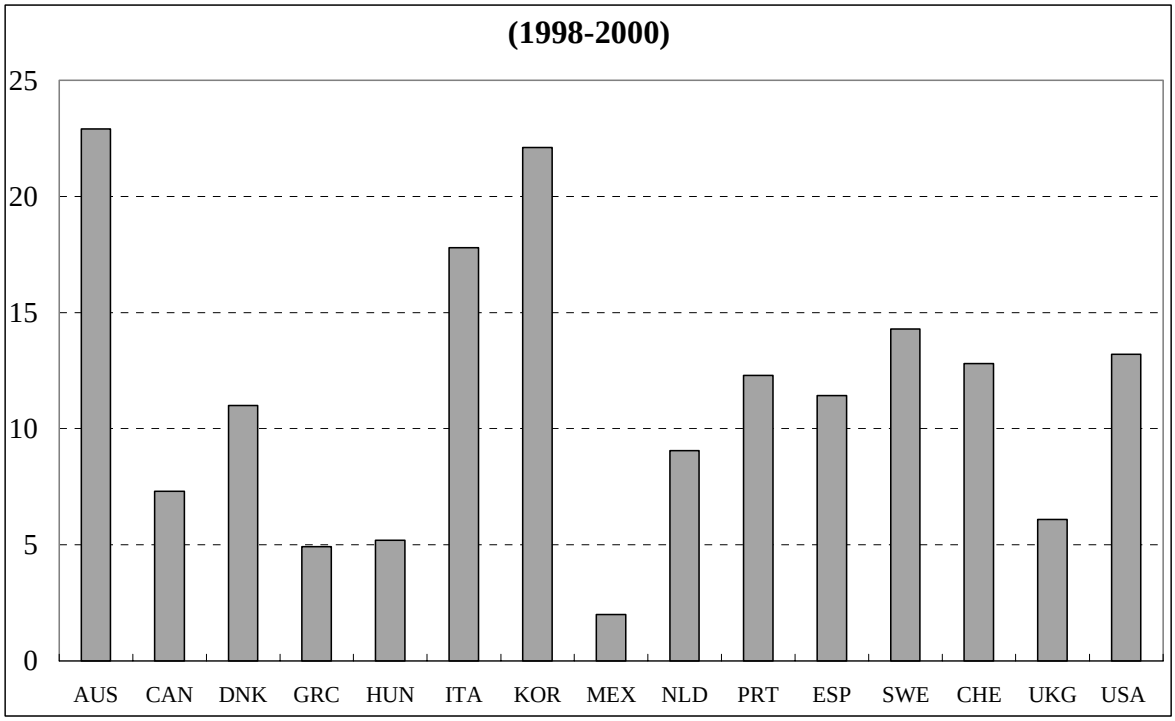
51. Many countries have attempted to arrest rising health care expenditures by putting constraints on the diffusion of costly medical technologies. These constraints have the potential to create problems of insufficient supply, which could impede access to these technologies and lead to queues for these services. They may also create situations of inequitable access if patients with private insurance are able to avoid public sector queues. In our study we found the longest waits for both CT scans and MRI were in Canada, Denmark, Sweden and the UK (Table A2.6 in the appendix). These countries, with the exception of Canada, allow patients to jump public sector queues to receive services in the private sector. Whether this

practice eases average waiting times or simply allows more room on the waiting lists for patients not previously considered as candidates for CT scan or MRI is not clear.

52. We have collected data on the number of CT and MRI scanners. These data are displayed in Figure 2.3 (CT scanners) and Figure 2.4 (MRI scanners).

53. Computed tomography is the older of the two technologies we look at. Japan (71.8), Australia (23.9) and Korea (22.1) are the only countries with more than 20 scanners per 1 000 000 population. 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 fewest number of CT scanners per 100 000 population (2.0), which is likely a reflection of its lower per capita income.

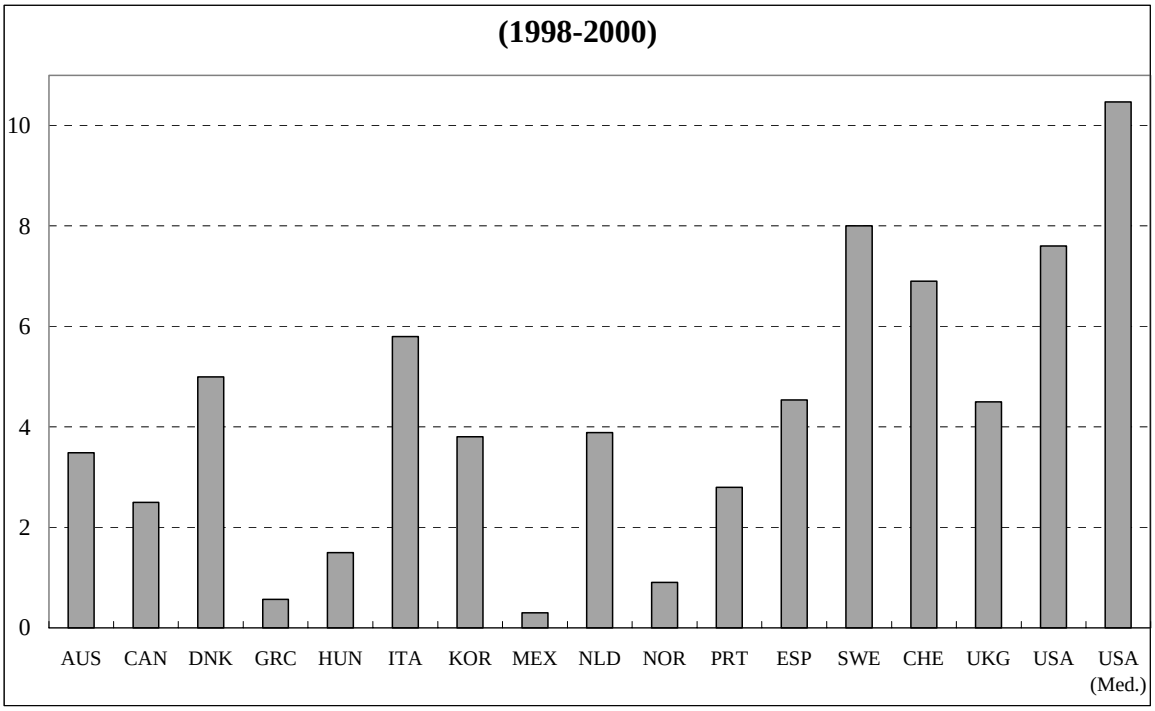
Figure 2.3 Number of CT scanners per 1 000 000 population



Note: 1993 data for the Netherlands and 1997 for Portugal. For Japan the rate was 71.8 in 1996.
Sources: ARD questionnaire for stroke and OECD Health data (2001) for Canada, Hungary, Mexico, Portugal, the United Kingdom and the United States.

54. 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 US 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 2001). However, this does not explain why Japan or Sweden, two countries with lower per capita incomes have more MRIs per capita than the US or Switzerland. Nor does it explain why Canada, with the fourth highest per capita income respectively of the countries displayed in Figure 2.4, has the fourth lowest number of MRIs per capita. However, from Table A2.6 in the appendix we see that waiting times for MRIs in Canada is a significant problem, which suggest there is a problem of undersupply or excess demand.

Figure 2.4 Number of MRI scanners per 1 000 000 population



Note: 1995 data for the Netherlands. For Japan the rate was 18.8 in 1996.
Sources: ARD questionnaire for stroke and OECD Health data (2001) for Canada, Hungary, Mexico, Portugal, the United Kingdom and the United States.

Policies for regulating supply at a micro level

55. In addition to macro-regulation of technology, third party payers may attempt to micro-regulate physicians' decisions through the use of clinical practice guidelines (CPG). We found no evidence that CPGs are used in any way to influence physician treatment decisions for financial reasons. Where they exist, CPGs are used for clinical purposes.

56. We collected information on a particular procedure, carotid endarterectomy (CE), to observe the influence of CPGs on a specific procedure used for treating stroke. CE is a good example to use since there is strong evidence for specific guidelines to be used when performing this procedure (NASCET ; Europ trial) . The information collected is in Table A2.7 in the appendix. We found that not all countries have guidelines regarding CE, and where guidelines are in place there are some deviations from the recommendations of the two main control trials. As mentioned above, we did not find any evidence that guidelines have been used by third-party payers to regulate the use of CE.

2.2.3. Establishing a continuum of stroke care

57. The nature of ischaemic stroke, rapid onset of a highly disabling (and often fatal) disease followed by a potentially prolonged period of recovery for survivors, makes the organisation of health care for treating stroke unique in many respects. This section explores some of the policy implications of specific treatment modalities for post-acute stroke care: stroke units and rehabilitation.

Stroke Units

58. At a minimum, a stroke unit can be defined as: a multi-disciplinary team of dedicated inpatient resources for treating stroke, from the acute stage of the disease to rehabilitation. See Section 4.3.1. for more details about stroke units.

59. Despite their proven efficacy in treating stroke patients (SUTC 1997a; Cochrane Review 2002), few guidelines exist regarding the planning, establishment or utilisation of dedicated stroke units (Table A2.8 in the appendix). Where guidelines do exist, they tend to be local guidelines, products of the efforts of health professionals who regularly treat stroke patients and realise the potential of stroke units in improving outcomes for stroke patients. Furthermore, for the most part stroke units are not yet considered important cogs in the operations of acute care hospitals in the sense that coronary care units are in treating acute myocardial infarction.

60. If stroke units are as effective as studies seem to show 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.

61. 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 in most countries. It is possible that, because there is no standard definition of what stroke units are, there are no variables in hospital administrative databases that identify them. Furthermore, various regular surveys of health care institutions may not include questions on stroke units due to the lack of a standard definition. Therefore, the actual number of stroke units may be underestimated because they have not all been identified. The other consequence of not having a standard definition is that it complicates the planning process for creating stroke units. If the experts in these matters cannot agree among themselves on a proper definition of a stroke unit, then it stands to reason that health care planners will be reticent about establishing stroke units.

62. A second possible explanation why stroke units are not more common is that the use of stroke units is still evolving. In the 1970s it was recognised that organised stroke care, from acute care to rehabilitation, could result in beneficial outcomes for stroke patients (Indredavik 1999). Since then the development of stroke units has been 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 Nordic countries of Europe. It is likely that the number of stroke units will continue to grow as the evidence base regarding their efficacy continues to grow.

63. A third possible explanation why stroke units apparently are not part of the regular organisation of hospitals is the lack of an established "evidence base," an explanation put forth by Charles Wolfe in an editorial in the British Medical Journal (Wolfe 2001). Practice in the United Kingdom, he states, 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."" Some of the studies that have demonstrated the efficacy of stroke units have been observational studies of individual stroke units, there is little trial evidence in existence and only one known meta-analysis (SUTC 1997a). If the proliferation of stroke units in the UK 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.

Rehabilitation

64. It has been recognised that one of the benefits of stroke units is the attachment of a dedicated rehabilitation team. One of the reasons offered for better outcomes following treatment in a stroke unit is the short-term benefits of earlier reduction in disability through rehabilitation treatment lead to improved long-term survival (SUTC 1997a; Indredavik 1997). Unfortunately, dedicated stroke rehabilitation units, whether for acute or post-acute care, are few in numbers relative to their potential benefits.

65. The main problem with stroke rehabilitation is that treatment is often provided in a general rehabilitation setting instead of a unit designed specifically for stroke patients, despite the fact that stroke is a leading cause of disability. It is possible that rehabilitation units dedicated to stroke specifically may appear to be a luxury for health care planners, so recovering stroke patients are placed in general rehabilitation units. Certainly, as populations age, there will be an increasing demand for dedicated stroke units, but more trials demonstrating the efficacy and cost-effectiveness of stroke rehabilitation units will likely be required if health planners are to develop more of these units.

66. Another issue regarding stroke rehabilitation is the establishment of post-acute rehabilitation. Many stroke rehabilitation units are part of the acute care for stroke component of stroke care. What is not clear is whether a rehabilitation unit designed to treat acute stroke patients is appropriate for treating stroke patients once they have moved beyond the acute phase of the disease. Some experts advocate such a policy and there are several studies that show there to be a benefit to establishing separate postacute rehabilitation units (Langhorne 2001). Perhaps even more important for postacute care than inhospital rehabilitation is rehabilitation offered at home or on an outpatient basis (Wilson 2001). The goal of rehabilitation is to get patients mobile as soon as possible and home-based rehabilitation combined with early release has been shown to have no adverse affects on stroke patients (Anderson 2000). The danger with such an approach is that the availability of community rehabilitation services may be used to lower health care costs by reducing hospital lengths of stay for stroke patients, playing down any potential adverse clinical consequences.

3. EPIDEMIOLOGICAL CONTEXT

3.1 Background

67. This section provides some background on the epidemiology of stroke, which is one of the more prevalent diseases in OECD countries, both in terms of the associated mortality and disability burdens. More detail on various aspects of stroke definition, epidemiology, clinical characteristics and treatment are presented in the medical annex.

3.1.1 Mortality burden

68. The burden of stroke world-wide is substantial. It is estimated that more than 5.5 million people died from cerebrovascular disease in 1999, accounting for 10% of all deaths (9% of all male deaths and 11% of all female deaths) (WHO 2000). This results in a combined death rate of 93 per 100 000 people.

69. However, there is evidence of significant variation in the burden of stroke around the world. Estimates for 6 world regions further subdivided by their overall mortality rates show that, for the regions with the lowest overall mortality rates, the stroke mortality rate varies between 59 per 100 000 in the Americas to 115 per 100 000 in Europe in 1999 (WHO 2000). The low mortality regions in the Western Pacific had a cerebrovascular disease death rate of 109 per 100 000. While the majority of OECD countries fall into the regions with low overall mortality, not all do The corresponding groups relevant to this study display further variation in death rates for cerebrovascular disease, with rates as high as 250 per 100 000.

70. There is also variation in the proportion of total deaths caused by cerebrovascular disease for each region/mortality stratum group, ranging from 7% to 20%. This shows that deaths from stroke represent a higher proportion in some regions compared to others, which will reflect both the stroke death rate in the regions as well as the death rates from other diseases.

71. Further variation exists at the country level. Figure 3.1 presents mortality rates for cerebrovascular disease for the 14 countries included in this study. The countries have been arranged in descending order by the combined mortality rates for males and females. From these data, Portugal and Hungary have the highest mortality rates, followed by Greece and Japan. The majority of other countries fall into the middle group. The North American countries have the lowest mortality rates from cerebrovascular disease.

72. The mortality data presented above are for ‘cerebrovascular disease’, which include all types of strokes. There remains further variation in the death rates by type of stroke. These variations are examined in some detail later in this chapter in the mortality section.

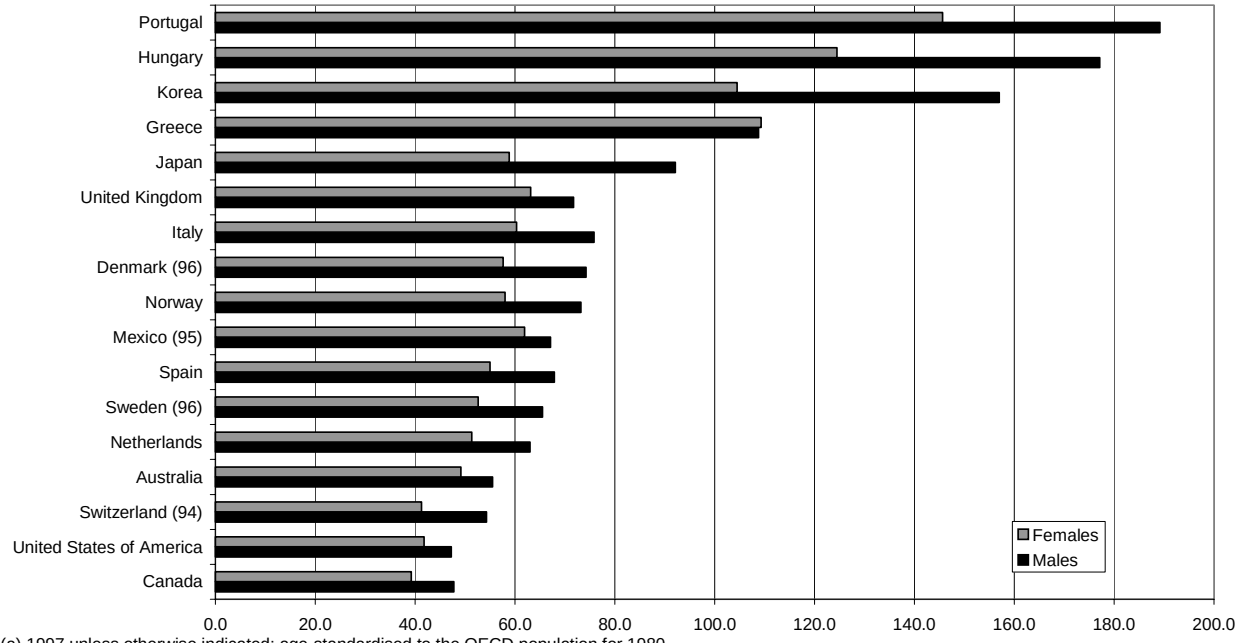
3.1.2 Disability burden

73. As well as producing a high mortality burden, strokes also result in a high disability burden. Stroke patients that survive the acute episode are often left with some degree of disability, with many remaining dependent on care-givers because of their disability.

74. Information on the disability related to strokes is not available to the same extent as mortality information. One measure that takes account of both the burden due to deaths and disability for a particular disease is DALYs (Disability Adjusted Life Years), which is measured in days of life lost to death and disability. The WHO Burden of Disease study uses DALYs to estimate the burden of disease (WHO 2000). There were almost 50 million DALYs lost world-wide to stroke in 1999. This is a rate of around 840 per 100 000 people, representing 3.5% of the total burden of all diseases. There is significant variation between the regions relevant to this study in the total disease burden, from around 440 to 2300 DALYs per 100 000. For these regions, stroke represents between 3.1 and 11% of the total disease burden as measured by DALYs.

Figure 3.1

Age-standardised mortality rates for cerebrovascular disease, 1997[(a)]



(a) 1997 unless otherwise indicated; age-standardised to the OECD population for 1980.
Source: OECD Health Data 2001.

3.1.3 Causes of differences in stroke burden

75. There are a number of factors that effect death and disability rates (that is, the health 'burden') resulting from stroke. Firstly, the incidence rate (new cases of the disease relative to the population size) will obviously affect the mortality and disability rates. Secondly, the severity of the stroke will have an impact on the outcome for individual patients. Thirdly, the patient's access to and the effectiveness of the treatment and rehabilitation received will have an impact. Finally, an individual's general health prior to the event will influence their capacity to recover. Information on these factors, where we have relevant data, are presented in this report.

3.1.4 Data issues

Comparability of measures

76. This chapter provides information primarily on the incidence of and mortality from stroke, along with some information on risk factors. This information is intended to provide context for our analysis of

differences in treatments, costs and outcomes. The information specifically collected for the study provides some new data not previously published. While we have taken care in defining and compiling the data, difficulties are inevitable with international comparisons of this nature. If detailed epidemiological data are required, the reader should consult the various research studies cited in the text as well as other sources.

77. Specific differences exist in relation to the methodologies and definitions used in both the research projects and in administrative data collections used as the source of these data. Appendix 2 provides a brief summary of the data sources, and specific notes are made throughout the text where relevant. There are also some differences in the ICD codes used, mainly due to changes over time within the countries (for example, many countries have moved from ICD9 to ICD10 in recent years).

Data on stroke subtypes

78. As discussed in the Medical Annex, there are a number of different types of stroke. Three of the main sub-types include ischaemic stroke, haemorrhagic stroke and subarachnoid haemorrhage. The main focus of this report is on ischaemic stroke. This is because these account 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, which is the main focus of this report. By limiting the majority of our analysis to ischaemic stroke, we increase the homogeneity of the cases, thus increasing the validity of comparing differences in treatments, costs and outcomes. To provide context for our analysis, in this chapter we present information primarily on ischaemic stroke, but also some information on some other sub-types of stroke.

79. As discussed in the medical appendix, a transient ischaemic attack (TIA) is a temporary condition similar to a stroke, but which does not leave any permanent damage. We have not included any data on TIAs in this chapter, because it is difficult to obtain reliable quantitative information on the number of TIAs in the community. Some information is available from hospital records, though this will only cover a proportion of all people experiencing a TIA. Further, mortality rates for TIA are extremely low. However, the treatment of TIAs is important which is included in the following chapters.

80. The International Classification of Diseases codes used to specify the different types of stroke used in this study are listed in Table 3.1.

Table 3.1. International Classification of Diseases (ICD) codes used in this study

ICD8 code	ICD8 label	ICD9 code	ICD9 label	ICD10 code	ICD10 label
Ischaemic stroke					
433, 434	Cerebral thrombosis, cerebral embolism	434	Occlusion of cerebral arteries	I63.3,4,5,8,9	Cerebral infarction [excluding I63.6]
436	Acute but ill-defined cerebrovascular disease	436	Acute, but ill-defined, cerebrovascular disease	I64	Stroke, not specified as haemorrhage or infarction
Trans Ischeamic Attack					
435	Transient cerebral ischaemia	435	Transient cerebral ischaemia	G45	Transient cerebral ischaemic attacks and related syndromes
				I65	Occlusion and stenosis of precerebral arteries, not resulting in cerebral infarction
				I66	Occlusion and stenosis of cerebral arteries, not resulting in cerebral infarction
Haemorrhagic stroke					
431	Cerebral haemorrhage	431	Intracerebral haemorrhage	I61	Intracerebral haemorrhage

3.2 Incidence

81. Incidence information presented in this chapter relates to the number of new cases of 'stroke' for a given year. The results are presented as rates, that is, the number per 100 000 population. Two types of measures are presented: age-specific rates for three age groups (40-64, 65-74 and 75 and over), and age-standardised rates for summary measures for the whole population aged 40 years and over. Further information on age standardisation is presented in Appendix 2.

82. Incidence is not straight-forward to measure, and information is rarely collected in routine administrative data collections. Registers have been established in some countries, usually in particular regions within a country. If the data collection procedures for these registers ensure a high proportion of new stroke cases are registered accurately, these will usually provide the best source of stroke incidence. An alternative approach is to use hospitalisation data collections as the main source of stroke incidence data. This will only be accurate if almost all stroke patients are admitted to hospital (this is not likely to be the case), or if information is available on other cases of stroke not admitted to hospital to supplement the hospital admission data. In addition, it is necessary to be able to identify initial admissions for stroke, in order to ensure that cases of stroke are only counted once (at the time of the initial event and not for any readmission). Because of these difficulties, Norway and Denmark are the only countries we have included incidence information based solely on hospitalisation data (and using our restricted ICD9 codes, Ellekjaer *et al.* 1999), as it is considered that data from these hospital-based collections are a reasonably accurate indication of incidence.

83. Due to the difficulties involved in collecting incidence data, we only have information on a relatively small number of the countries included in this study, which may not be generalisable to the other countries in this study. In addition, the data are usually sourced from a register covering one particular region, and therefore may not be representative of the entire country. This gap in information on stroke incidence is unfortunate, as such information would be extremely useful for both international comparisons, as well as to enable each country to better monitor the number of new cases of stroke within their own country.

3.2.1 Cross-sectional

84. Where available, recent information on stroke incidence for specific OECD countries participating in this project are presented here, in most cases for ages 40 years and older. Due to the difficulty in obtaining strictly comparable data on stroke incidence, we have included results from a variety of studies to illustrate the main trends and patterns in the incidence of stroke. In particular, care needs to be taken when making comparisons between countries, as different methodologies, age groups and sample sizes may have been used.

85. Some data are available for ischaemic stroke (the main focus of our report), and some data for a wider set of stroke sub-types. Although the rates for these different boundaries on the definition of stroke are not comparable, estimates for both stroke groups are presented here to provide as much information on stroke incidence as possible.

86. The studies included here that provide information on the incidence of both haemorrhagic and ischaemic stroke confirms that haemorrhagic stroke only represents a small proportion of strokes compared to ischaemic stroke. As part of this study, we have information on both haemorrhagic and ischaemic stroke for Sweden, Japan, Denmark and Australia (Figure A3.1 in the appendix). For all of these countries, the incidence of haemorrhagic stroke is small compared to ischaemic stroke. However, in Japan haemorrhagic stroke contributes a higher proportion of the combined (haemorrhagic and ischaemic) stroke incidence compared to the other countries. The common age group for all these countries is the 65-74 year group. For

this group in Japan, haemorrhagic stroke contributes 20.0% and 39.6% to the combined incidence rate for males and females respectively. The corresponding figures for the other countries ranged between 12.0% and 11.5%.

87. Figures A3.2 and A3.3 in the appendix show available incidence rate data for 'all stroke' and ischaemic stroke respectively. These include some data for Sweden, Italy, Denmark, Japan, UK, Norway and Australia.

88. These country specific data suggest there is variation in stroke incidence between countries, although care needs to be exercised in making direct comparisons as the studies have not used a common methodology. In particular, there appears to be sizeable differences between countries in the estimated incidence rates for the older age groups. The observed differences may be artefacts of the data collection and research methodology used, or they may be due to differences in the underlying incidence rates of the populations. In general terms among the countries with data included here (for 'all strokes' or for 'ischaemic stroke'), Sweden has the highest incidence rates, followed by Norway, Italy, Denmark and Japan. The UK and Australia have the lowest incidence rates among these countries.

89. Three countries provided data from more than one study. For Australia, data on ischaemic stroke incidence rates were available both from the Perth Hospital Morbidity Data System and the North East Melbourne Stroke Incidence Study. Relative to the other countries included in Figure A3.3 in the appendix, these two studies estimated similar incidence rates, although the Melbourne study demonstrated higher rates for the older age group compared to the Perth study. For Italy, as well as the data included in Figure A3.2 in the appendix, some other information was also available, but only for persons aged up to 65 years. For the overlapping age groups, the second study estimated substantially lower incidence rates for females than the first, though the difference may be attributed to different diagnostic criteria. For Japan, incidence rates are available from a number of studies, though the majority of these cover time periods at least 10 years ago. Amongst the 3 studies related to 'all stroke', estimates were fairly consistent, though some evidence of regional differences was apparent.

90. Ischaemic stroke incidence data for Hungary is available for 'all persons' only, which therefore cannot be compared to the age-specific data mentioned above. For Hungary, the estimated incidence rate for all males is 380 per 100 000 and 355 per 100 000 for all females.

91. The country-specific graphs in Figures A3.2 and A3.3 demonstrate that, as expected, the incidence of stroke increases with age, with by far the largest incidence rates occurring in the 75+ age group. For the studies using our standard 3 age groups (40-64, 65-74 and 75+), the incidence rate for the middle age group was generally between 6 and 7 times greater than the rate for the lower age group, while the rate for the oldest age group ranged between 2 and 4 times higher than the rate observed for the middle age group.

92. The stroke incidence rates for males are higher than for females in nearly all the age groups and studies examined. Similarly, the age-standardised incidence rates for males are higher than for females for persons aged 40 years and over (Figure 3.2; ischaemic stroke only). These results are age standardised using the same base population (that is, the European standard population), and thus control for differences in the age structure between males and females. This enables valid comparisons to be made between the male and female rates. The age-standardisation also removes differences in the age structure from populations in the different countries. However, as stated earlier, care needs to be exercised when making comparisons between countries from these incidence data due to differences in the study methodologies, age groups and sample sizes.

93. The ratio of the male to female incidence rates shown in Figure 3.2 ranges between 1.3 and 1.6. There is also variation in this ratio within the three age groups. Figure 3.3 shows this ratio for our three standard age groups. Of these, the largest ratio (that is, the biggest gap between the male and female rate) is generally found in the youngest age group, where the male rate is almost twice that of the female rate. For the oldest age group over 75 years, the ratio is nearing 1 in most cases, indicating similar rates for both sexes.

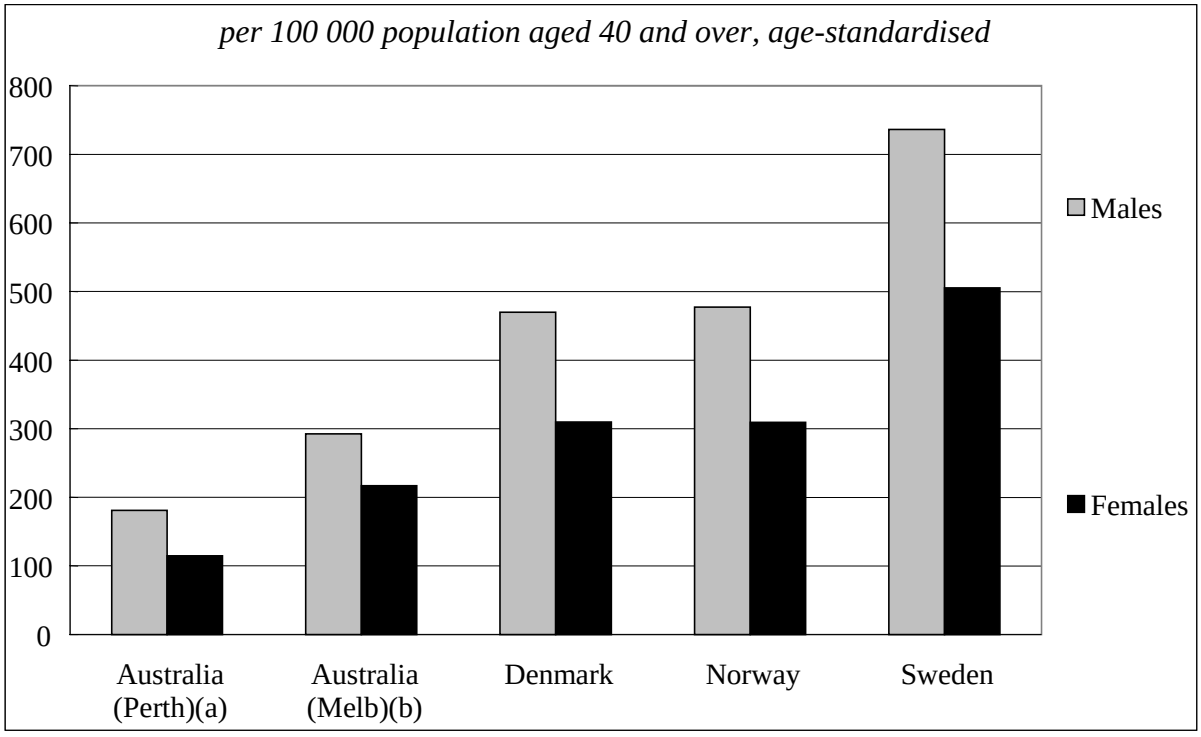
3.2.2 Recent trends

94. 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). Data available for our study are presented in Figure A3.4 in the appendix showing age-standardised trends in ischaemic stroke incidence (for persons aged 40 years and over) for regions within five countries. One country demonstrates declining incidence (Australia), two countries increasing incidence (Denmark and Norway) and the remaining two having relatively stable incidence (Italy and Sweden).

95. The Swedish, Danish and Australian data have been age-standardised using the same population (the European standard population), but the others have been age-standardised using their own population. In addition, the Italian data relates only to under 65 year olds). Therefore, it is not possible to compare the incidence rate levels from one country to another. However, valid observations can be made regarding the trends for each country individually.

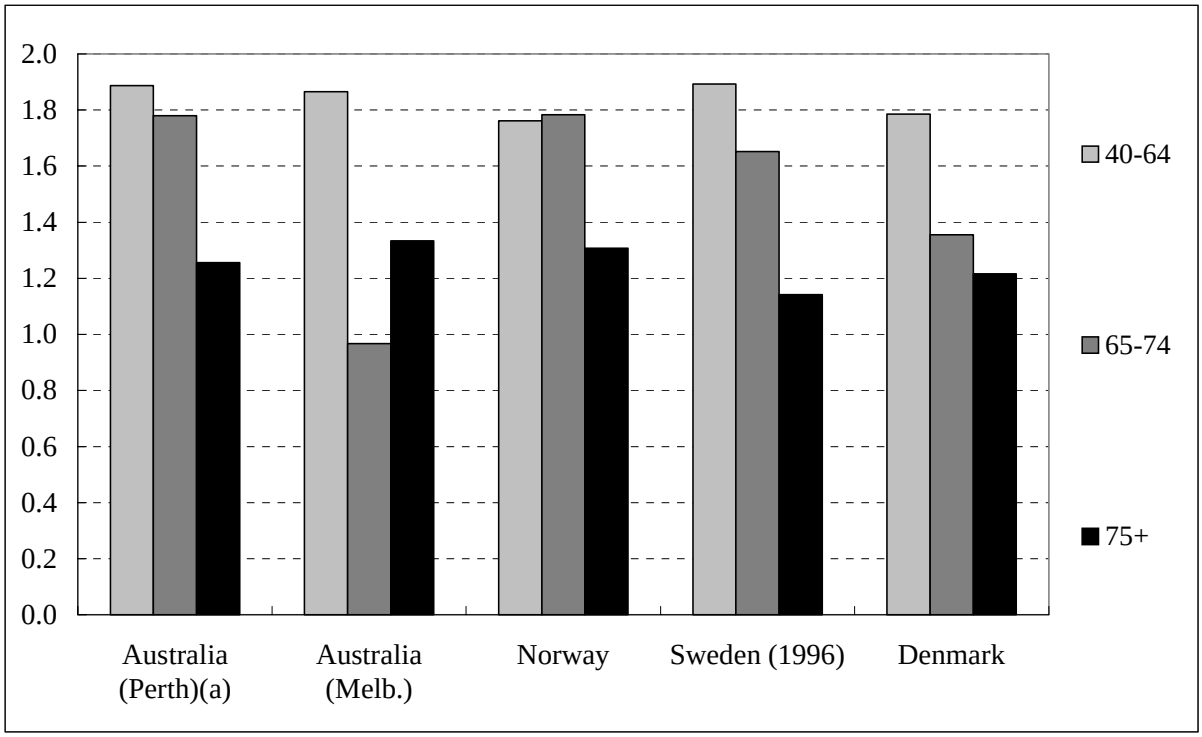
96. A number of other countries only have data available for 'all stroke' rather than only ischaemic stroke. For Japan, it appears from the crude rates that stroke incidence is declining. For over 55 year olds in the Netherlands, there were declines in the incidence rate in the late 1980s, but increases again in the early 1990s up until the latest available data in 1993.

Figure 3.2 Ischaemic stroke incidence by sex, 1997



(a) for 40-84 years old., ***(b)*** refers to the fiscal year 1996-97.
Note: Age-standardised to the European standard population.

Figure 3.3 Ischaemic stroke incidence rate ratio [males to females], 1997



(a) for 40-84 years old.
(b) refers to the fiscal year 1996-97.

3.3 Mortality

97. Compared to incidence rates, it is easier to obtain information on mortality rates as most OECD countries maintain routine death registration data indicating the cause of death. The usefulness of the data are reliant on the accuracy of the cause of death coding and the completeness of the death registration system. It is generally accepted that the data from these registration systems are reliable and fairly comparable across countries[7].

3.3.1 Cross-sectional

98. Currently available international data on total cerebrovascular disease deaths across all ages indicate variation between countries in the age-standardised mortality rates (see section 3.1). The highest rates were in Portugal, Hungary and Greece, and the lowest rates in Canada and the United States. The rate for Portugal was around 4 times higher than that for Canada. In this study we are interested in mortality rates for different types of stroke, particularly ischaemic stroke. We also wish to focus on the stroke mortality rates for the population over 40 year of age, and for different age groups within this population. Information was collected from the participating countries to examine these issues, and the results are presented in this section.

99. Figure A3.5 in the appendix shows crude mortality rates for ischaemic and haemorrhagic strokes, by age groups. These graphs demonstrate that variation exists between countries for both ischaemic stroke and haemorrhagic stroke. Adding haemorrhagic stroke to ischaemic stroke rates generally does not greatly

[7] However, in some countries there may be some changes in the proportion of deaths registered as of unknown causes, which may impact on the examination of trends in death rates (Juel 2000).

alter the rates for the older age group. But there is an age effect apparent. In the oldest age group haemorrhagic stroke accounts for around 5-15% of the combined (haemorrhagic and ischaemic) rate. For the middle group it accounts for around 15-35% and for the youngest group around 35-70%. Ischaemic stroke appears to be much more related to ageing than haemorrhagic stroke, with sharper increases in mortality across the increasingly older age groups. The results for Japan are a little out of these ranges, where haemorrhagic stroke accounts for 24, 40 and 70% of the combined rate respectively.

100. Figure A3.6 in the appendix shows the mortality rates for ischaemic stroke only. These data demonstrate large increases across age groups in the rates. For males, the mortality rates for the middle age group are between 9 and 15 times higher than for the youngest age group. Between the oldest and middle age groups the difference is less—between 5 and 8 times higher. For females, the jump is only slightly larger between the younger two age groups than the older two: between 10-17 and 8-15 respectively. Japan is not included in these estimates because the data are only available for different age groups to those used by the other countries. However the pattern in Japan is similar, with the jumps becoming larger as you move between successively older age groups.

101. The male rate is nearly always higher than female rate for a given age group except for older ages where females have higher rates in most cases. To make valid comparisons between males and females in the overall rates as well as differences between countries, we need to remove differences in the age structure of the population (for example, there are more older women than men) which can distort the results. Age-standardisation removes the differences in the age structures in the different populations.

102. Figure 3.4 shows the age-standardised ischaemic stroke mortality rates for persons aged 40 years and over. These data show similar rankings as in Figure 3.1, which is mortality for all cerebrovascular disease. In Figure 3.4, the rates in Hungary and Japan are high; the UK, Denmark, Switzerland, Hungary and the Netherlands are in the next group, while the rates in the United States, Sweden, Australia and Canada are the lowest.

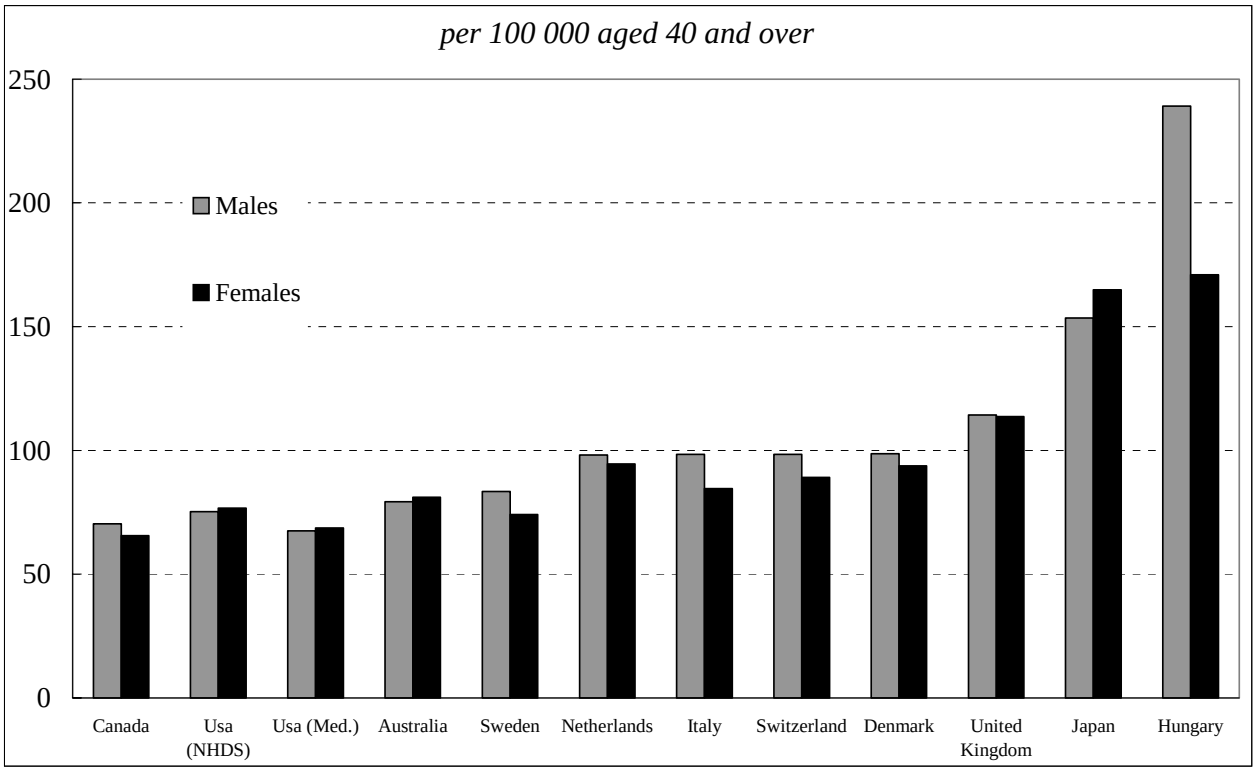
103. In most countries included here, the age standardised rate for those 40 years of age and older has the female rate lower than the male rate, though often the difference is not large. The exceptions are in Australia, the United States and Japan, where the female rates are higher than the male rates. The biggest relative differences between the male and female rates was in Hungary and Spain (?) where the ratio of the male to female rate was 1.4.

104. It is difficult to compare the age and sex rates for each country, so the ratio of the male to female (crude) rate for each of the 3 age groups are presented in Figure 3.5. At the younger two age groups, the male rates are consistently higher than the female mortality rates. Hungary and Denmark have the biggest difference for the youngest age group, while Sweden and Switzerland have the highest ratios for the middle age group. For the oldest age group, the female rate is higher than the male rate (that is, the ratio is less than 1) for most of the countries. Australia and the United States have the biggest difference between the male and female rates for this age group. This is a particularly interesting result, given that the incidence rates are higher for males than females regardless of age for most countries. It could be that older females experience more severe strokes than males, and therefore are more likely to die than males. Alternatively, it could be the result of demographic patterns where, within this age group (75+ years), there are more older women than older men. These issues will be examined in more detail in the following chapters.

3.3.2 Recent trends

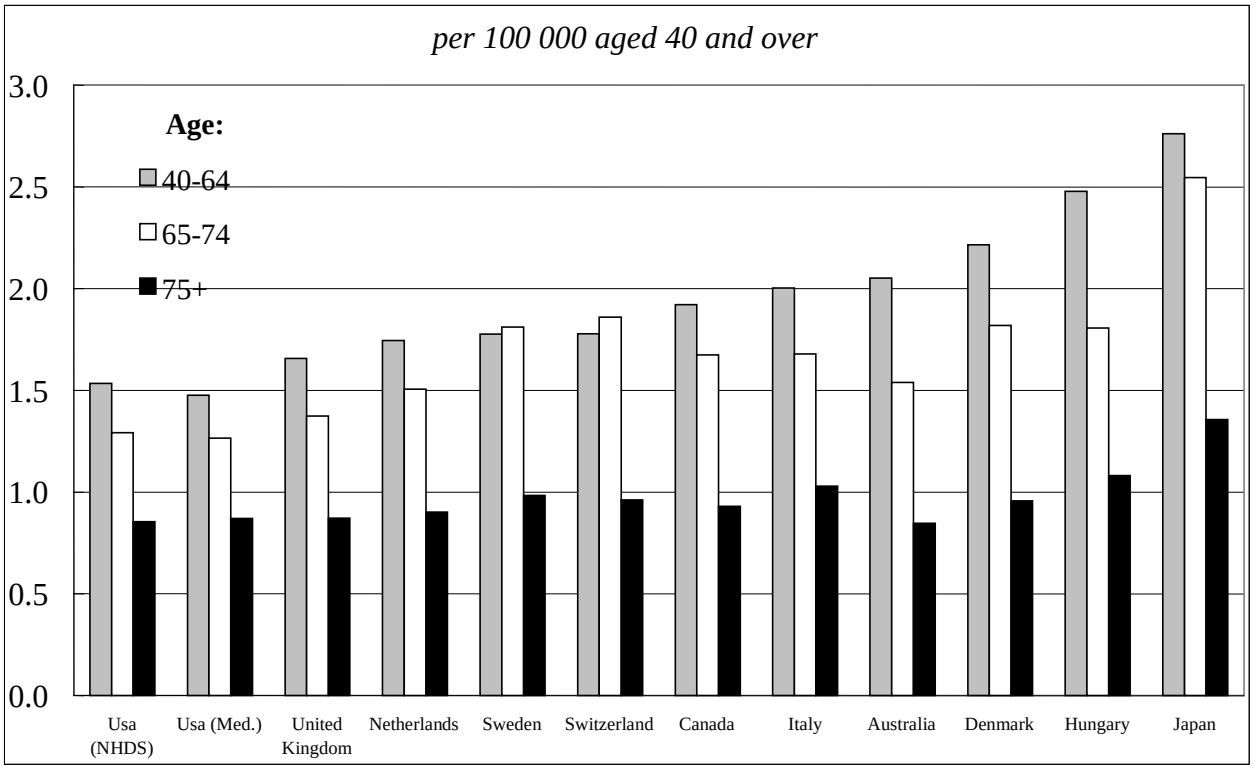
105. The trend data of mortality rates presented here has been age standardised both to account for changes in the age structures over time within countries, and to account for the differences in the age structures between countries.

Figure 3.4 Ischaemic stroke age-standardised(a) mortality rates (1997)



Note: Age-standardised to the European standard population.

Figure 3.5 Ischaemic stroke age-standardised(a) mortality rate ratio of males to females (1997)



(a) to the European population

106. Figure A3.7 in the appendix shows the age-standardised ischaemic stroke mortality rates for persons aged 40 years and over for the majority of countries in this study. There are three main patterns displayed in these graphs. Firstly there are a group of countries displaying decreasing mortality rates: the UK, Switzerland, Italy, Australia, the Netherlands, the United States and Canada. Secondly, there are a group of countries with relatively stable trends, seen in Hungary and Japan. And finally, there are some countries that have experienced increasing rates, though not over the entire period examined. For Denmark, the rate was stable in the 1980s, it increased in early 1990s, but may now be decreasing. Although not large, there was some increase in the mortality rate in Sweden between 1980 and 1998. Note that between 1994 and 1995 Switzerland moved from using ICD8 to ICD10. This accounts for the dramatic drop in the mortality rates between those to years.

107. For the majority of countries, there are similar patterns for males and females, with both tending to experience similar trends. In some countries, the gap between the male and female rates has narrowed in recent years, and in the United Kingdom, the United States and Australia the female rate is now higher than the male rate.

108. Although the data are not shown, trend data were supplied for many countries for mortality from haemorrhagic stroke and ischaemic stroke combined. These data show that, due to the relatively small share of the combined rate being accounted for by haemorrhagic stroke, the trend for the combined rate is very similar to that for ischaemic stroke only.

109. Figure 3.6 shows the trends in ischaemic stroke mortality for persons aged 40 years and over (as shown in Figure A3.7) for two groups of countries (and for males and females separately). Firstly, the top graphs include the countries displaying decreasing trends in stroke mortality. For these countries, the male mortality rate has fallen to 70-100 per 100 000. For females, the rates have fallen to 65-105 per 100 000. The identification of two distinct patterns in stroke mortality has also been identified in the research literature (Sarti *et al.* 2000).

110. Secondly, the bottom graphs include the other countries: those with steady or increasing trends. For both males and females, the three countries with the lower rates (the Netherlands, Denmark and Sweden) currently have rates at similar levels to those countries with decreasing trends. The outstanding 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 included on the graph.

3.3.3 Place of death

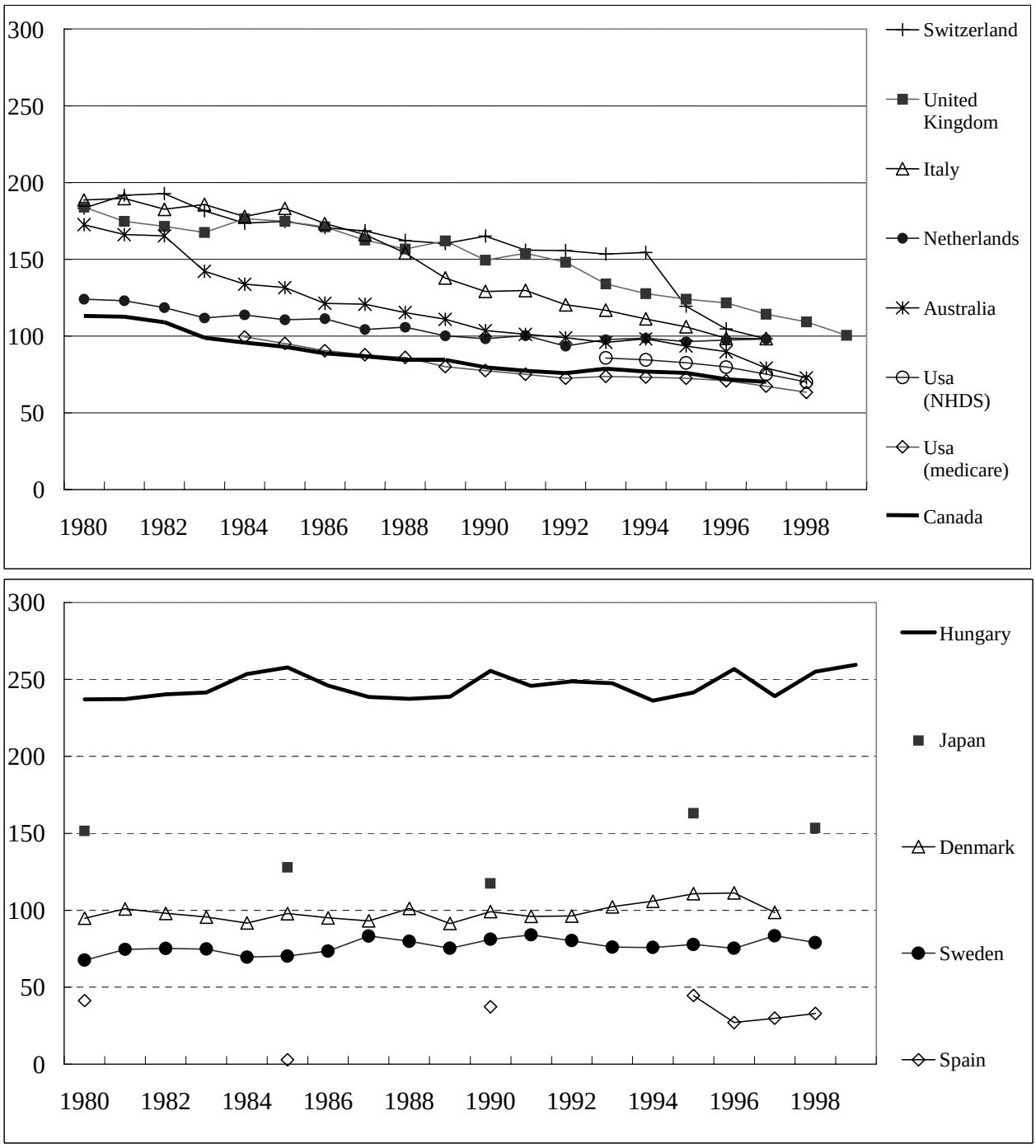
111. A fairly large number of stroke deaths occur outside hospitals. This can occur in a number of situations including when the patient does not reach hospital for treatment (due to the severity and/or delayed presentation at hospital), or when they get to hospital but die in emergency prior to formal admission, or they may be in nursing home and are not transferred to an acute treatment setting. There may also be a proportion of people with long-term cerebrovascular disease (or other chronic disease), who chose not to be treated and cared for in an acute setting. From data we have for Australia, Hungary, Denmark and Sweden, between 30 and 58% of stroke deaths occur outside hospitals.

3.4 Disability

112. As outlined in the introduction to this chapter, the disability burden associated with stroke is large. It has been estimated that while approximately one third of stroke patients will die within the first 12 months, another third will be permanently disabled and dependant on the assistance of others (Bath *et al.* 2000). A detailed assessment of disability outcomes for stroke patients was outside the scope of the

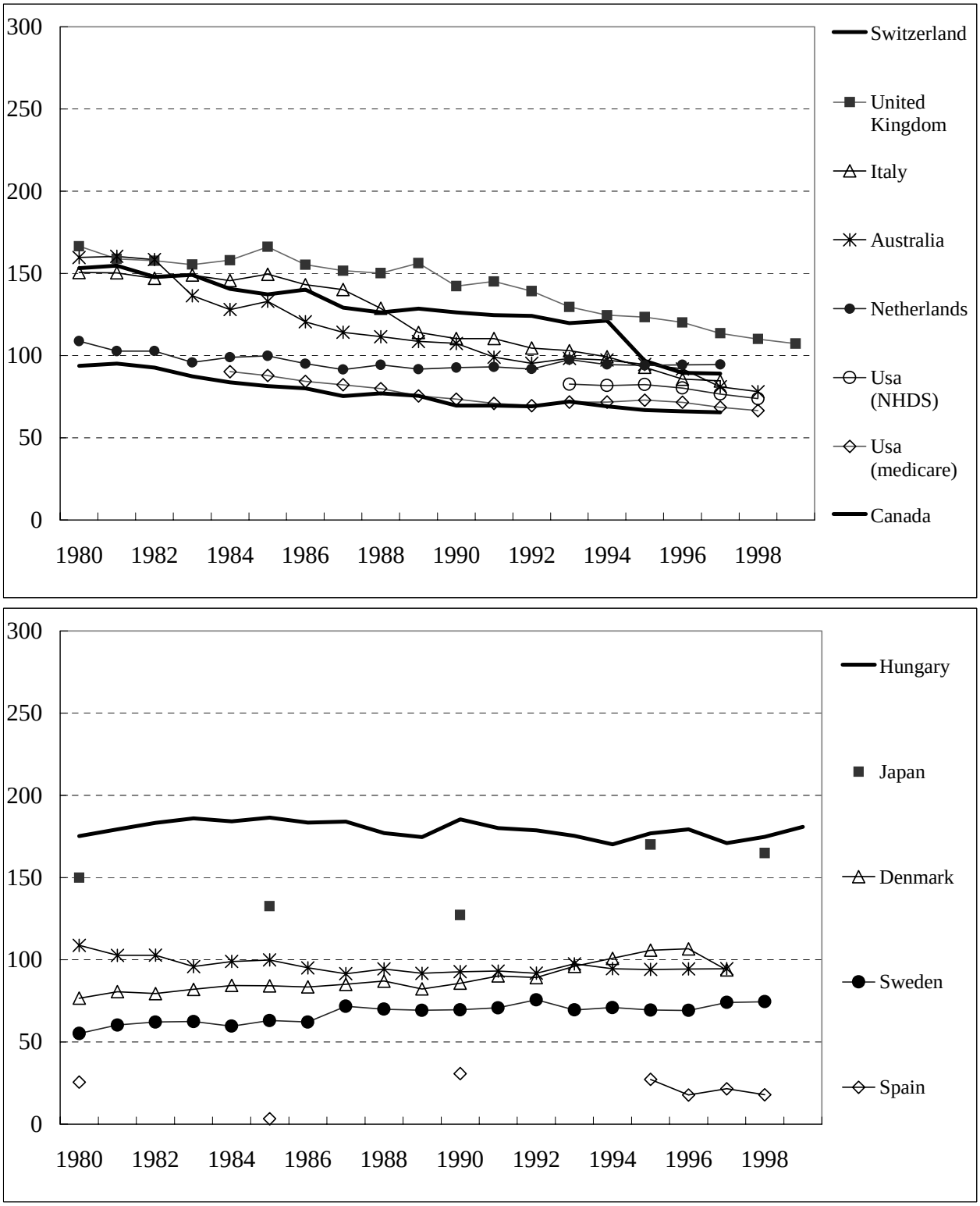
analytic component of this study. However, it is still useful to review some of the main issues in relation to stroke-related disability.

Figure 3.6 Trends in the age-standardised ischaemic stroke mortality rates (males)
(per 100 000 population aged 40 and over, age-standardised to the European standard population)



Note: Switzerland changed versions of ICD in 1994-1995, which accounts for the substantial drop in the mortality rate over that period.

Figure 3.6 *(cont.)* ***Trends in the age-standardised ischaemic stroke mortality rates (females)***
(per 100 000 population aged 40 and over, age-standardised to the European standard population)



113. Increases in disability following stroke are commonly thought of as impacting on activities of daily living, largely through the loss of physical functioning. However, other important issues in stroke-

related disability include emotional disorders and reductions in social activities. Finally, for stroke patients with large increases in disability levels associated with their stroke, institutional care is often required. A recently published study of long-term disability associated with first-ever stroke found that, among patients who survived at least 30 days, 1 in 7 were in permanent institutional care (Hankey *et al.* 2002).

3.5 Risk factors

114. 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, and a number of medical conditions. Further background on the different stroke risk factors is provided in the Medical Annex (Appendix 1).

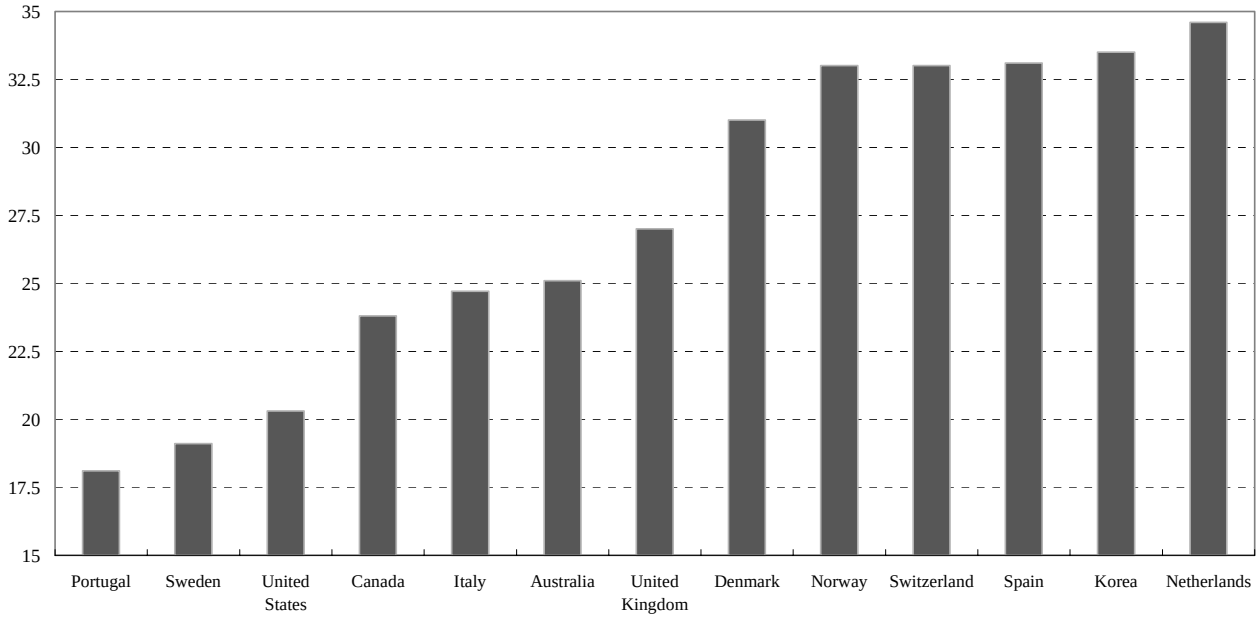
3.5.1 Smoking

115. Countries included in this study differ substantially both in terms of current smoking rates, as well as those observed in the past. The proportion of the population aged 15 years and over who are daily smokers (Figure 3.7) ranged between about 18 and 35%, with the highest rates found in the Netherlands, Korea, Spain, Switzerland, Denmark and Norway. The lowest rates were in Portugal, Sweden, and the United States.

Figure 3.7:

Tobacco consumption (1995-98)

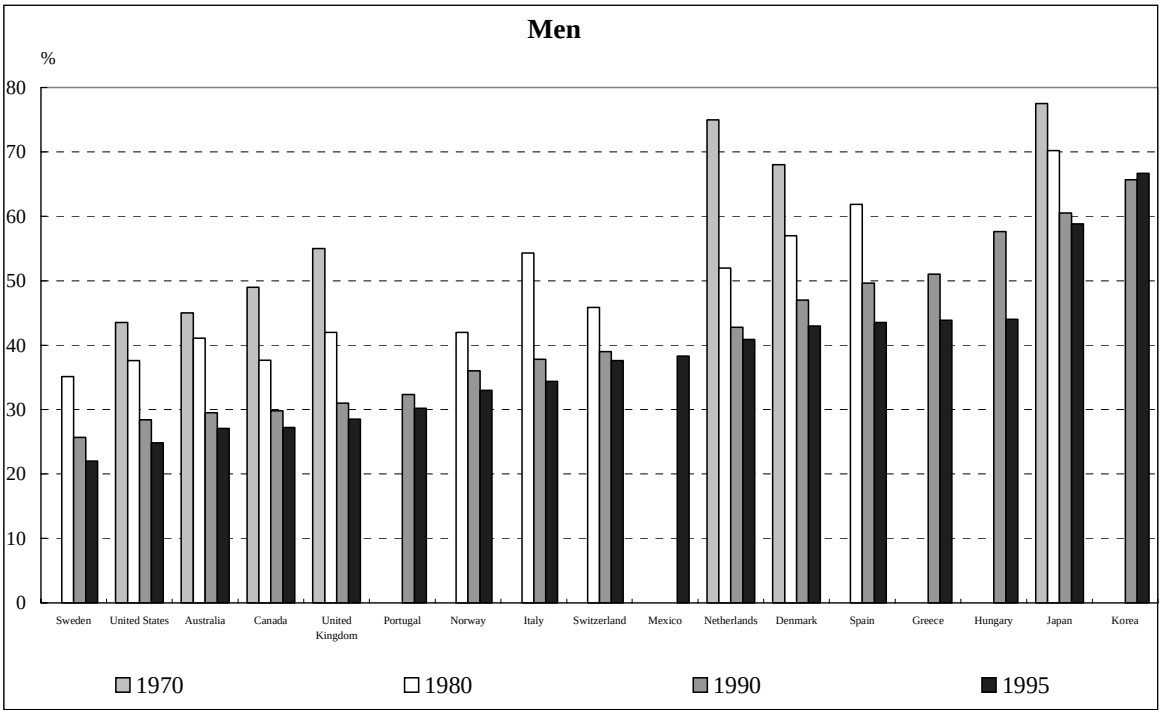
(% population aged 15 and over who are daily smokers)

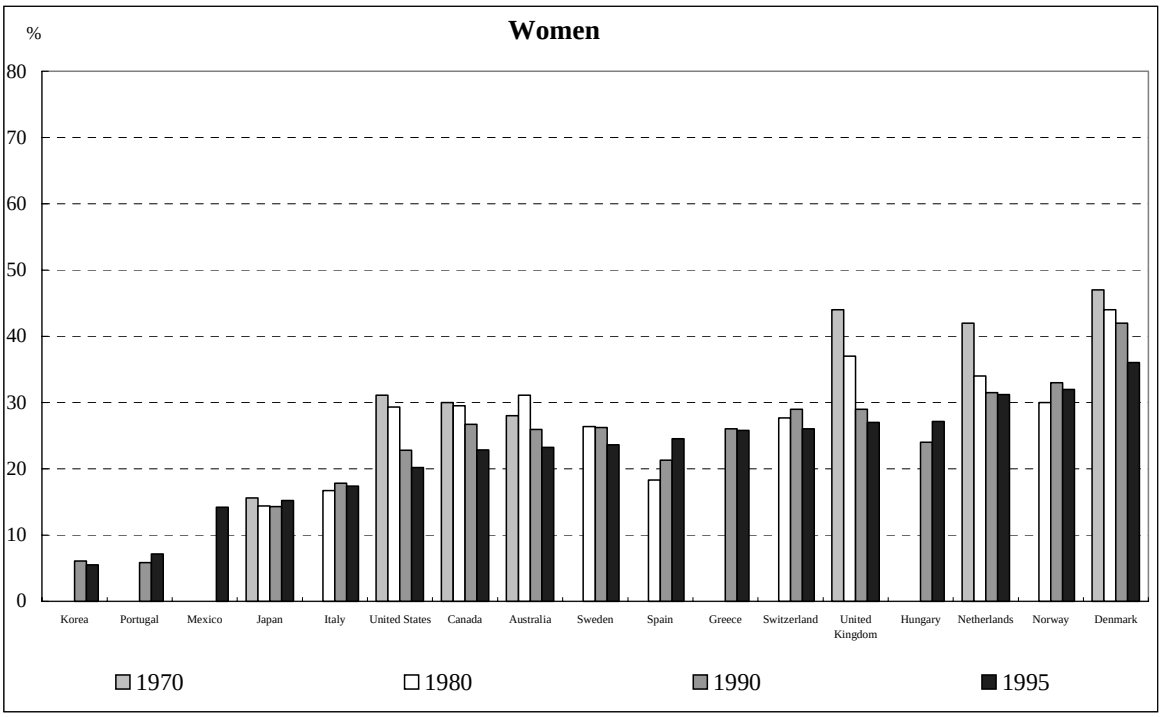


Source: OECD Health Data 2001.

116. These aggregate figures hide substantial variation by sex. Available sex-specific data are presented in Figure 3.8. For males in 1995, the highest proportions of smokers was found in Korea and Japan were around 60% of males were smokers. The next highest proportions were in Hungary, Greece and Spain. The lowest proportions were found in Sweden, the United States, Australia and Canada. For females, the highest proportions in 1995 were in Denmark, Norway and the Netherlands, each over 30%. The lowest proportions were in Korea, Portugal, Mexico and Japan.

Figure 3.8: Trends in tobacco consumption, by sex





Note: Share of the population aged 15 and above who are daily smokers. Women: Australia (1969); Switzerland (1981); Interpolation based on available data: Canada, Spain (1980); Australia, Hungary, Korea, Portugal, Spain (1990); Canada, Greece, Hungary, Switzerland, United Kingdom, United States (1995). Men: Australia (1969); Hungary (1994); Mexico (1993), Interpolation based on available data: Canada, Spain, Switzerland (1980); Australia, Hungary, Korea, Portugal, Spain (1990); Canada, Greece, Switzerland, United Kingdom, United States (1995);
Source: OECD Health Data (2000).

117. In addition, countries have also differed in their trends in smoking rates, although almost all have experienced declines in the proportion of the population who are smokers. For males, Korea is the only country included in Figure 3.8 that has not experienced a decline. However, for females there are a number of countries with increases in the proportion of smokers, including Hungary and Spain.

3.5.2 Hypertension

118. Hypertension, or high blood pressure, is defined here as persons having systolic blood pressure>=140mmHg and diastolic blood pressure>=90mmHg. The proportion of the population with hypertension increases with age (Figure 3.9). For the countries included here, around 20-30% of males and 10-20% of females aged between 40 and 50 were classified as having hypertension. In contrast, for people aged between 70 and 80 years, the proportions were between 30-60%.

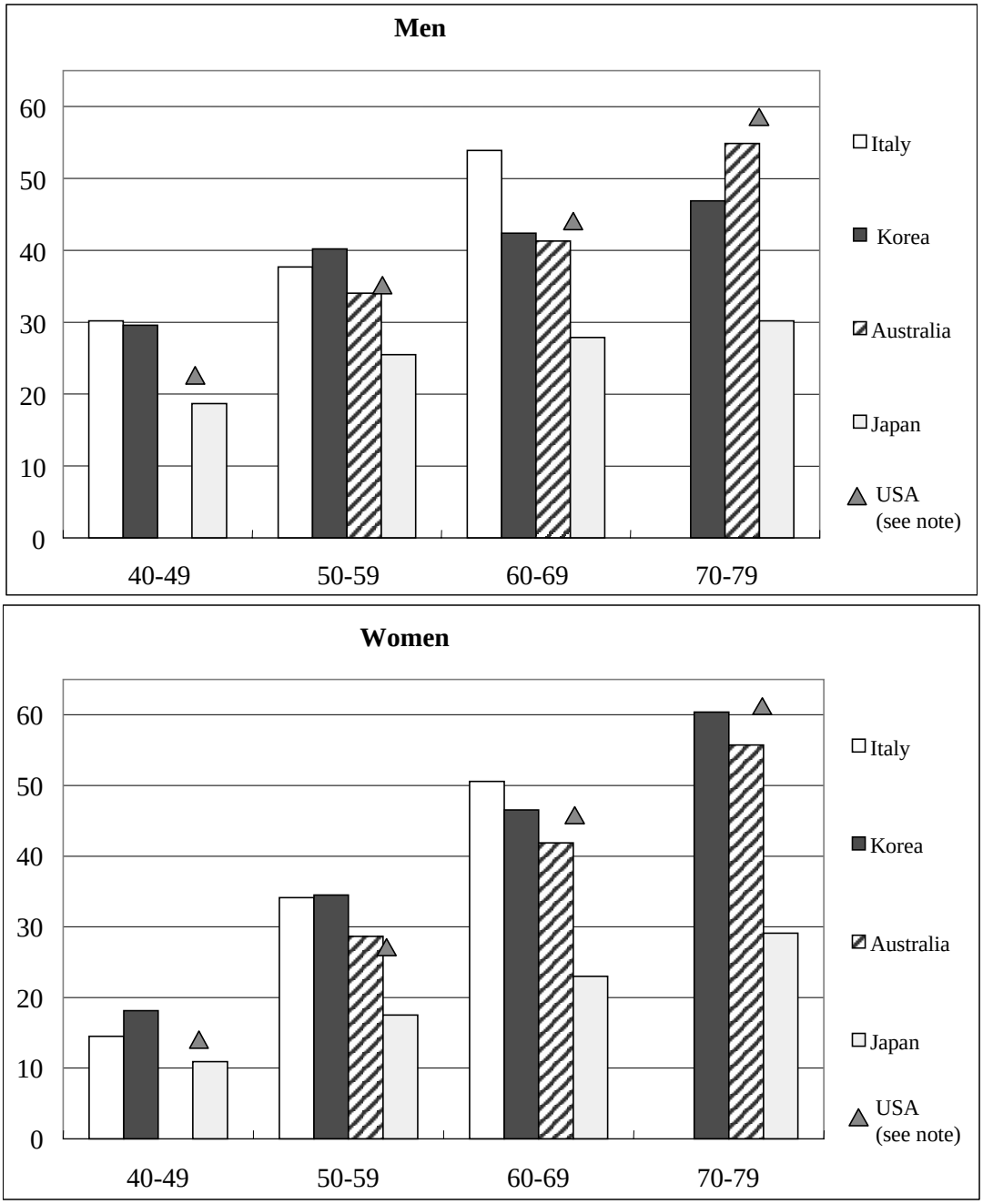
3.5.3 Other physical risk factors

119. There are a number of other physical risk factors that are important for stroke, including diabetes, body mass index, other cardiac disease and poor nutrition. The proportion of populations aged 15 years and over that are obese varies from about 2% in Korea to around 20% in the UK, Australia and the United States (OECD Health Data Base 2001). Also of concern is that these proportions have been increasing in many countries in recent years, for example in Australia and the UK (trend data are not available for most countries in this study).

3.5.4 Socio-economic determinants

120. Strong associations between socio-economic status and stroke risk have been clearly demonstrated in a number of studies, including international studies (Maheswaran *et al.* 1997, Kunst *et al.* 1998, van Rossum *et al.* 1998, Hart *et al.* 2000). These studies found that people from lower socio-economic backgrounds had higher incidence of and mortality from stroke. The differences were only partly explained by known risk factors, and early life experiences were found to be important factors. The socioeconomic patterns were found in all 12 OECD countries included in one international study (Kunst *et al.* 1998). Large variations were found between countries in the relative contribution of various risk factors (tobacco smoking for example) to the increased risk for people from lower socioeconomic groups.

Figure 3.9: Proportion of populations with hypertension



Note: Hypertension is defined as systolic blood pressure>=140 mmHg and diastolic blood pressure of <90 mmHg. Data were available for Norway, but only for persons aged 40-42 years. The data were collected in a screening program from 11 (out of 19) counties. High blood pressure defined as systolic blood pressure >=160mmHg or diastolic pressure > 95mmHg. The levels recorded were as follows: Men 4.6%, Women 2.1%.
Australia: missing observations were deleted from the analysis; data are for 1995.
Japan: the last age group corresponds to people aged 70 and over.
United States: the corresponding age groups are: 35-44, 45-54, 55-64, 65-74 and the studied period is 1988-94.
Sources: AIHW analysis of the ABS/DHAC 1995 National Nutrition Survey (Australia); ARD country report (Italy and Korea), ARD country report for stroke (Japan); National Health Screening Service, Oslo (Norway); National Center for Health Statistics, Health United States (2000).

4. RECENT TRENDS IN TREATMENT PATTERNS

121. 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.

122. 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, data are available more commonly in relation to the acute phase.

123. This chapter firstly examines the organisation of different stages of stroke care. The next section covers diagnostic and surgical procedures, followed by drug treatment. Further information on the medical aspects related to this chapter can be found in the Medical Annex.

4.1 Organisation of care

124. Stroke patients may receive a variety of treatments and are cared for in a range of settings. These include acute care in a hospital setting, specialised care in a stroke unit, rehabilitation, and long-term support and care in a home-based or residential setting. Relevant ambulatory care and preventative measures may occur both before and after a stroke event. These different aspects of stroke care are examined in more detail in this section.

4.1.1 Prevention

125. Prevention of strokes, as well as prevention of second or subsequent strokes, occur both at an 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).

126. In relation to stroke, an important preventative measure aimed at individuals is the management of hypertension, often through drug treatment. Control of hypertension has been shown to be highly effective in reducing the risk of stroke for all age groups. Further, it has also been shown that lifestyle advice from medical practitioners (for example in relation to smoking cessation) is also effective at the individual level. Further discussion on drug treatment is included in section 4.3.

127. Population-level preventive measures are aimed at groups of people, rather than individuals. These measures may take the form of education programs, or other policies aimed at changing behaviour. Tax changes to discourage smoking or to change dietary habits are examples. Countries differ both in their involvement in and the approach taken for these population-level measures.

4.1.2 Hospitalisation

128. The majority of stroke patients who do not die at the time of the stroke event are admitted to hospital for treatment. Estimates in the research literature suggest that between approximately 70% to close to 100% of these stroke patients are admitted to hospital for care (Bhalla *et al.* 2001, Anderson *et al.* 1997,

Du *et al.* 1997, Asplund *et al.* 1995, Wolfe 1993). It is likely that this treatment will 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 has occurred.

129. Information on hospitalisation for stroke is available from many countries in this study from administrative data collections. These data systems provide a valuable source of information on hospitalisations, generally containing diagnostic, demographic and treatment information. Care has been taken in the data specification and analysis of the information to ensure a high degree of comparability. However, it is important to remember that differences still exist between countries in the definitions and counting practices used. For these reasons we have emphasised comparisons in treatment trends rather than comparisons of absolute levels of hospital treatment.

130. A key difference exists between data systems able to link patient information between hospital episodes (that is counting patients) and unlinked systems (counting hospital episodes). Results from these two types of data systems are therefore based on different counting structures making comparisons complex. Therefore results from these two types of information systems are generally analysed separately here.

Ischaemic stroke- cross-sectional

131. As expected, hospitalisation rates for stroke increase with age, and in a fairly consistent pattern across the countries included in Figure A4.1 in the appendix. The rate for the middle age group (65-74 years) was generally around 5-7 times higher than for the youngest age group examined (40-64 years). The jump to the oldest age group was not as big, with rates for the older age group around 3-4 times higher than for the middle age group. These rate ratios are similar to those found for stroke incidence as recorded through registry-based data, suggesting that a reasonably constant proportion of stroke patients are admitted to hospital across the 3 age groups.

132. Males consistently have higher hospitalisation rates than females for all three of the standard age groups included in our analysis (40-64, 65-74 and 75+). The difference between the male and female rates is largest at the younger age groups (usually between about 50 and 100% higher in males than females). But for the oldest age group, the male hospitalisation rate is only about 10-20% higher than the female rate in most cases. These patterns between the male and female rates are similar to that found in the incidence data included in Chapter 3.

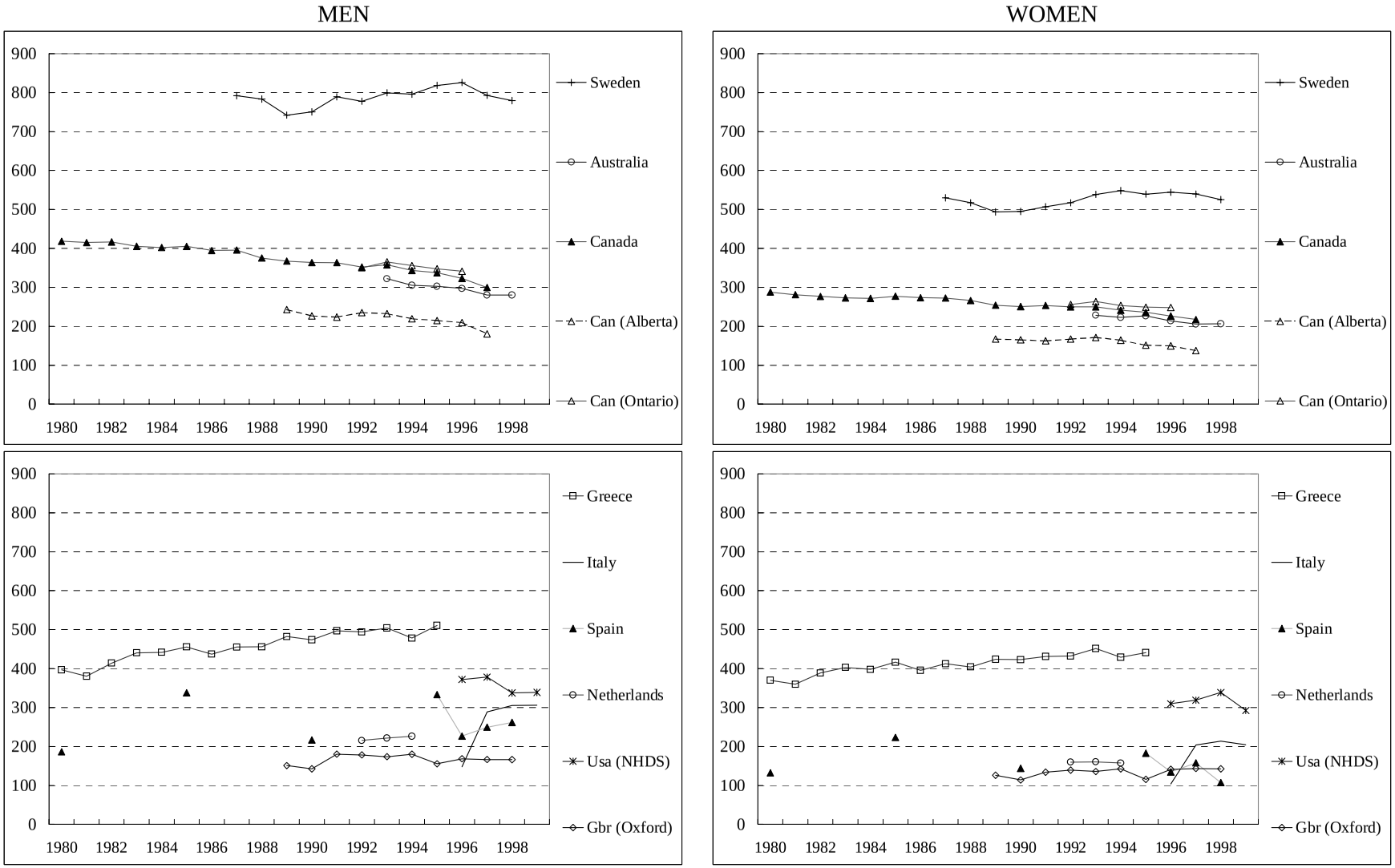
Ischaemic stroke- trends

133. The graphs in Figure A4.1 show age-specific hospitalisation rates for selected years. From these graphs, 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 and Sweden have remained largely unchanged. However, the age-specific hospitalisation rates in Greece and Italy show evidence of having increased over time, though it is not clear whether this increase can be partly explained by improved reporting. The rate in Denmark also increased for much of the period examined, but has again decreased in the most recent years. For Japan, the hospitalisation rates have increased slightly, though remain considerably lower compared to the other countries. It is not easy to determine the trend in Spain, as the rates have fluctuated markedly between the years examined.

134. The age-standardised rates for persons aged 40 years and over is shown in Figure 4.1, where data are available. These results demonstrate similar trends to those observed in Figure A4.1.

Figure 4.1: Stroke hospitalisation rates

Per 100 000 population aged 40 and over, age standardised to the European population



TIA

135. Figure A4.2 in the appendix includes age-specific hospitalisation rates for TIAs, showing similar patterns to the hospitalisation rates for ischaemic stroke. The rates declined steadily in both Australia and Canada. In contrast, there was a steady increase in the hospitalisation rates in Sweden and, although only over 2 years, increases in Italy and for some age groups in the United States. Country patterns are generally similar for both ischaemic stroke and TIA admissions.

Length of stay

136. Hospital length of stay is examined in detail in Section 6.2, therefore only a brief summary is presented here. Absolute levels of length of stay between countries may vary because of differences in definitions as well as differences in the underlying length of stay. Whilst keeping in mind that direct comparisons of the absolute length of stay between countries needs to be undertaken with caution, in general the majority of means and/or medians of length of stay for ischaemic stroke patients were around 10-15 days. The main country with length of stays longer than this is Japan, where considerably longer stays were observed. The countries that are notable for lower lengths of stays are Denmark and the United States. Over recent years, the length of stay for stroke patients has decreased in all countries with trend data available.

4.1.3 Specialised stroke units

137. Stroke units (organised, specialist inpatient stroke care) have been demonstrated to result in a positive outcome for stroke patients, with a systematic review of over 20 trials showing benefit both in terms of survival and disability (Cochrane Review 2002, Stroke Unit Trialists' Collaboration 1997a). Evidence is also emerging suggesting that stroke units also have benefits in terms of cost-reduction (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).

138. 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 (such as a mix of doctors, nurses, physiotherapists, speech therapists)
- access to technology such as CT scanners
- organised care usually in a dedicated unit with dedicated staff
- usually includes both acute and rehabilitation care

139. Definitional aspects are an issue when comparing the use of stroke units in the data collection undertaken for this study. Nevertheless, it is still valuable to make general comparisons between the use of stroke units in the various countries with data available.

140. Information is available on the use of stroke units in seven of the countries participating in this study, and is summarised in Table 4.1.

141. These results show that stroke units are being implemented in many countries, and the use of organised stroke units is tending to increase over time. 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.

Table 4.1: Available information on the use of stroke units

Country	Year	Stroke units (per 100 000)	Stroke unit beds (per 100 000)	% of patients care 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[(a)]		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%	

Source: Australia: National Survey of Hospital Stroke Services.
(a) Estimated from survey data based on hospital size.

4.1.4 Rehabilitation

142. Rehabilitation following a stroke is an important component of the continuum of care, and ideally commences as soon as possible after the patient's condition has been stabilised. Around 70% of stroke patients survive long enough to benefit from the rehabilitation phase, which aims to reduce the impact of any activity restrictions.

143. It is of interest to know what percentage of patients are receiving organised rehabilitation care. Information is available on this issue for a subset of countries, and is shown in Table 4.2. However, this measure is not specific enough to permit use as an outcome measure, because a proportion of patients may not require transfer to a rehabilitation unit (due to the consequences of the stroke being relatively minor), or they may have received appropriate rehabilitation care whilst in hospital or in a home-based setting. Therefore the measure reflects both the need for and the utilisation of the service. Nevertheless, the information provides context to this discussion on the organisation of stroke care.

144. The percentage of patients transferred to a rehabilitation facility differs between these regions and countries, with lower percentages in Perth, Alberta and Switzerland, and higher percentages in Norway, Sweden and Ontario.

145. The results did not differ greatly between males and females, but there were different patterns across the age groups. In Perth, Sweden, Norway and Switzerland, those in the oldest age group were more likely to be transferred to rehabilitation than those in the younger age group. In Alberta, the situation is reversed. In Ontario, all age groups have a similar chance of being transferred to a rehabilitation centre.

146. Although not presented above, information on trends in the use of rehabilitation facilities is available for some of these regions/countries. In Norway, Perth and Alberta the percentages have remained relatively stable in recent years. In Sweden, the percentages have declined slightly. In contrast, the percentages in Ontario have generally doubled in the last 10 years, although they remain below those observed in the Scandinavian countries.

Table 4.2: Percentage of ischaemic stroke patients transferred to a rehabilitation unit

		MALES			FEMALES			TOTAL*
Country	**Year**	**40-64**	**65-74**	**75+**	**40-64**	**65-74**	**75+**	
Perth, Australia	1997	3.4	10.1	13.9	3.2	8.6	22	
Alberta, Canada	1997	11.7	8.3	6.2	7.9	7.1	6.3	7.3
Ontario, Canada	1998	20.3	21.4	21.7	22.0	21.2	21.7	21.4
Norway	1998	19.7	24.8	33.5	20.3	27.5	38.1	
Sweden	1998	23.1	24.4	27.0	24.2	26.9	26.4	25.9
Switzerland	1998	11.0	11.8	14.6	5.4	9.6	14.7	

Notes:
Perth: Discharged to rehabilitation refers to patients discharged from an initial episode of ischaemic stroke to a rehabilitation facility having not come from one initially.
Alberta: For index admission only.
Ontario: The source of patients' admission was not a long-term care facility or a nursing home.
Norway: All patients that were not discharged to their home and who did not die during the hospital stay are recorded here as being "transferred to rehabilitation facilities".
Switzerland: All first stay admissions.

4.1.5 Ambulatory and long-term care

147. Ambulatory and long-term-care include care aimed at reducing the risk factors associated with stroke, as well as long-term care following a stroke.

148. Treatments aimed at stroke risk factors include drug treatment (especially treatment for hypertension), management of associated medical conditions (for example diabetes and atrial fibrillation) and potential behavioural changes (such as cessation of tobacco smoking, diet changes). Targeting these risk factors is not just stroke specific, as many of the stroke factors are shared by other conditions such as ischaemic heart disease. A discussion on drug treatment is covered later in this chapter (section 4.4), while targeting of risk factors is discussed in section 4.1.1.

149. Long-term care of stroke patients also often includes assistance with daily living due to activity and participation restrictions resulting from a stroke. This may range from a small amount of assistance in or modification to the individual's home, right up to full-time, high-level care in a nursing home.

4.2 Diagnostic and surgical procedures

150. Diagnostic procedures are used to determine the stroke type and severity, which impact on treatment options. The procedures examined here are CT scans, MRIMRA, and to a lesser degree doppler ultrasound and contrast arteriography. These procedures are described further in the medical annex to this report.

151. Information is presented both on procedures received by ischaemic stroke and TIA patients, sourced from patient-based and episode-based data systems separately. Countries differ in the completeness of recording these diagnostic procedures in their hospital data systems. Often the use of these procedures is only recorded if it is linked to payments. Therefore the information from the hospital data collections is supplemented by information from other sources were available.

4.2.1 In hospital diagnostic procedures

CT scan- ischaemic stroke

152. Of the four procedures analysed, CT scan is the most frequently used for ischaemic stroke and TIA patients. The percentage of ischaemic stroke patients receiving a CT scan in-hospital is presented in Figure 4.2 (with detail by country and over time in Figure A4.3 n the appendix). These results do not include countries that have provided linked data - that information is presented in Figure 4.4.

153. According to these data, around 60% of ischaemic stroke patients in Australia and Spain, received a CT scan whilst in hospital. In Italy[8] and the United States, around 20% of patients received a CT scan. However, it is important to remember that there is likely to be a degree of undercounting in at least some of these estimates.

154. Generally equal proportions of men and women received CT scans in the four countries included in Figure 4.2. In addition, there was very little variation noted across the 3 age groups. The exception to these patterns is for the oldest women (aged over 75 years) in Spain, for which the percentage receiving a CT scan was nearly half that for all other age/sex groups examined.

155. For both Australia and Italy, increases over time are apparent. In Australia, increases of around 50% occurred between 1993-94 and 1997-98. The increases in Italy were more modest. Surprisingly, decreases were observed in the United States, although this may be an arterfact of the survey method used to obtain these data.

CT scan- TIA

156. As for ischaemic stroke patients, considerable variation exists between these countries in the percentage of TIA patients receiving a CT scan in hospital (Figure A4.4 in the appendix). And again, within each country very similar proportions in each age/sex group received the procedure. In most cases, considerable increases over time in the percentage of patients receiving the test were apparent.

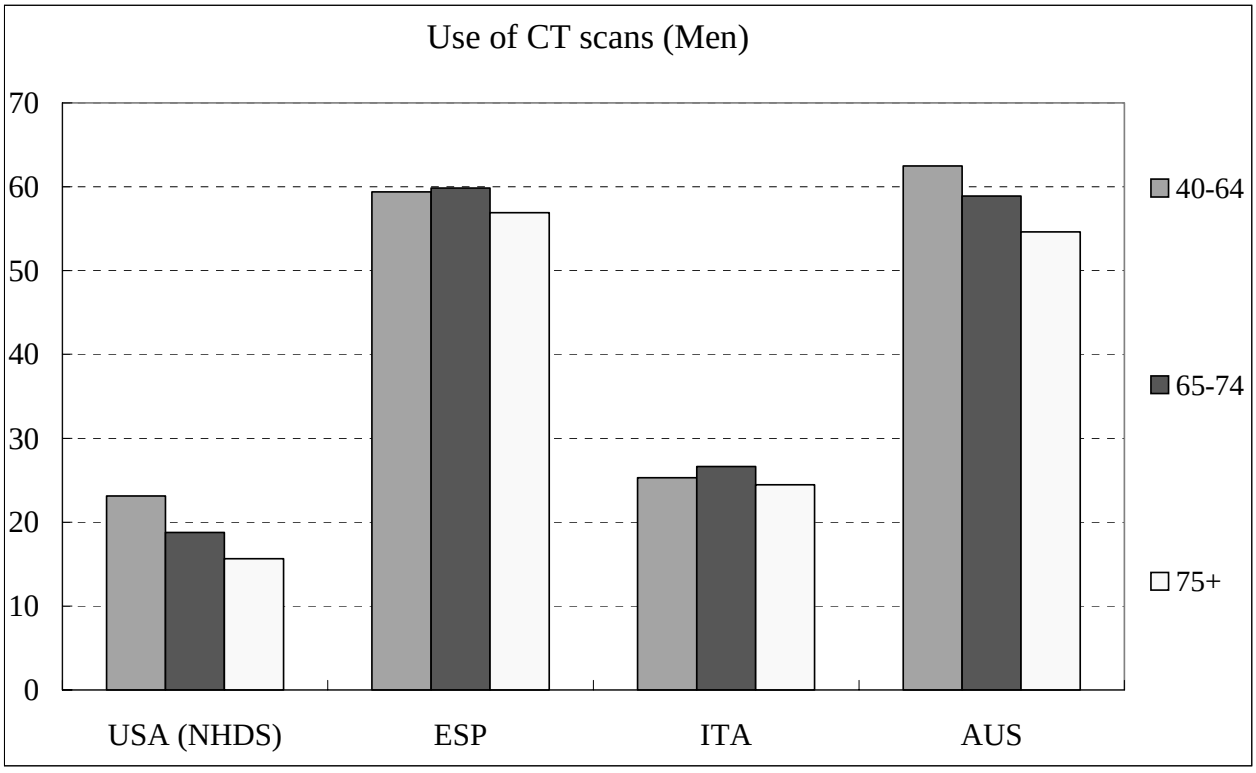
157. Also of interest is the comparison between ischaemic stroke and TIA patients in the percentage receiving a CT scan. In Australia, considerably less TIA patients received a CT scan compared to ischaemic stroke patients. In Italy, the difference is not as great, while in Spain the proportions are almost equivalent. The United States differs markedly from this pattern, however, where in many of the age/sex groups in 1999, higher percentages of TIA patients received CT scans than ischaemic stroke patients.

MRI/MRA: ischaemic stroke

158. Across the countries included in this study, MRI/MRA are used less often than CT scans, although in some countries the use has increased substantially in recent years, notably in Australia and to a lesser extent in Italy (Figure 4.3, with detail by country and over time in Figure A4.5 in the appendix). The most recent data demonstrate that generally no more than 15% of ischaemic stroke patients in the youngest age group received a MRI or MRA in hospital. The exception was Korea where rates were higher for all age groups, and with up to 30% of patients in the youngest age group underwent the procedure. However the Korean data has been sourced from one university-based hospital only.

8. May be underestimated since the data have been gathered from hospital discharge records taking into account not all procedures performed but only the most important.

Figure 4.2: Use of CT scans for ischaemic stroke patients: unlinked data (1997)



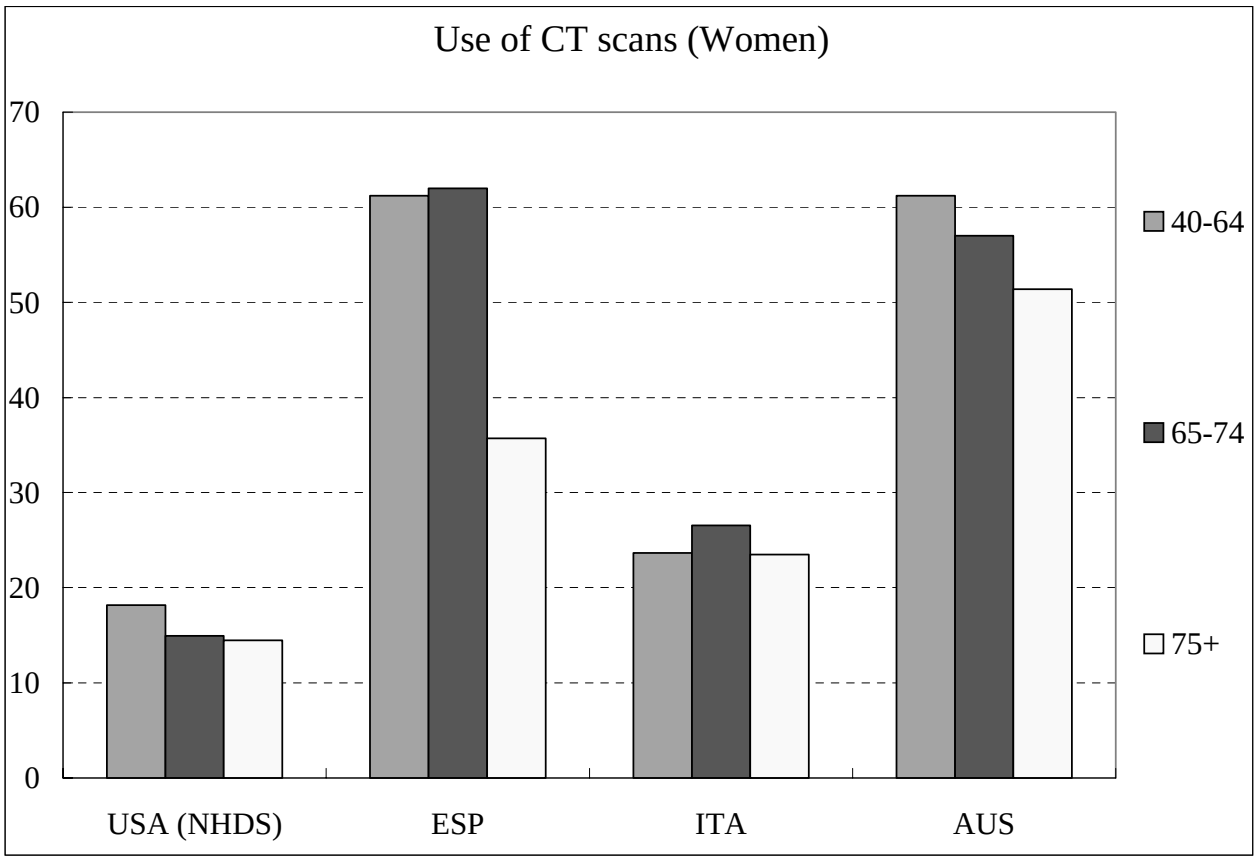
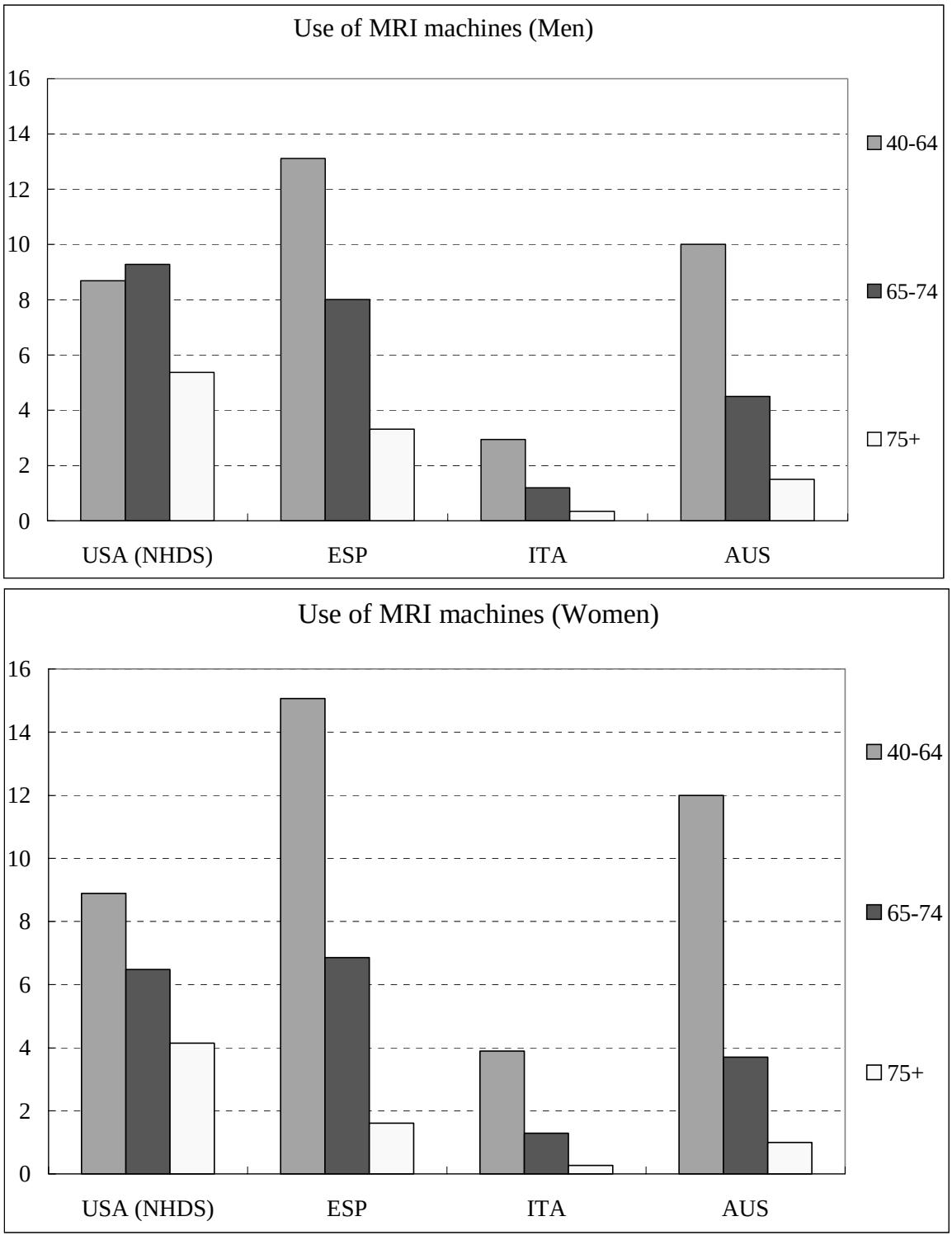


Figure 4.3: Use of MRI/MRA for ischaemic stroke patients: unlinked data (1997)



159. Unlike the patterns of use of CT scans, the newer technology of MRI/MRA is used to a much greater extent in the younger age groups compared to the older age groups. In most cases, patients in the youngest age group (40-64 years) were at least twice as likely to receive the procedure than those in the

next age group (65-74 years), and often greater than 4 times likely to receive the procedure than those in the oldest age group (75+ years). This age differential was greater in women than in men.

MRI/MRA: TIA

160. In general, MRI/MRA are used to a much lesser extent for TIA patients than for ischaemic stroke patients (Figure A4.6 in the appendix). The age differential occurs for TIA patients as well, with in general more younger patients receiving the test than older patients.

161. In most of the countries for which we have trend data, the use of MRI/MRAs for TIA patients is increasingly over time (Australia, Italy and Spain). However, the evidence is mixed in the United States with substantial increases evident for males aged 40-64 and 65-74. For women and men aged 75 years and over, no such increase is evident.

Other procedures

162. Information has also been collected on the use of contrast arteriography and doppler ultrasound for ischaemic stroke and TIA patients (data not shown). Generally, these procedures are only used on a small proportion of these patients.

163. Arteriography is used for only a small proportion of hospital stroke patients– for less than 5% of ischaemic stroke patients in Australia, Italy and Spain. In the United States around 10% of ischaemic stroke patients received the procedure in 1999. In Spain, 7% of younger men (40-64 years) with ischaemic stroke received the procedure, while all other age/sex groups had much smaller proportions. The procedure is generally used more often for the younger age group compared to the older age group. There is little evidence of changes in the usage (per stroke patient) of the procedure over time, though there have been some increases in the United States.

164. For TIA patients, the procedure is used more often, particularly in the younger age group. Despite this, the use of the procedure may be declining in some countries (Australia and Spain), though again use in the United States has increased.

165. Doppler ultrasound is used more extensively in Spain than in the other countries included here. For ischaemic stroke patients, around 20% of 40-64 years received the procedure in Spain, compared to not more than 10% in most other countries. Nearly 30% of TIA patients in Spain received the procedure, again substantially higher than for the other countries. The use of the procedure in Australia has increased in recent years, but remains relatively low (around 5% in 1997-98). For TIA patients, use of the procedure has increased in Spain in recent years.

4.2.2 Diagnostic procedures during episode of care

166. Additional insights into the use of diagnostic procedures for stroke patients are gained from the countries able to supply ‘linked’ data (two provinces in Canada, as well as Sweden). This enables us to determine the use of these procedures for individual patients over essentially the total episode of care rather than only during the initial hospital phase. We have not defined the length of an episode of care for stroke patients, but have used 3 cut-offs within the episode to measure various aspects of the care:

- the period up to the end of the initial hospital admission
- the period up to 30 days after the initial hospital admission
- the period up to 180 days after the initial hospital admission.

CT scan: ischaemic stroke

167. There is marked variation in the usage of CT scans across the linked data sets (Figure 4.4, with detail by country and over time in Figure A4.7 in the appendix). Sweden has the highest usage, with close to 100% of ischaemic stroke patients receiving a CT scan during the episode of care. This was followed by Australia (Perth) where 70-80% of patients received the procedure. In Ontario, around 60% of patients received a CT scan, while in Alberta, less than 10% of patients received the test.

168. There is evidence of lower usage for the older patients in the majority of results presented here. However, the converse was true for women in Alberta. The percentage of patients receiving a CT scan was fairly consistent for men and women.

169. Data were only available from Canada (Alberta) and Australia (Perth) for the three time points during the episode of care. There was very little variation between the time points, indicating that the majority of the patients receiving a CT scan undergo the test during their initial admission. This is confirmed in Figure A4.8 (in the appendix) for Canada (Ontario) and Australia (Perth).

170. Figure A4.8 also indicates the trends in CT scans during the episode of care. Use in Canada (Ontario), Australia and Sweden has increased sharply in the 1990s. In contrast, use in Alberta has remained relatively stable during the 1990s. In Sweden, the rates increased from just over 20% in 1985 to almost 100% in 1998.

CT scan: TIA

171. Similar CT scan usage patterns are observed for TIA patients (Figure A4.9 in the appendix), although usage is somewhat lower than for ischaemic stroke patients. Australia (Perth) had the highest usage out of these countries, where between 40 and 60% of TIA patients received a CT scan. Again, use in Alberta is substantially lower than in Ontario. There is also more of an age pattern evident, with younger patients generally being more likely to undergo the procedure that older patients. Again, use in Alberta has remained fairly steady, while in Canada (Ontario) use has increased markedly (Figure A4.10 in the appendix).

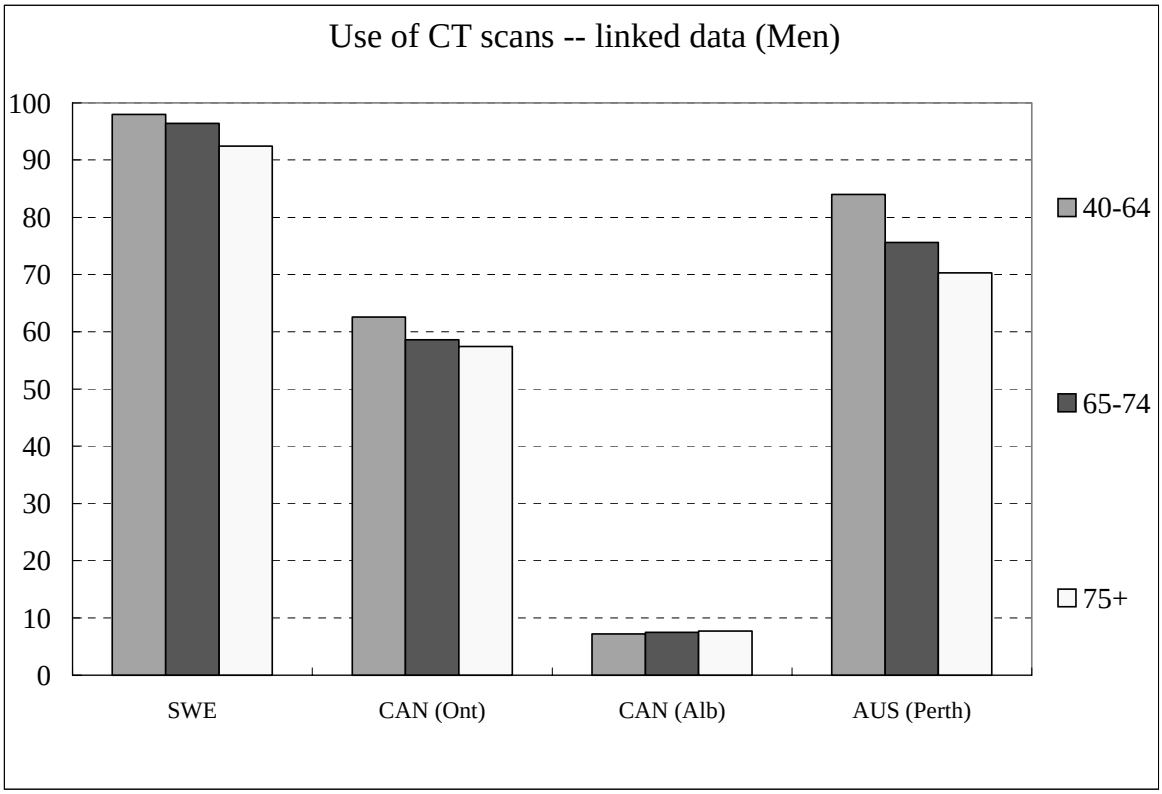
172. In contrast to the use of CT scans as identified in linked data sets, Australia (Perth) and Canada (Alberta) have the highest use with Sweden following (Figure 4.5, for detail by country and over time in Figure A4.11 in the appendix). In Australia, 15-18% of the ischaemic stroke patients in the 40-64 year age group received an MRI/MRA, while in Alberta the figure was around 10-20%. In all three regions, those in the youngest of these age groups were much more likely to receive the test than other age groups.

173. Figure A4.12 in the appendix displays the increase in the use of these procedures over time in Canada (Alberta) and Australia (Perth). Use in Ontario has remained very steady during the 1990s.

MRI/MRA: TIA

174. Use of MRI/MRA for TIA patients is substantially less common for TIA patients than for ischaemic stroke patients in the two Canadian provinces and in Australia (Perth) (Figure A4.13 in the appendix). In these cases, less than 10% of patients in all age/sex groups received the diagnostic procedure. However, again in both Canada (Alberta) and Australia (Perth), use increased substantially during the 1990s (Figure A4.14 in the appendix).

Figure 4.4: Use of CT scans for ischaemic stroke patients: hospital and community data (1997)



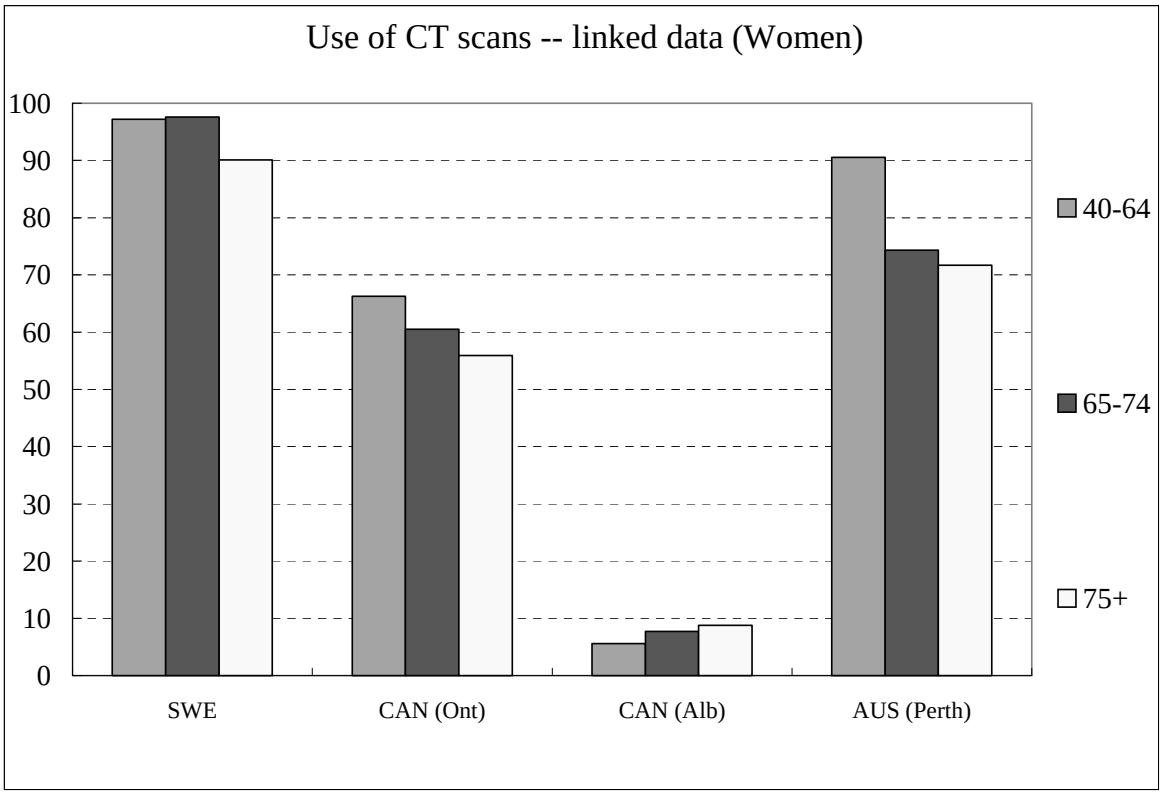
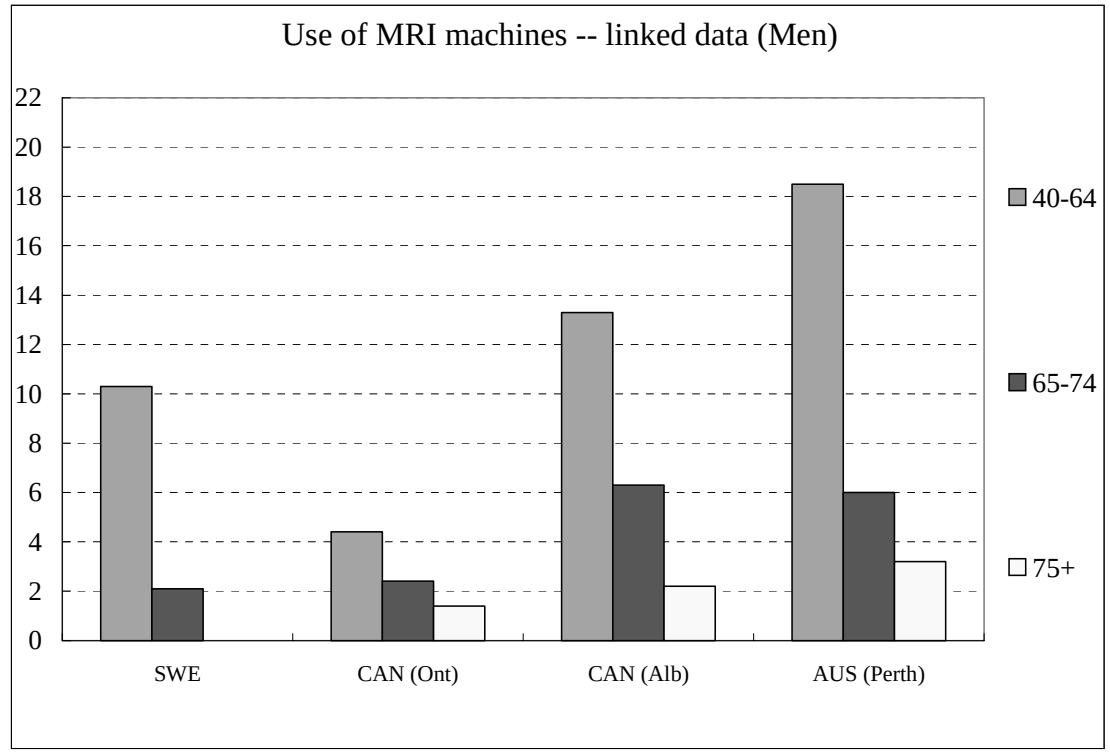
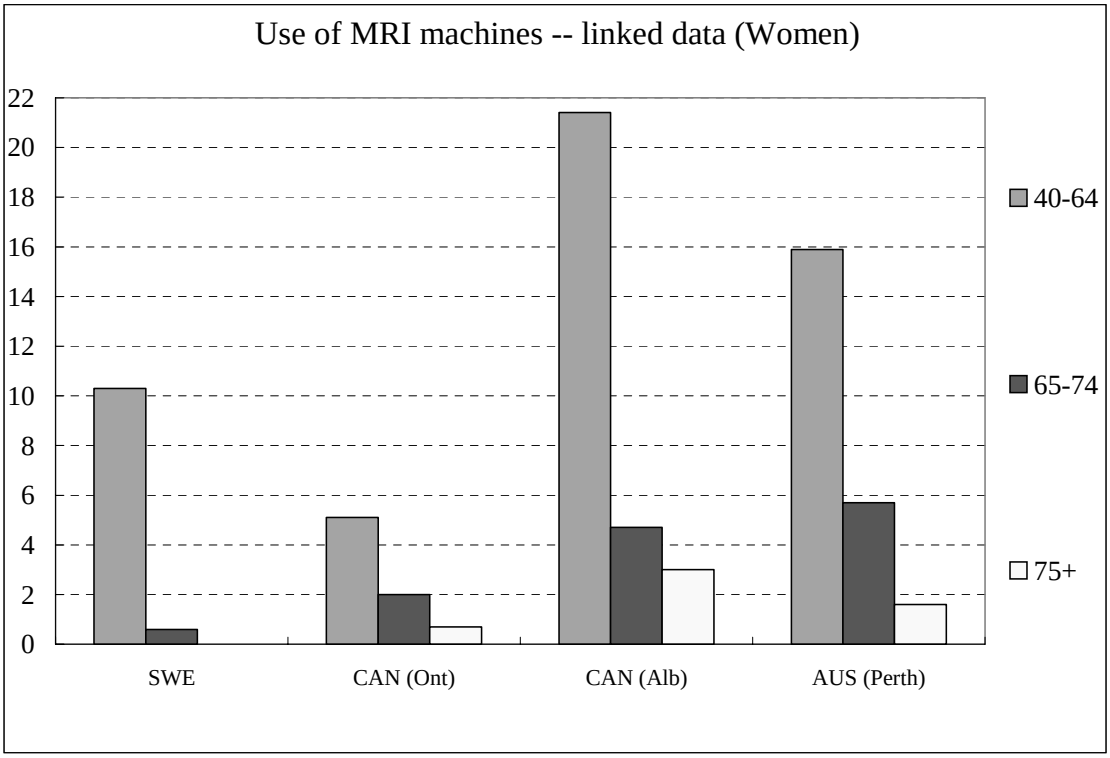


Figure 4.5: Use of MRI/MRA scans for ischaemic stroke patients: hospital and community data (1997)





Other procedures

175. Data collected as part of this project demonstrate that the use of contrast arteriography is quite low in the regions with linked data sets, where it was generally used for less than 10% of patients even in the youngest age group. The use of the procedure has declined substantially in recent years.

176. Use of doppler ultrasound, however, is somewhat higher in these three regions compared to arteriography. This is particularly the case in Sweden, where between 30 and 40% of 40-64 year old ischaemic stroke patients received the test within the first 28 days following the initial admission to hospital. In Australia, the test was used on approximately 10-20% of younger patients (aged 40-64 years) and 5-10% of older patients (aged 75+ years). Use in Canada (Ontario) was around 5%, while in Alberta the procedure was rarely used.

4.2.3 Summary of diagnostic procedure use

177. Use of CT scans for stroke patients varied considerably between countries. It was close to 100% in Sweden, around 60% in Australia, Spain and Ontario, and only 10-20% in Italy, the United States and Alberta. Use of the procedure tended to be fairly similar across age groups. There are considerable increases over time in the use of this procedure in many of these countries.

178. MRI/MRA were used less frequently than CT scans, with no more than approximately 15% of patients in the younger age group receiving the test. However, there were large increases in the use in some countries (for example Australia) and, in contrast to CT scans, higher use in the younger age groups compared to the older age groups.

179. Contrast arteriography was used rarely for these patients. The use of doppler ultrasound was more common.

180. The three main points coming from this analysis on the use of diagnostic tests for ischaemic stroke and TIA patients are:

- Variation across 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/MRA has increased substantially in Alberta.

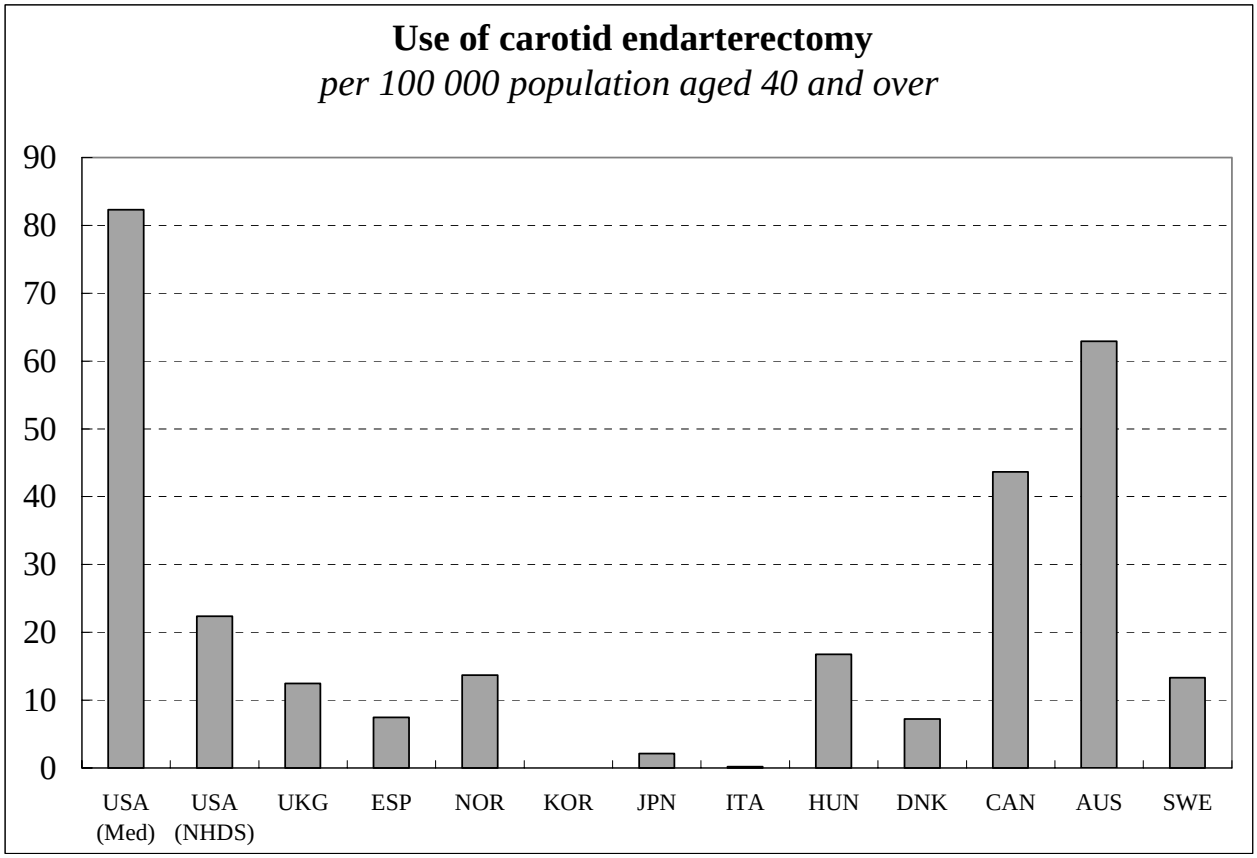
- Age patterns: The use of CT scans is generally constant across the age groups. However, the other procedures are used more commonly in the younger age groups compared to the older age groups.

4.2.4 Surgical treatment

181. Carotid endarterectomy (CE) is used as a preventive measure in individuals at high risk of stroke or recurrent stroke. Patients undergoing the procedure are admitted into hospital with a variety of diagnoses, many of which do not fit into the general framework for this study (which concentrates on ischaemic stroke and TIA admissions to hospital). For these reasons, information on CE is presented at an aggregate level (crude rate per 100 000 population aged 40 years and over), rather than related to a particular diagnosis.

182. Currently, CEs are not a common procedure in most OECD countries. Of the countries included in Figure 4.6 (with detail by country and over time in Figure A4.15 in the appendix), the United States had the highest number of procedures per population at around 80 per 100 000 (based on Medicare data)[9], 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 UK. The procedure was used very rarely in the remaining countries with data available (Spain, Japan, Italy and Korea).

Figure 4.6: Trends in the use of carotid endarterectomy



183. Note that the measure used here is relatively crude, as it does not take account of differing proportions of populations who are potential candidates for the procedure. However, as it is not possible to obtain this information consistently across these countries, the number of people aged 40 years and over was used as a proxy measure.

184. Time trends over 5 or more years are only available for some of these countries—Sweden, Australia and Canada (Ontario)—there is evidence of a gradual increase in the usage 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 operative procedure.

185. The use of carotid endarterectomy has been shown to fall and rise dramatically during the 1980s and early to mid 1990s (Tu *et al.* 1998), mostly during the period prior to that included in Figure A4.15.

[9] Estimate is based on the number of procedures performed on patients 65 years and over (Medicare patients), expressed as a rate using the United States population 40 years and over. As this excludes procedures performed on persons aged 40-64 years, the estimate presented here will be an underestimate compared to the other countries.

The trends observed by Tu *et al.* were substantially influenced by the published findings from randomised clinical trials conducted during that period.

4.3 Drug treatment

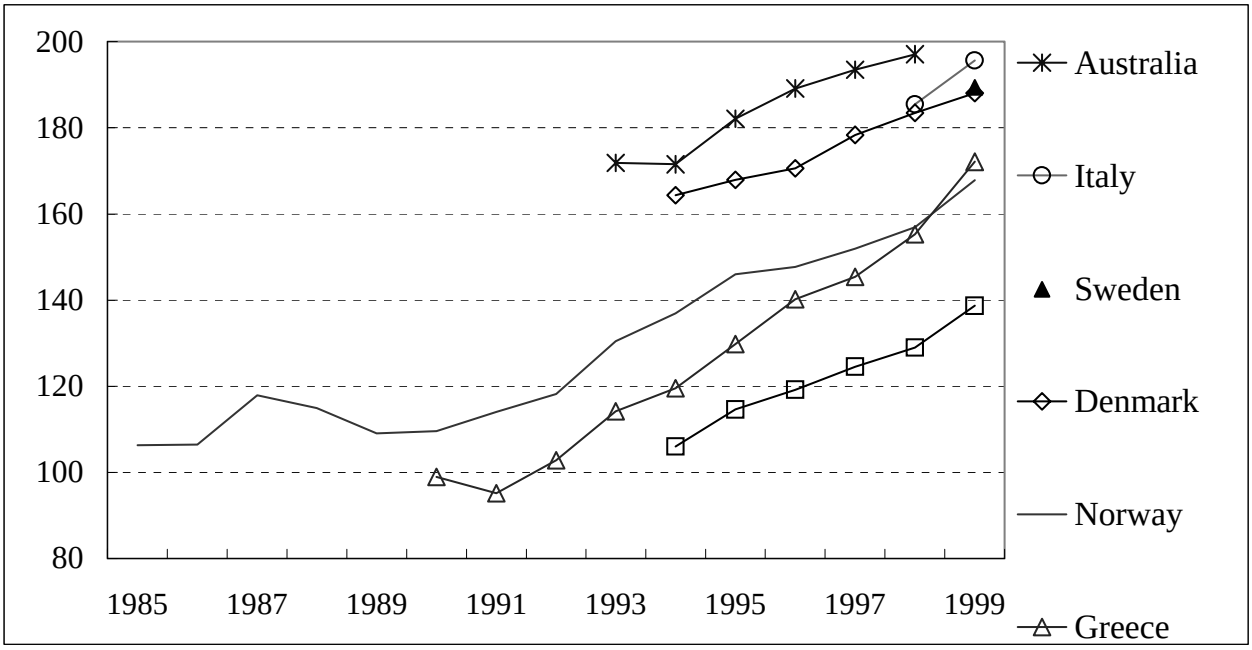
186. Drug therapy is a significant component in the prevention and treatment of stroke. As outlined in the medical annex, it may include thrombolytic drugs in the early acute phase, and longer acting anti-coagulants in the later acute phase and longer term. It also includes management of certain risk factors, with the use of antihypertensives and lipid-lowering drugs for example. Many of the issues related to drug treatment is similar for both ischaemic heart disease and stroke treatment. In relation to ischaemic heart disease, detailed analysis was undertaken in Dickson and Jacobzone (in press). This includes a demonstrated large increase in lipid-lowering drugs in some countries in recent years, most notably in Australia and Norway. Specifically in relation to stroke, two key issues examined in more depth below are the use of antihypertension drugs and anticoagulants.

4.4.1 Management of hypertension

187. Information on consumption by type of drug used to treat hypertension has been collected as part of this project, including antihypertensives (ATC code C02), diuretics (C03), peripheral vasodilators (C04), beta blocking agents (C07), calcium channel blockers (C08), ACE inhibitors, plain (C09A) and ACE inhibitors, in combination (C09B).

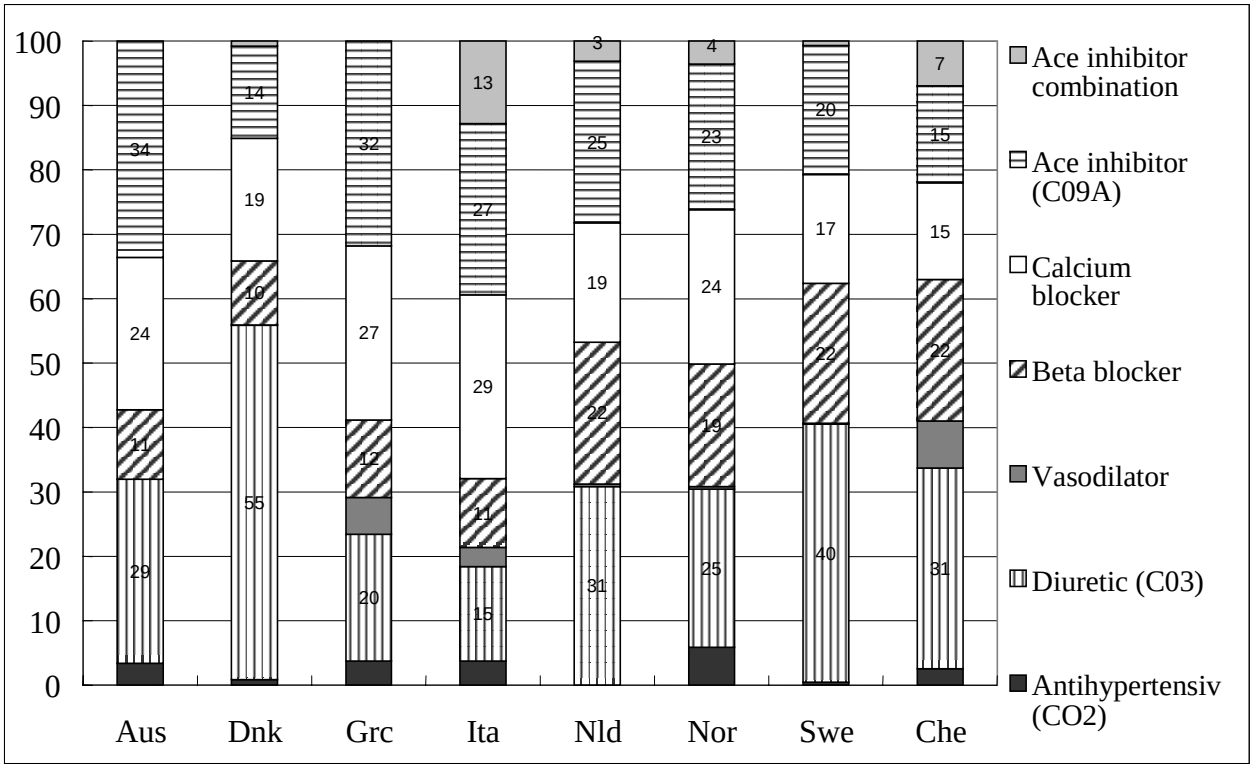
188. The total use of anti-hypertension drugs has been rising steadily in all the countries able to supply drug consumption data as part of this project (Figure 4.7). In Denmark, Norway and Australia, consumption of these drugs rose by between 12 and 15% between 1994 and 1998. In the Netherlands, consumption 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 4.7 Trends in the use of antihypertension drugs



189. Figure 4.8 shows the percentage share each of these antihypertension drugs accounted for in the most recent year. 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 was 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.

Figure 4.8: Consumption of antihypertension drugs by type, 1998-1999



Note: Drug group labels given in Figure 4.9.

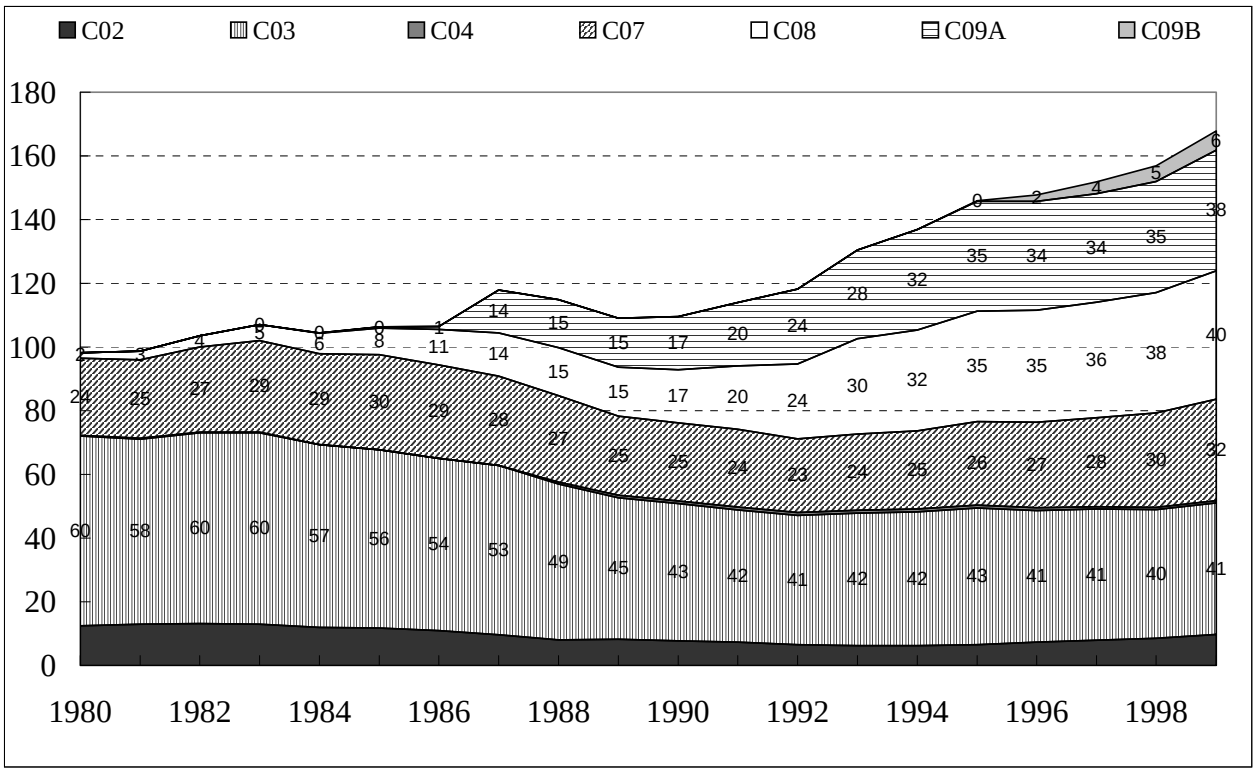
190. Trends in the total use of the different types of antihypertension drugs suggests some level of substitution, as well as overall growth in the use of these drugs. Norway is able to provide the longest trend data on the use of these sub-types of drugs (Figure 4.9). These data demonstrate that there has been a decline in the total use of the more traditional antihypertension drugs (C02 to C07) in Norway over the last 20 years. This decline is mainly reflected in a 32% fall in the use of diuretics during this period. Even adding the relatively large current use of calcium channel blockers which began in the mid 1980s, the trend in the total use of antihypertension drugs did not increase dramatically. The substantial increase in the total use of these drugs really began with the introduction of ACE inhibitors towards the end of the 1980s. Although data are not available over such a long period for other countries, similar trends are observed in recent years. See for example AIHW 2001a for data on the Australian use over the last 10 years.

4.4.2 Antithrombotics

191. Another key issue in the use of drug therapy for stroke treatment and/or prevention is with the use of antiplatelet therapy such as aspirin. Its use has been shown to be effective even when used soon after the stroke event in the case of non-haemorrhagic strokes. Aspirin is also often used on a long-term basis for stroke patients or those at risk of stroke. However, due to the multiple uses of aspirin (for example use as an analgesic), it is very difficult to determine consumption trends over time in relation to stroke from

administrative data. Nevertheless, due to aspirin's relatively low cost, it is unlikely to make a large impact in terms of total expenditure, even if used by a significant number of people over a medium to long time period.

Figure 4.9 Trends in the consumption of antihypertension drugs by type, Norway



192. Thrombolysis used within 3 hours of the onset of stroke significantly increases the chance of full recovery when administered by specialists. It is given only after confirmation that the stroke is not a haemorrhagic stroke, usually determined by a CT scan. Currently, the use of thrombolytics for stroke is not widespread.

5 VARIATIONS IN OUTCOMES

5.1 Definition and data issues

193. Health outcomes can be defined as 'those changes in health status strictly attributable to the activities of the health system' (Hurst 2002). Similar, though less stringent, definitions have also been given in AIHW 2001b and Rudd *et al.* 1999. Available data, however, can rarely disentangle the health system effects (aiming to prevent or treat the condition) from other effects (such as those related to the natural course of the disease, socioeconomic or environmental factors for example). The particular focus in this chapter 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. Outcomes are measured in terms of a variety of indicators, including mortality, morbidity, physiological measures of health and function, and more subjective patient-based assessment of health.

194. A report was published in 1999 discussing the measure of stroke outcomes in the UK context (Rudd *et al.* 1999). This material was adapted for the following discussion and table on health outcome indicators for stroke in OECD countries. This material relates to ischaemic and haemorrhagic stroke only, thus excluding subarachnoid haemorrhage and TIA.

195. In order to more easily understand the spectrum of outcome measures that ideally would inform us on stroke care, Table 5.1 provides a matrix of four main groups of potential measures, and examines these against various components of stroke care. The groups of outcome measures considered are in relation to:

- the *risk* of stroke (first and subsequent strokes),
- *deaths* from stroke,
- *complications* from stroke,
- and *functioning* levels after stroke.

196. The main treatment phases considered are prevention, acute care, rehabilitation and long-term care. The ticks represent the health outcome groups that relate to significant aims of the corresponding treatment phase. For example, significant aims for prevention include reducing the risk of first and subsequent stokes, and reducing deaths from stroke. In addition, we have indicated which of the treatment phases is the key phase for each outcome group. The right side of the table lists examples of the care components relevant within each outcome group, as well as examples of potential measures for each outcome group. These lists are not meant to be exhaustive, but rather to illustrate potentially relevant outcome measures.

Table 5.1: Matrix for stroke outcome measures

		Treatment type/phase (b = significant aim)					
Aim of health intervention		**Prevention**	**Acute care**	**Rehabilitation**	**Long-term care**	***Examples* of care components**	***Examples* of potential outcome measures**
Reduce risk of stroke	- For first ever strokes	**b** (key phase)				1. detection and treatment of hypertension 2. level of tobacco smoking	Incidence rates Percentage of the population who are smokers Proportion of community having BP taken in last 5 years
	- For subsequent strokes	**b**	**b** (key phase)	**b**	**b**	1. detection and treatment of hypertension 2. appropriate use of aspirin	Levels of untreated hypertension Percentage of stroke (non-haemorrhagic) patients on aspirin after 6 months
Reduce deaths from stroke		**b**	**b** (key phase)		**b**	1. appropriate and effective acute care	Hospital fatality rates (hospital treatment) Case fatality rates (hospital and community treatment) Community case fatality rates Care in stroke unit
Reduce complications from stroke			**b** (key phase)	**b**	**b**	1. avoiding unplanned readmissions to hospital 2. no pressure sores	Emergency readmissions for stroke Percentage of stroke patients with pressure sores after 3 months
Improve functioning after stroke			**b**	**b** (key phase)	**b**	1. Levels of impairments 2. Activity (disability) levels 3. Ability to participate	Care in stroke unit, or receive specialised rehabilitation care Measures based on Index of Activities of Daily Living Return to original category of accommodation (home, nursing home) after discharge

197. 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 fatality rates, which are part of the deaths outcome group in Table 5.1. Some of the other potential measures listed in the final column are discussed in other parts of this report. However, in those section the data are not available in a form that provides reasonable links to health interventions, or they are only available for a small number of countries, and therefore can only be used as a general indication of 'outcomes'. The relevant chapters are:

- Incidence rates (see chapter 2)
- Risk factor information (see chapter 2)
- Drug treatment (see chapter 4)
- Care in a stroke unit (see chapter 4)
- Transfers to rehabilitation (see chapter 4).

198. The main gap in the available information for this study is in relation to the fourth outcome group listed in Table 5.1: levels of functioning after stroke, largely due to lack of comparable data between countries. Sections 5.2 and 5.3 present data on hospital fatality rates and case fatality rates collected as part of this study. These measures only focus on deaths occurring after hospitalisation.

199. Information on some of the outcome measures described above were available from a subset of the countries participating in this study. In some cases data were only available for a region within the country. In addition, information was available from 2 sources in the United States. Abbreviations used to indicate these specific data sources on the figures in this chapter are as follows:

- Aus (Per): information covers the Perth region in Australian only.
- Can (Alb): information covers the province of Canadian province of Alberta only.
- Can (Ont): information covers the province of Canadian province of Ontario only.
- Jap (VHJ): information covers only the tertiary teaching and private hospitals participating in the VHJ Quality Indicator Project in Japan.
- UK (Oxf): information covers the Oxford region of the UK only.
- USA (Med): information obtained from Medicare data systems in the United States.
- USA (NHDS): estimates from the National Hospital Discharge Survey in the United States, conducted by the National Center for Health Statistics.

200. Significant fatality information was also available from the Netherlands (Evers *et al.* 2002). For ischaemic stroke, information was only available for overall hospital fatality, and not for specific time points (7-day, 30-day). Information that was available for specific time points included other types of stroke as well as ischaemic stroke. Due to these differences in definitions, the Netherlands results were not able to be included here.

5.2 In-hospital mortality

201. This section deals with the proportion of patients who died in hospital, information which is available for approximately half of the countries involved in this study. Rather than use crude in-hospital mortality rates within a varying period, we present information on two case-fatality rates which relate to distinct periods of time: 7 days and 30 days. These better define the time component of the case-fatality rate, and provides a measure of the fatality rate in the very acute phase, and another related to a longer, less acute period. The two measures for ischaemic stroke patients, and collated for 12 month periods, are defined as follows:

- 7 day hospital fatality rate = (no. deaths in first 7 days in hospital) / (total no. of stroke admissions) * 100

- 30 day hospital fatality rate = (no. deaths in first 30 days in hospital) / (total no. of stroke admissions) * 100

202. While these measures are important and useful to monitor at an aggregate level, it is also important to be aware of the limitations involved in aggregate analyses. 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. These links can only be made in detailed research studies that are able to account for casemix differences amongst other factors. In addition, differing admission practices between countries (and thus differing average lengths of stay) may also affect the relative comparisons between countries.

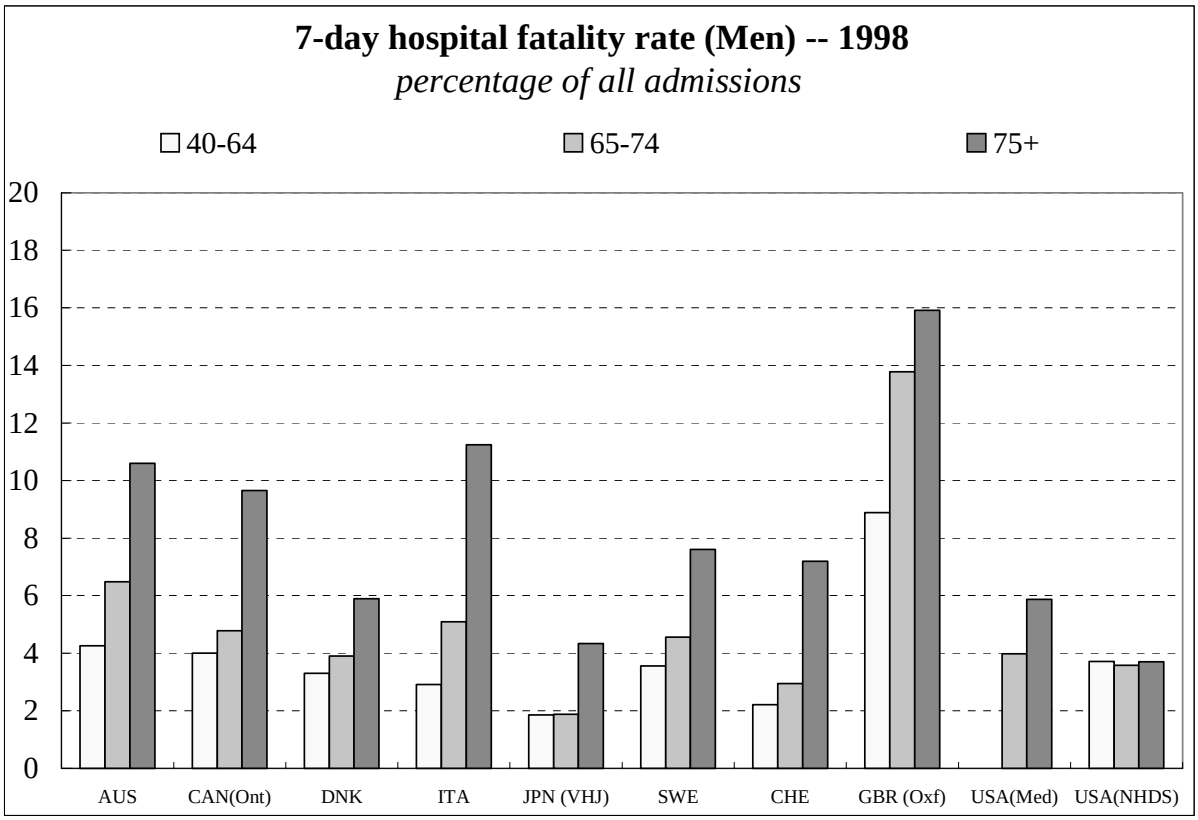
203. We have aggregate data on the hospital fatality rates for ischaemic stroke patients corresponding to two time points, 7 days and 30 days. Thus we are measuring the percentage of hospitalised ischaemic stroke patients admitted to hospital who died in hospital within the first 7 days, and within the first 30 days. The denominator for this measure is the number of hospital episodes with a main diagnosis of ischaemic stroke. This counts the number of stroke episodes, not the number of patients. Therefore, it is possible that some patients may be counted more than once (if they are re-admitted for the same stroke event), though this double counting is not expected to be large for ischaemic stroke patients. If it does occur, this will decrease the percentage to some degree.

5.2.1 Seven day hospital fatality

204. The percentage of ischaemic stroke patients admitted to hospital who died within the first 7 days of their stay is fairly consistent across the countries able to supply these data (Figure 5.1, with detail by country and over time in Figure A5.1 in the appendix). Generally around 5% 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 10% of these patients died within the first week.

205. Figure 5.1 shows an obvious, and expected, relationship between hospital fatality and age. Patients in the oldest age group (aged 75 years and over) were at least twice as likely to die in the first week of their hospitalisation than patients in the youngest age group (aged 40-64 years). The differential between the measures for the youngest and oldest age groups was particularly apparent for Italy. In some cases women had a higher chance of dying in the first week in hospital than men of the same age, but the difference was not great.

Figure 5.1 Seven-day hospital fatality



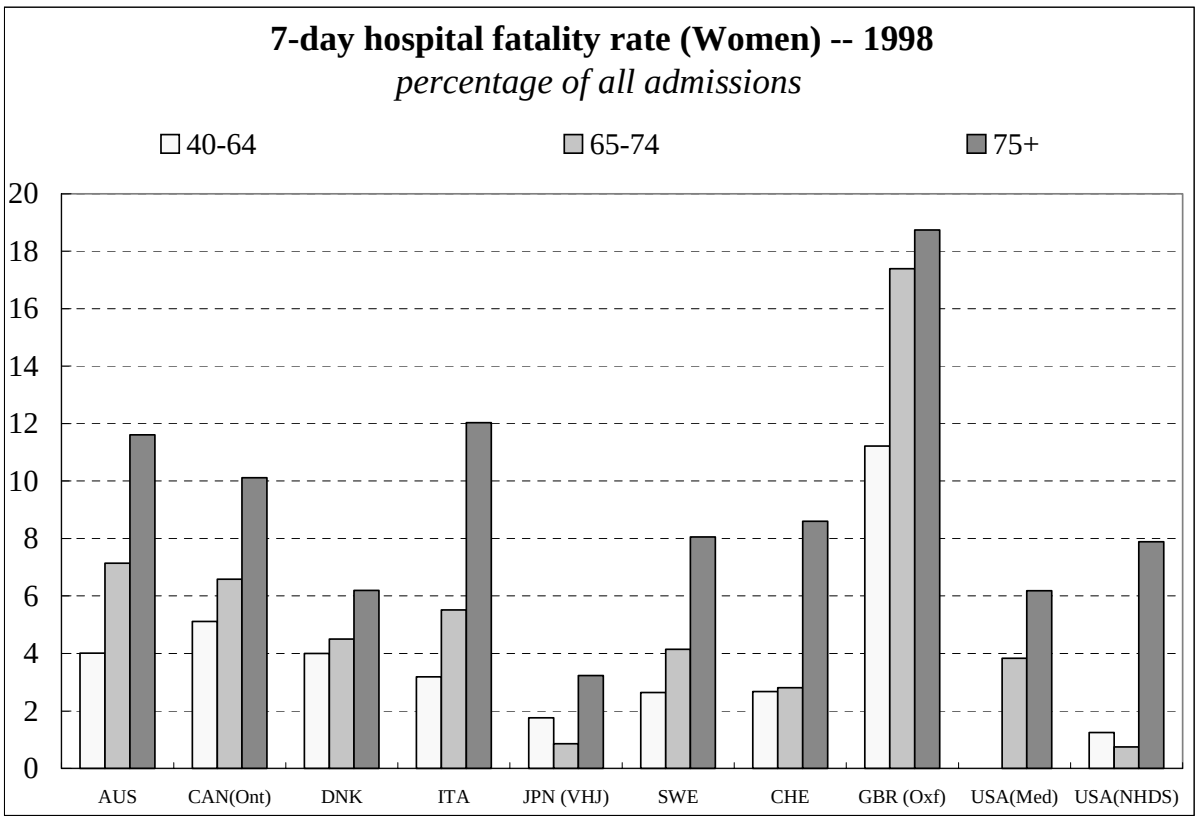
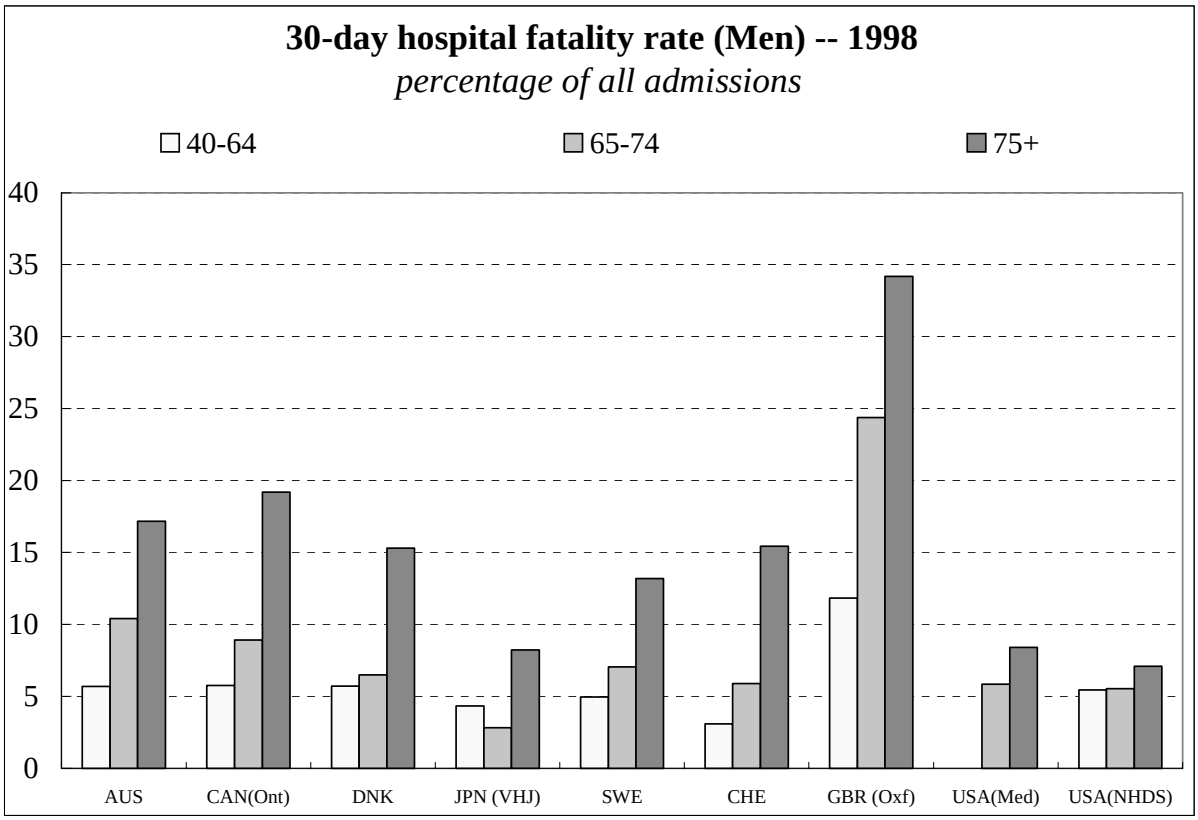
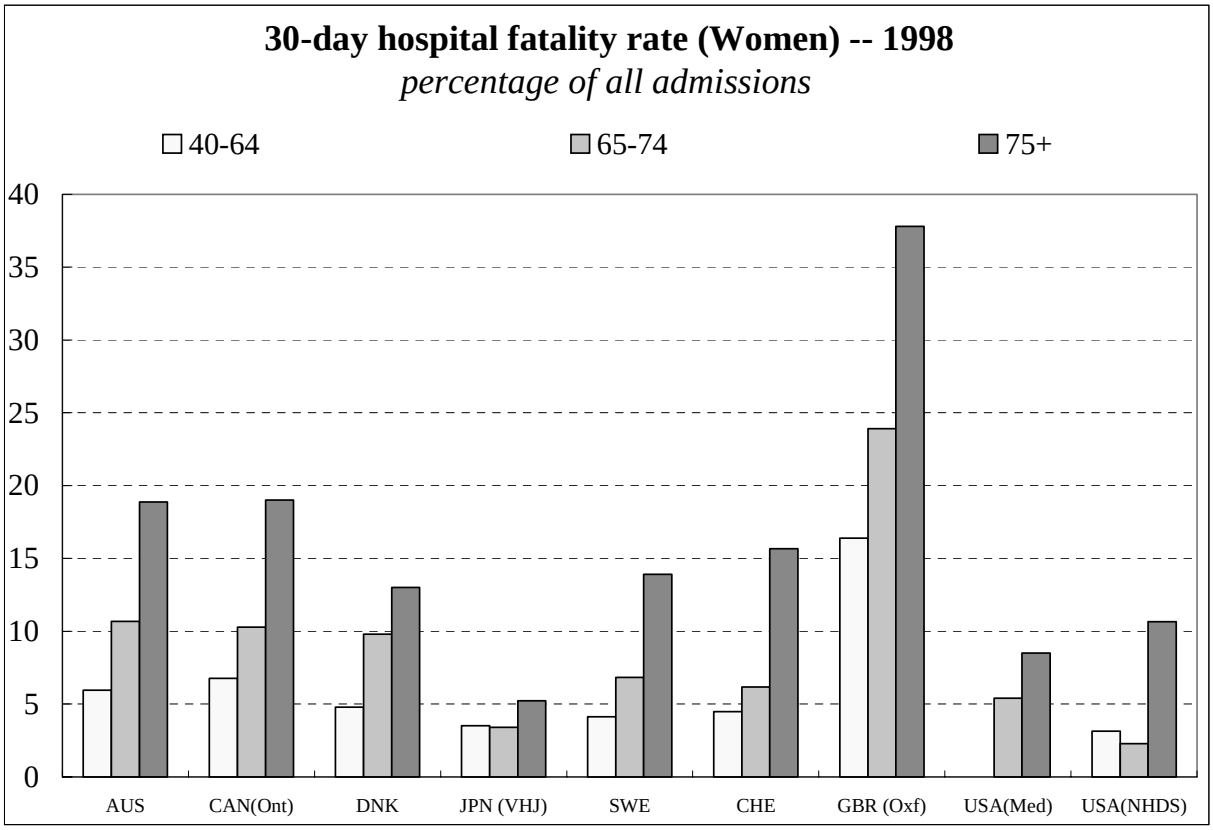


Figure 5.2: Thirty-day hospital fatality





206. Over time, different patterns emerge in different countries. In Denmark, Sweden, the United Kingdom and United States, some improvements are apparent, while in Australia and Japan (VHJ) the situation has remained largely unchanged in recent years. In Canada (Ontario) there have been some increases in the proportion of ischaemic stroke patients dying in the first week in hospital, particularly in the youngest age group. However, from these data it is not possible to link the results to the quality of treatment, mainly because it is not possible to determine whether or not the severity of cases is constant between countries or over time.

5.2.2 Thirty day hospital fatality

207. Similar patterns emerge when the hospital fatality rates at 30 days are examined (Figure 5.2, with detail by country and over time in Figure A5.2 in the appendix). The deaths counted here are all those occurring in the first 30 days in hospital, including those in the first 7 days discussed above. It does not include deaths occurring outside of hospital, thus patients discharged in the first 30 days who die after discharge are not included in these figures.

208. In most cases presented here, around 5% (or just above) of ischaemic stroke patients in the youngest age group (40-64 years) died within the first 30 days in hospital. However, at the oldest ages (75 and over), between 15 and 20% of ischaemic stroke patients died during this first month. There is some variation in these rates between countries, though this variation is relatively small. At the oldest ages, the rates are lowest in the United States and highest in the UK (Oxford). Again, these differences may be influenced by different levels of case severity, rather than simply resulting from different treatment patterns in hospital.

209. As with the 7-day hospital fatality rates, the risk of dying in the first 30 days in hospital increases with age. However, the difference in risk between the youngest and oldest age groups is greater at the 30 day mark than at the 7 day cut-off. In the first 30 days in hospital, ischaemic stroke patients are 3-4 times more likely to die if they are in the 75 and over age group compared to the 40-64 year age group. Again, there is very little difference between men and women, though women may be at a slightly higher risk of dying than men.

210. The main variation between countries occurs over time (Figure A5.2 in the appendix). Decreases in the 30-day hospital fatality rates are apparent for Denmark, Sweden the United Kingdom and the United States, and slightly for Australian men. However, no decline or small increases are demonstrated for the younger age group in Canada (Ontario), and in Japan (VHJ). The declining average length of stay for ischaemic stroke patients (see Section 6.2) is a plausible explanation for the increases. This is because the less severe cases are the ones more likely to be discharged earlier (thus reducing the average length of stay) which could result in the casemix becoming more severe over time.

5.3 Case fatality

211. The discussion in section 5.2 above focuses on deaths occurring in hospital. Although these data are available from a relatively large number of countries, they do not reflect the total continuum of care which includes 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 divided by the number of new cases. The two case fatality rates used here measure the percentage of ischaemic stroke patients who die within, firstly, the 30 days following initial treatment or, secondly, within the first year following initial treatment. These fatality rates also have the added advantage over the hospital fatality rates of being able to count the number of patients in the denominator rather than the number of admissions (the latter may count some patients more than once). The main limitation with the case fatality rates is that they are

only available for a limited number of countries. This is because they are harder to measure due to the need to be able to track patients over a period of time and in a number of settings.

212. The same cautions in relation to attribution for these outcome measures apply as for the hospital fatality rates. That is, 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. Nevertheless, these data are an essential component of the comparison of the health care systems in the different countries in relation to stroke.

5.3.1 Thirty day case fatality

213. Thirty-day case fatality rates for two regions in Canada, one region in Australia, one in the UK, and for Sweden and the United States (limited to persons aged 65 years and over), are presented in Figure 5.3 (with detail by country and over time in Figure A5.3 in the appendix). These results in conjunction with Figure 5.2 show that, for patients receiving at least some hospital treatment for ischaemic stroke, the majority of deaths occur prior to discharge from hospital. The 30-day case fatality rates are fairly consistent across these six regions, with generally around 5-10% of the younger stroke patients (40-64 years) dying in the first month following their stroke, and around 15-25% of the older patients (75 years and over) dying within the same period. Thus those in the oldest age group are around 3-4 times more likely to die in the first 30 days compared to those in the youngest age group. The UK is the exception, with higher case fatality than in the other regions.

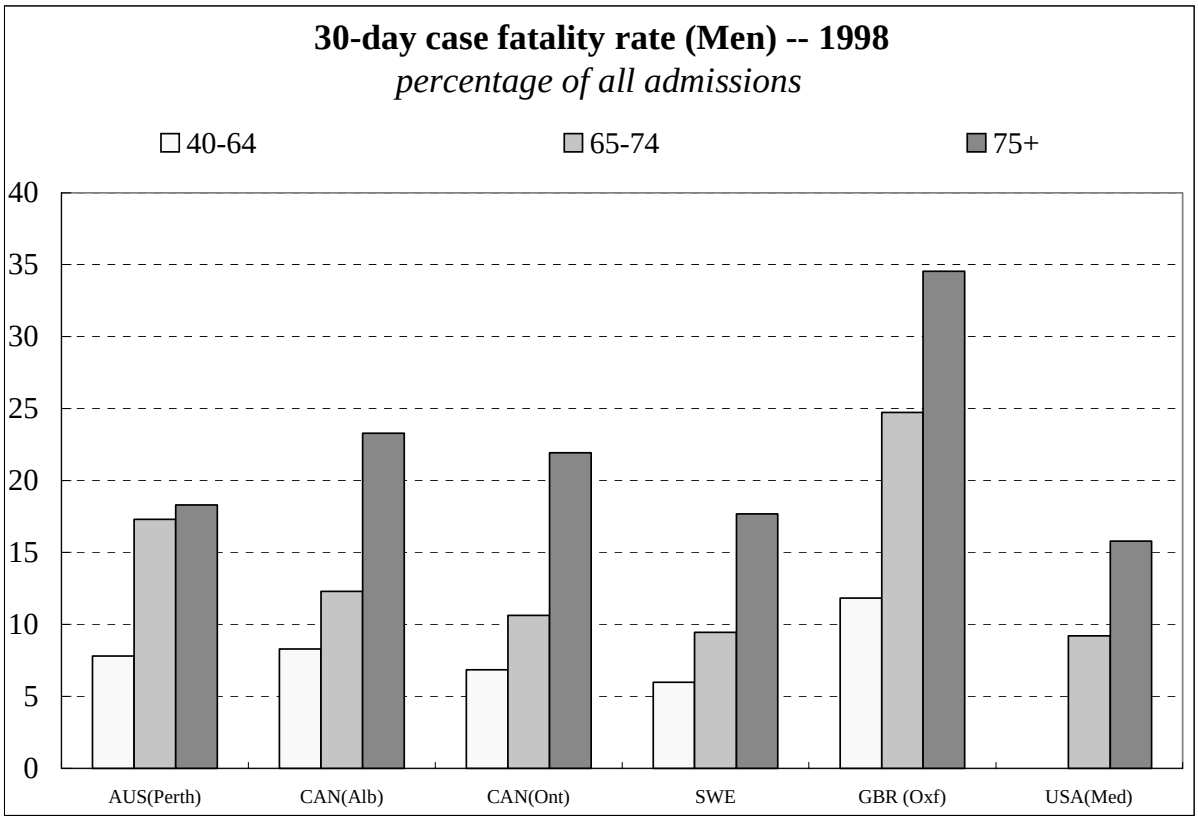
214. Very little difference exists in the case fatality rates for males and females. In addition, the trends over time for this measure are quite variable. Sweden is the only region showing consistent reductions in this fatality rate. In the other regions, no clear pattern emerges.

5.3.2 One year case fatality

215. The final set of charts displays the one year case fatality rates, using data from Canada (Alberta), Canada (Ontario), Denmark, Sweden, the United Kingdom (Oxford) and the United States (for person aged 65 years and over) (Figure 5.4, with detail by country and over time in Figure A5.4 in the appendix). 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 4 times higher in the oldest age groups compared to the youngest. Again, the UK rates fall outside these ranges demonstrating higher rates that in the other countries. Little difference is apparent between males and females.

216. Again, the aspect with the greatest difference between these countries is in the trends over time. Declines in the case fatality rates are apparent in Denmark, Sweden, the United States and to some extent in the United Kingdom. However, the rates in the other groups remained fairly steady.

Figure 5.3: Thirty-day case fatality



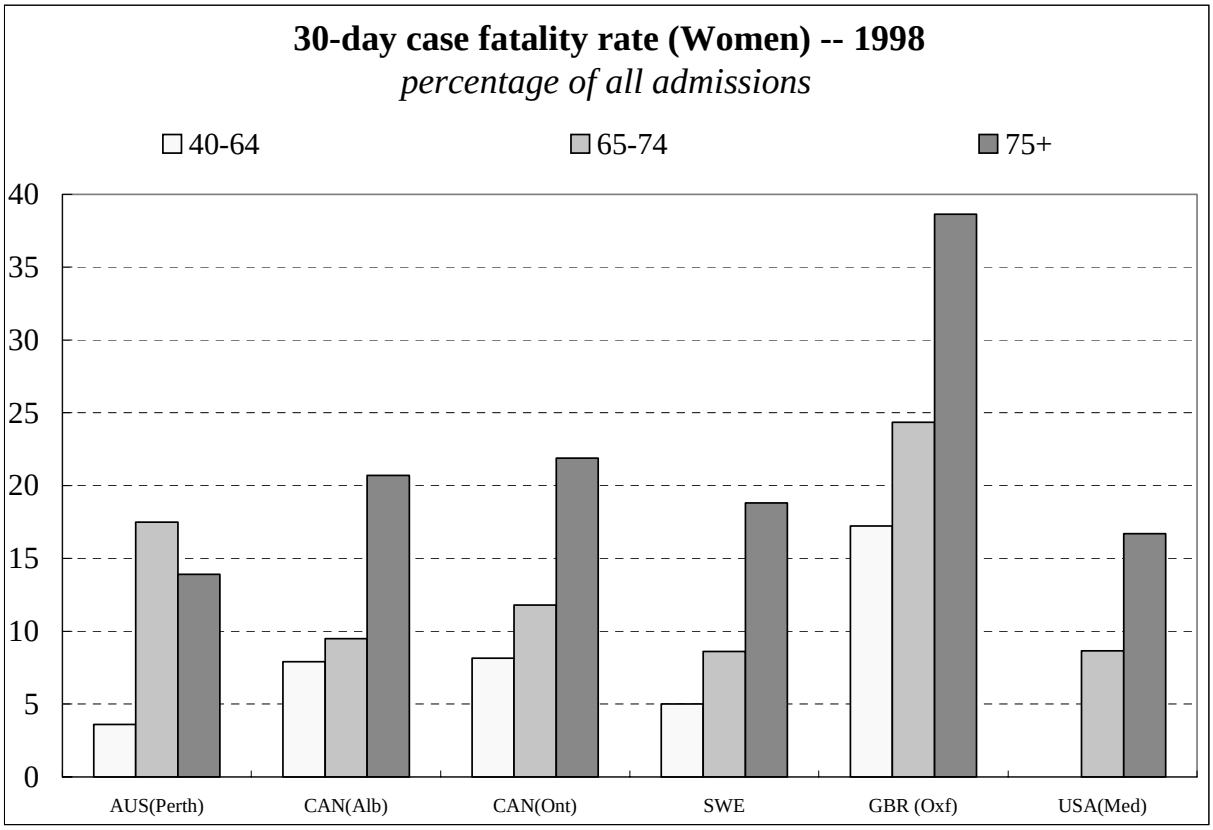
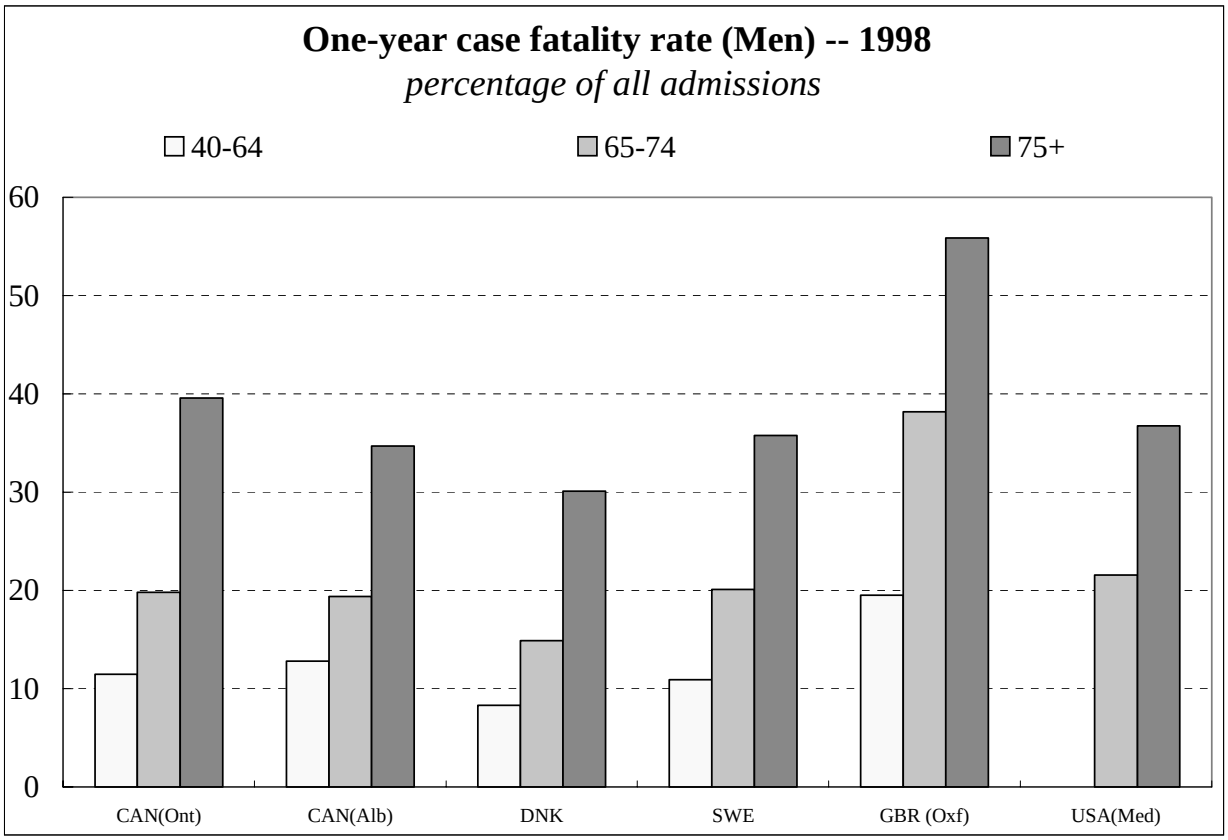
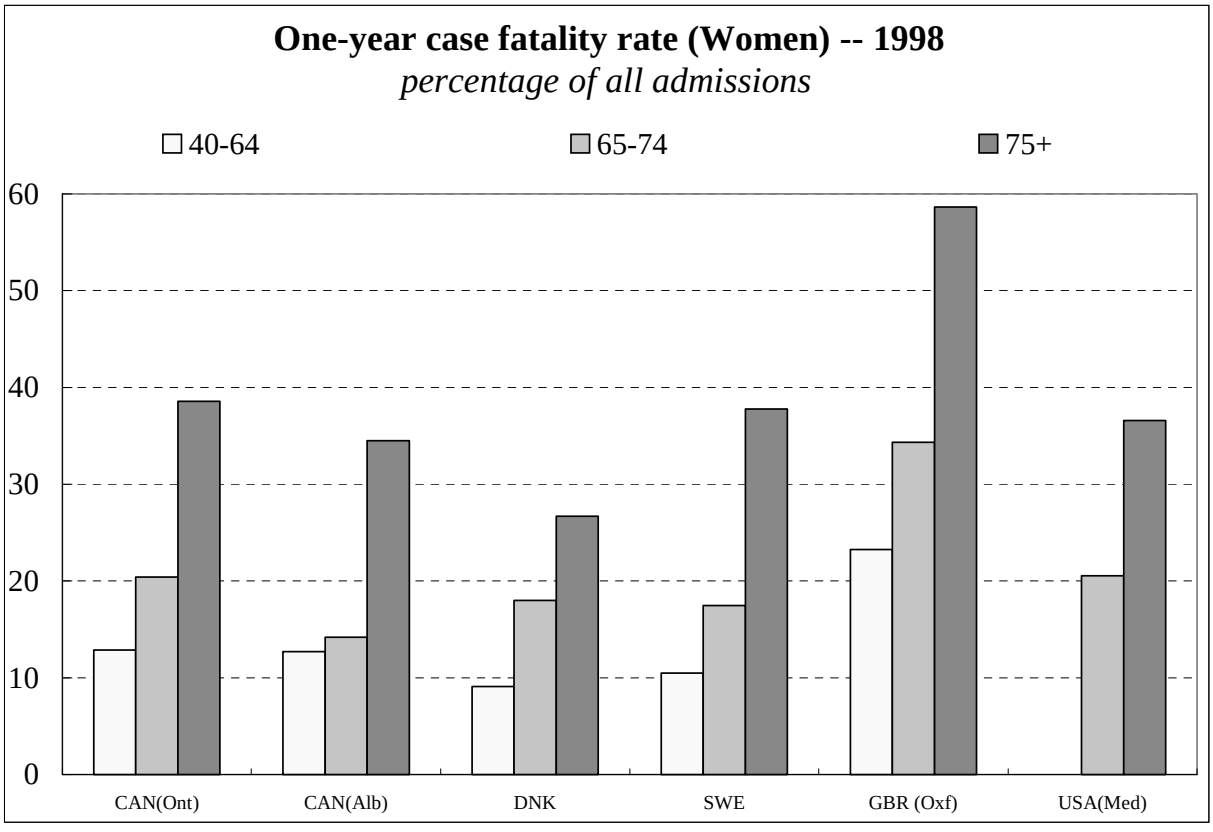


Figure 5.4: One-year case fatality





5.5 Explaining differences in outcomes

217. There are a number of possible explanations for observed variation in health outcomes. From the data available for this study, it was not possible to determine which of the following applies. To assist in interpreting the results in this chapter, the following possible explanations for health outcome variation are proposed:

- a proportion of the variation may be due to treatment differences, where approaches taken in countries, or within countries, vary in ways that impact on health outcomes
- differences in the severity of the illness, or in the existence of co-morbidities
- demographic differences, such as variation in the mix of the patient group by age and/or sex
- differing risk factors in the patient group which may impact on health outcomes independently of treatment decisions; for example smoking rates or socioeconomic status
- availability of resources.

6 ECONOMIC ASPECTS OF STROKE TREATMENT

218. 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 *et al.*, 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).

219. This chapter presents available information on some economic aspects of stroke care. Firstly, aggregate direct expenditure on all cerebrovascular disease is examined. Secondly, data on the length of stay in hospital for ischaemic stroke patients is presented. Thirdly, information follows on the relative unit expenditure for particular subsets of stroke cares. And finally, relative unit expenditure for other phases of care is summarised.

6.1 Aggregate expenditure on cerebrovascular disease

220. Information on aggregate expenditure on cerebrovascular diseases has been drawn from cost of illness studies in four countries — the United States, Canada, Australia and the Netherlands. Cost of illness studies estimate the costs associated with specific disease groups using one of two broad approaches. Firstly, a 'top-down' approach can be used to apportion expenditure for the whole health care system (obtained from national data systems) amongst disease groups. Or secondly, a 'bottom-up' approach can be used to aggregate individual costs for patients with a given disease (usually based on a new data collection specifically for the project). The cost of illness studies in this section all used the top-down method. All of these studies are prevalence-based, so the costs for each patient are counted in the year in which they occur. While cost of illness studies often examine both the direct and indirect costs of the disease[10],, in this report we concentrate on the direct cost component (Evers *et al.*, 2001).

221. Information from these four cost of illness studies shows expenditure on all cerebrovascular diseases (ICD-9 codes 430-438) ranges between 2 and 3.3% of total health care expenditure (Table 6.1). These results are quite consistent across the four countries, but with the Netherlands and Canada having slightly higher percentages. The results are also similar to the range reported in Evers *et al.* (2000), which included information from a wider group of studies including those relating to earlier periods.

Table 6.1: Aggregate expenditure on cerebrovascular diseases

Country	Year	%total health on stroke	%GDP on total health[(a)]	%GDP on stroke
Australia	1993-94	2.0	8.2	0.16
Canada	1993	3.3	9.8	0.32
Netherlands	1993	3.0	9.2	0.28
US	1995	2.8	13.9	0.39

(a) Average over 1993 to 1995
Sources: See Table A6.2.

[10] Direct costs are the health sector costs of providing the service; indirect costs usually focus on any lost production due to death or illness, but may also include costs from outside the health sector.

222. The share of total expenditure devoted to cerebrovascular disease reflects both the incidence (which is related to the 'need' for health care) and the priority given to stroke compared to other areas of health spending. But these figures do not take into account different levels of spending on health care across the four countries. The United States devotes a substantially higher proportion of their GDP to health than the other countries included in Table 6.1 (around 14% for this period compared to 8-9%), and indeed all other OECD countries (OECD, 2001).

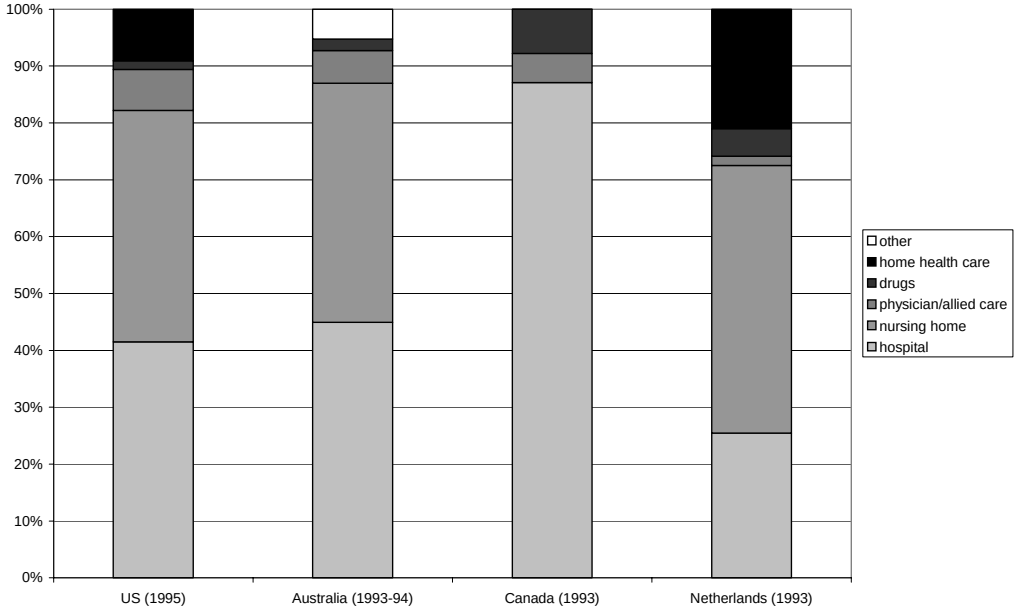
223. The final column showing the percentage of GDP spent on stroke care reflects the previous two columns: that is, it is influenced by both the total expenditure on all health care, and the relative share spent on stroke. The United States has the highest figure, largely due to its relatively high expenditure on overall health care. However, the figures for the Netherlands and Canada are only slightly lower, which reflects their higher relative spending on stroke care. Of these four countries, Australia has the lowest percentage of GDP spent on stroke.

6.1.1 Expenditure on different components of cerebrovascular disease care

224. For the countries in Table 6.1, information is also available on the allocation of stroke care expenditure. Some differences exist in the definitions used for the various components and thus the boundaries between these components may differ somewhat. Nevertheless, the information does permit broad comparisons to be made.

225. 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 expenditure (Figure 6.1). 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.

Figure 6.1: Aggregate expenditure on cerebrovascular diseases, by component of expenditure



Sources and notes: See Table A6.2.

226. Expenditure on two groups of health professionals (physicians and allied health professionals) was under 10% in all four cases[11]. Similarly, expenditure on drugs was also less than 10% for these countries.

227. Information on home health care expenditure is only itemised for two of these four countries. For the United States, it represented 9% of total expenditure for stroke patients In contrast, the situation in the Netherlands was quite different, where it accounted for a much larger share– 21%.

6.2 Length of stay in hospital for ischaemic stroke

228. The length of a patient's stay in hospital closely reflects the expenditure on stroke health care. This is because, firstly, a large proportion of the health care system's expenditure on stroke care is from the care delivered in hospital. And secondly when in hospital, the majority of the expenditure is due to the ongoing staff costs and hospital overheads, rather than the intermittent costs for diagnostic tests or procedures. As ongoing costs are fairly even throughout a patient's stay in hospital, they correlate quite closely to the total length of stay (Jorgensen *et al.*, 1997).

229. The length of a stroke patient's stay in hospital is dependant 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.

230. In this report, a number of summary measures of length of stay are reported:

- *Mean length of stay* is a measure of central tendency, and equals the sum of all length of stays divided by the number of patients in the group

- *Median* is also a measure of central tendency, and indicates the point where 50% of the values are lower, and 50% higher; it is less effected by extreme points than the mean

- *75% percentile*: the point at which 75% of values are lower, and 25% higher; giving an indication of the longer length of stays

231. The majority of the length of stay information presented in this section relates to health care for ischaemic stroke, unless otherwise noted.

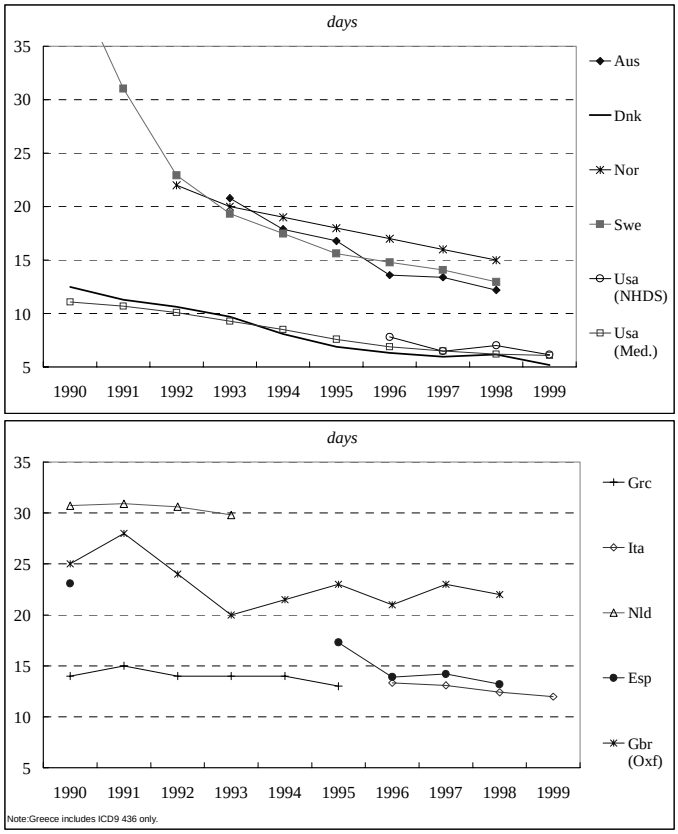
232. Over recent years, the length of stay for stroke patients has decreased in all countries with trend data available (Figure 6.2), and thus we expect that the total expenditure per patient to have also fallen. Although not every country has data for all three summary measures of length of stay listed above, it does appear that the reductions in length of stay are generally reflected in all three measures (Table 6.2). In particular, in most cases the values for the 75th percentile demonstrate larger falls than for the median. This indicates that there has been a substantial fall in the number of patients with very long lengths of stay.

233. Absolute levels of length of stay between countries may vary because of differences in definitions as well as differences in the underlying length of stay. For example, some countries include the rehabilitation phase in the hospital length of stay, while others discharge the patients to a separate rehabilitation facility, thus tending to reduce the hospital length of stay relative to other countries. In

[11] Expenditure on nursing care is included in the relevant component: hospital, nursing home or home health care expenditure.

addition, countries differ in how long after a stroke event patients may be transferred from acute care to longer term care arrangements if required (Grieve *et al.*, 2001).

Figure 6.2: Trends in mean length of stay in hospital for stroke patients



Sources and notes: See Table A6.2.

Table 6.2: Change in hospital length of stay for ischaemic stroke(a)

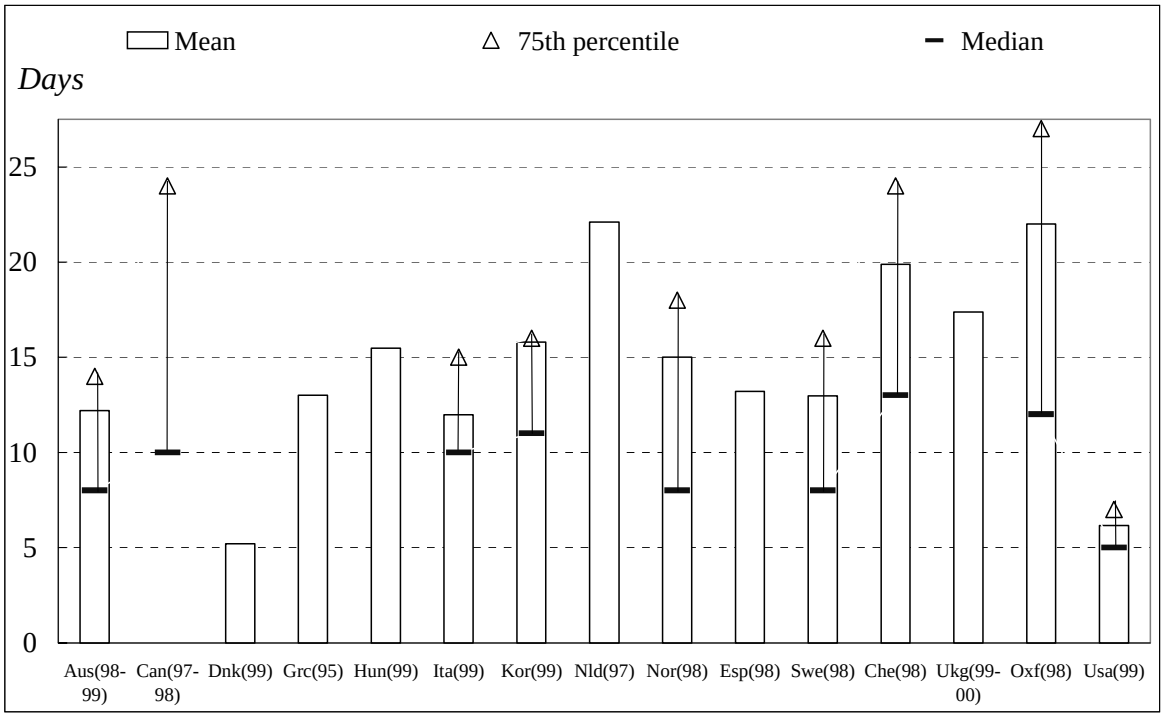
	Years	**mean**	**median**	**75th percentile**
		% reduction per year		
Australia	1993-1998	8.3	4.0	6.7
Canada	1994-1997		7.7	8.3
Denmark	1990-1999	6.5		
Greece	1990-1995	1.4		
Italy	1996-1999	3.4	0.0	3.9
Japan 1	1990-1995	2.0		
Japan 2	1996-1999	5.1	4.6	2.8
Netherlands	1990-1993	1.0		
Norway	1992-1998	5.3	4.5	5.1
Spain	1995-1998	5.3		
Sweden	1990-1998	8.6	5.4	6.3
United States	1996-1999	7.1	0.0	4.2

(a) Principal diagnosis of ICD9 codes 434 and 436 unless noted otherwise. Day admissions included unless noted.
Sources and country specific notes: See Table A6.2.

234. An example of the different components of length of stay is provided from the Copenhagen Stroke Study (Jorgensen, 1997). In that study, the mean length of stay in a stroke unit that included both acute and rehabilitation care was 37.4 days. However, after subtracting the component of the stay related to nonmedical reasons (such as waiting for nursing home placement), the mean length of stay was only 27.1 days. This same study also found that factors affecting the length of the stay were initial severity (increasing severity increased the length of stay), single marital status (also tended to increase the length of stay), and death (which decreased the length of stay). Other factors including age, sex, and the existence of other medical conditions were not found to influence the total length of stay. Similar results were also found in a study of stroke in the Netherlands, where it was found that 10 out of the 28 days of average stay were due to non-medical reasons (van Straten, 1997).

235. Whilst keeping in mind that direct comparisons of the absolute length of stay between countries needs to be undertaken with caution, in general the majority of means and/or medians of length of stay were around 10-15 days for ischaemic stroke patients (Figure 6.3). The main country with length of stays longer than this is Japan, which is discussed further below The countries that are notable for lower lengths of stays are Denmark and the United States.

Figure 6.3: Distribution of hospital length of stay for stroke patients



Sources and notes: See Table A6.2. Results for Japan not included on this graph, but are in Figure A6.2

236. For stroke, it is not uncommon to have a proportion of patients with substantially longer stays compared to the majority of patients, often resulting from high dependency levels due to the stroke. This situation (of a long 'tail' in the distribution of length of stay) is often indicated by a mean substantially higher than the median (see for example Japan and Norway).

237. The length of stay situation in Japan is substantially different to that in other countries, largely due to the inclusion of patients receiving long-term care in these statistics. Information on length of stay for stroke patients in Japan is available from two sources (Figure A6.1 in the appendix). Firstly, recent information from the Voluntary Hospitals of Japan Quality Improvement Project (VHJ QIP) indicates a mean length of stay of 43 days in 1999 for patients in 9 tertiary-level hospitals. Secondly, longer term trend

information is available for stroke patients in all Japanese hospitals (from the Ministry of Health and Welfare data base), with a mean of 93 days in 1999. Both of these figures are substantially higher than those in the other OECD countries included in our study. However, as the underlying type of patients counted appears to be very different in Japan (with the inclusion of patients receiving long-term care), it is not possible to compare these figures to that from the other countries.

238. Of interest is a comparison of trends in length of stay for Japan and the other countries. Using the second data source (Ministry of Health and Welfare), the percentage fall in mean length of stay for stroke in Japanese hospitals was 2.0 per year (Table 6.2). This is one of the lowest reductions in length of stay amongst the countries with trend data for the mean length of stay. But when using the first data source (VHJ QIP), the percentage fall per year was 5.1, which is more in line with the reductions observed in the other countries.

6.3 Relative unit expenditure for hospital treatment

239. Results from two main types of studies on the expenditure for different stroke-related treatment groups 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 related to stroke care. The two main treatment groups are hospital treatment for ischaemic stroke patients and for TIA patients. There is also extra information from some countries for TIA patients receiving a carotid endarterectomy, and for ischaemic stroke patients depending on whether they were discharged alive or dead. The second type of studies are those from smaller, usually research-based, studies providing information similar to that from the larger studies.

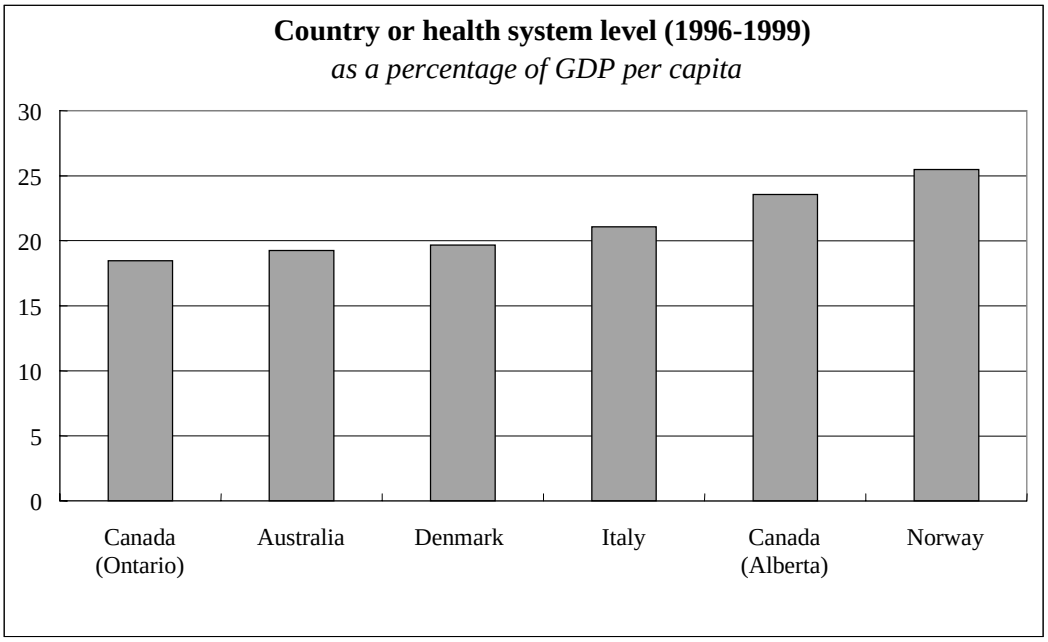
240. The majority of results from the larger studies come from costing estimates undertaken within a diagnosis-related group (DRG) framework. DRGs are used in a number of OECD countries to classify patients into groups with similar clinical and resource-use characteristics. These DRG systems may or may not be linked to payments.

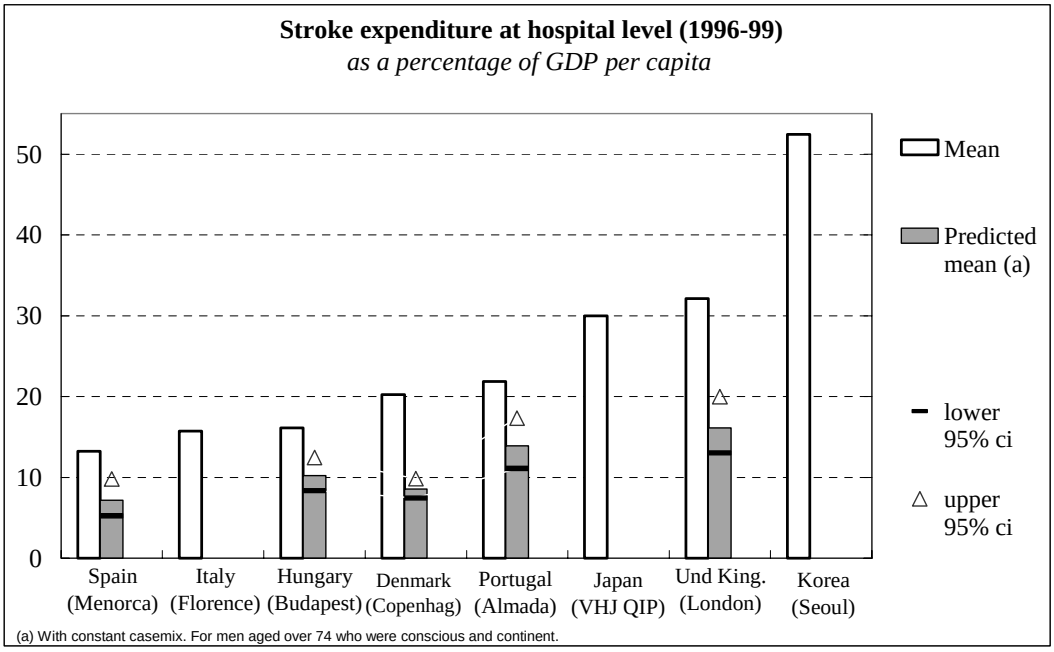
241. It is important to remember that these results are from studies that may not have used exactly the same definitions or methodologies. While we have indicated where there are differences in the scope of the assessment (for example whether or not administration costs were included), differences within the categories may still remain. See Table A6.2 in the appendix for details.

242. 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.

243. 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 6.4. The relative unit expenditure estimates for ischaemic stroke admissions shown in Figure 6.4 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 6.4: Relative unit expenditure for stroke admissions





Sources and notes: See Table A6.2.

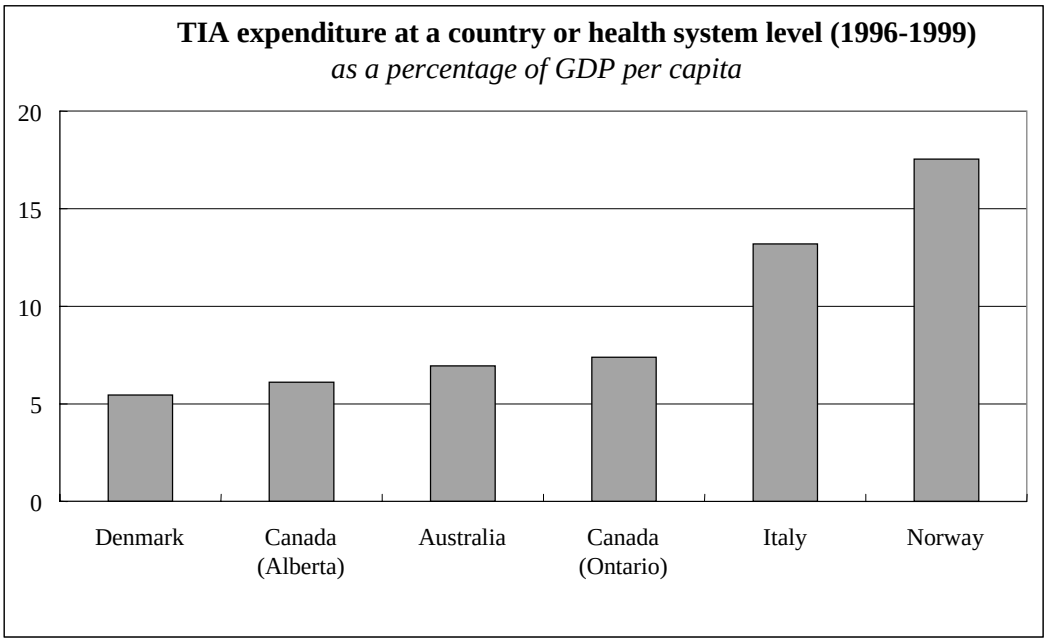
244. The second panel in Figure 6.4 provides similar information sourced from studies with a smaller scope. The majority of these relate to one hospital with the exception of Japan where the data come from nine tertiary level hospitals. Due to these limitations, the data are not likely to be representative of the whole country.

245. From these studies, the unit expenditure for a stroke admission relative to GDP per capita ranged from 13% to 52%, with the large figures generally based on studies in tertiary care hospitals. Therefore, the results in the first and second panel are plausible given the differences in scope.

246. 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.

247. As expected the relative unit expenditure for TIA admissions was lower than for ischaemic stroke admissions (Figure 6.5). However, the results for TIA demonstrated a great level of variability. In Denmark, Australia and the two Canadian provinces, the relative unit expenditures were between 19 and 26%. Higher percentages were found in Italy and Norway.

Figure 6.5: Relative unit expenditure for TIA admissions



Sources and notes: See Table A6.2.

248. Similar information is also available for Korea, though the results have been estimated from only one major referral hospital which is therefore not representative of the whole country. In that hospital, the estimated unit expenditure for TIA admissions was 15% of GDP per capita for patients not undergoing a carotid endarterectomy. Data available from the VHJ QIP in Japan (9 tertiary level hospitals) provides an estimate of 11% of GDP per capita for expenditure on a TIA admission.

249. Additional data from Alberta in Canada on the trends in the relative unit expenditure is shown in Figure A6.2 (in the appendix). Also, this information is available both for the in-hospital component of care, as well as for the care received after discharge. For ischaemic stroke, the relative unit expenditure as a percentage of GDP per capita have dropped dramatically during the 6-year period. For the in-hospital component, the relative unit expenditure has fallen by 46% during the period. The hospital component of total expenditure for the 180 days following admission has remained stable, at just over 63%. This indicates that the expenditure corresponding to the period after the initial admission has also dropped significantly during this period.

250. In Alberta, the relative unit expenditure per TIA patient have also dropped by a similar magnitude as for stroke: by 42%. However, the expenditures from the post-initial admission period have

dropped by a higher proportion: 54%. Consequently, the hospital proportion of expenditure has increased from 40% to 48% during the period.

251. Data from Australia demonstrates the significant extra expenditure associated with carotid endarterectomy. For TIA patients undergoing a carotid endarterectomy, the relative unit expenditure was almost 25% of GDP per capita (Table 6.3), compared with 6% for TIA patients not undergoing the procedure. In one Korean hospital, the relative unit expenditure for a carotid endarterectomy admission was 86% of per capita GDP. In Japan, the relative unit expenditure from the VHJ QIP data was 62% of GDP per capita.

Table 6.3: Relative unit expenditure for carotid endarterectomy admissions

		year	% GDP per capita
Australia	National	1998-99	24.8
Japan	VHJ QIP; 9 hosp.	1996-00	62.2
Korea	1 hosp.	1998	86.0

Sources and notes: See Table A6.2.

6.4 Relative unit expenditure for other care

6.4.1 Rehabilitation

252. A small amount of information is available on the relative expenditure on rehabilitation care (Table 6.4). This information demonstrates substantial variation, with the unit cost ranging from 7–54% of per capita GDP, and the expenditure per day ranging from 0.9–2.1% of GDP per capita. These results indicate that the rehabilitation component of stroke care results in significant expenditure. Amongst this small sample, variation in expenditure per admission is influence slightly more by differences in length of stay than by differences in the costs per day.

Table 6.4: Relative unit expenditure for rehabilitation

			Exp per admission	Mean LOS	Exp per day
		year	% GDP per capita	days	% GDP per capita
Canada (Ontario)	province	1998			1.3
Copenhagen (Denmark)	1 hosp	1996-97	9.9	10.4	1.0
Florence (Italy)	1 hosp	1996-97	7.4	8.3	0.9
Korea	1 hosp	1998	53.7	26.0	2.1

Sources and notes: See Table A6.2.

6.4.2 Inpatient and community care

253. A number of studies have confirmed that the most costly component of health care for stroke patients is the inpatient component (Porsdal and Boysen 1999, Zethraeus *et al.* 1999, Grieve *et al.* 2001). To examine the expenditure for different components of care including hospital and community care, results from a number of research studies are summarised in Table A6.1 (in the appendix). The first five results come from an international study of costs for stroke care covering the three months after initial admission to hospital (Grieve *et al.* 2001). Two estimates are also presented from this study. The first is based on the mean total expenditure for the 3 months after adjusting for a set of casemix variables: age, sex, stroke subtype, level of consciousness, incontinence, dysphasia and paralysis. These results range 14.6–37.8% of GPD per capita, with the relative expenditure being lowest in the centre in Spain, at a middle level in Italy and Portugal, and a higher level in Denmark and the UK.

254. Some of this variation is likely to be due to different cost components between centres, for example in the cost of a CT scan, or in the hourly staff costs. To control for these differences, a sensitivity analysis was carried out in the study (the second set of results presented in the first half of our table) where the costs in one centre for the various components of care was applied to all centres. This did reduce the variation but only slightly, with the resulting relative unit expenditure ranging between 13.8–34.3% of GDP per capita, however the broad ranking remained the same. Thus, considerable variation still remains due to treatment variations.

255. The authors found that the ranking (from lowest to highest) in the mean length of stay matched the ranking of the mean cost. Similarly, the staff costs closely correlated with the costs in the various study centres. However, they did not find a similar connection between use of CT scans and costs.

256. The second group of studies presented in Table A6.1 come from two other research studies carried out in Scandinavian countries, both of which followed patients for one year post stroke. The first study in Sweden concentrated on health care costs, and found that the mean relative unit expenditure was 52% of GDP per capita (median=33%). The final study, in Denmark, had a broader scope including social services, and estimated a relative unit expenditure of 78% of GDP per capita.

257. As mentioned earlier, the bulk of these costs relate to the inpatient component of care. In the five centres from Grieve *et al.* (2001), between 76% and 94% of total health costs for the three months were for inpatient care. The other two studies estimated inpatient costs for a year post stroke to be 88% and 72% of total costs respectively.

258. The study by Grieve *et al.* (2001) also collected information on effectiveness as well as costs, by measuring health outcomes using both survival and functional status. In most cases, the ranking for health outcomes matched that of costs, with the centres with higher costs having better outcomes. The exception, however, was in London by a relatively large margin (similar UK health outcomes found in Wolfe *et al.* (1999)). The authors therefore concluded that spending more on stroke does not necessarily improve outcomes, but instead careful consideration needs to be given to using the resources in a cost-effective way. It is suggested that the organisation of stroke care in the London centre was not well developed, particular in relation to the lack of stroke unit care.

7 DISCUSSION

259. The burden from stroke in OECD countries is large, both in terms of disease burden and health system costs. In OECD countries, cerebrovascular disease accounted for just over 10% of total deaths in 1997. For the countries included in our study, the percentage of total deaths that were due to cerebrovascular disease ranged from 6% in Mexico to 21% in Portugal (OECD Health Database 2002). We also know that the disability burden from stroke is high, though specific country estimates are not available for OECD countries to the same extent as they are for the mortality burden. However, It has been estimated that, in the low mortality regions of the world which include the majority of countries participating in this study, between 3 and 11% of the total disease burden (deaths and disability) is attributed to stroke (WHO 2000). Because of the large burden from stroke in terms of deaths and disability, the health system costs resulting from stroke are high, with estimates in four of the countries included in this study ranging between 2 and 4% of total health system costs.

260. This study has compared the treatment, costs and outcomes from stroke care between a subset of OECD countries — 17 countries in total. It complements the other two disease studies on breast cancer and ischaemic heart disease undertaken as part of the Ageing-Related Diseases (ARD) study. For the stroke study, a specific definition for a sub-type of stroke (ischaemic stroke) was used in order to remove much of the variation due to differences in severity. That is, the study aims for a homogenous subgroup of stroke patients as the basis of the analysis. Thus much of the discussion here is in relation to ischaemic stroke, though aspects of treatment for other types of stroke including transient ischaemic attack (TIA) is also included.

261. The scope of the study is the health system's role in the treatment and care of stroke patients over the whole continuum of care from prevention to rehabilitation. The notable boundary on the scope of the study is between 'health care' and 'social care' such as long term care. However, a current OECD study on dementia care includes the social care system in its scope.

262. This chapter discusses some of the main relationships between treatments (interventions), costs and outcomes, aiming to explore some policy-relevant relationships. The context of the discussion here is exploratory rather than conclusive. Further analysis is underway to explore these relationships, including analyses also drawing on results from the other two ARD studies (Hughes *et al.* 2002; Moise *et al.* 2002). Within this chapter, 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 only undertaken in order to simplify the discussion.

263. The key issues identified through the stroke study 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 phase is a significant component of high 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. These findings both relate to the co-ordination and organisation of health systems over the whole continuum of care, 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.

7.1 A policy perspective on treatment variations

Are there variations in stroke prevention and treatment?

264. 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 between 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 and in the types of antihypertensive drugs used.[12]

265. The interpretation of these variations is not straightforward. Notably, levels of use are affected by the underlying rates of the disease in the different countries, which determine the medical '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 (see Box 3.1). Mortality rates can provide a perspective on underlying disease rates, but as both disease rates and treatment affect mortality rates, mortality has not been used as a measure of need when analysing treatment variations.

266. An illustration of how treatment variations between countries are driven by disease rates is given in Figure 7.1, which shows the relationship between ischaemic stroke incidence rates and hospitalisation rates for ischaemic stroke. It is clear for this subset of countries that those cases with the highest hospitalisation rates are those with higher incidence rates. Thus, for ischaemic stroke, it appears that a reasonably constant proportion of stroke patients are admitted in these countries. It is thus reasonable to conclude that hospitalisation for ischaemic stroke patients is driven by medical need rather than by different policy approaches or economic incentives.

267. Specific treatment variations are discussed in the following sections. The effect of differing policies and economic incentives are discussed where relevant.

268. Management of risk factors

269. The focus placed on prevention of stroke through the management of risk factors varies between countries. Two of the major risk factors for ischaemic stroke are tobacco smoking and hypertension. Differing approaches to managing these two determinants are discussed in more detail here.

270. Tobacco smoking has been shown to account for a large proportion of the attributable burden for stroke (for example Makomaski-Illing &Kaiserman 1999, Mathers *et al.* 1999, Tuomilehto 1991). 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. This is important from a policy perspective both in the long-term and short-term, as it has been shown that quitting has an immediate affect on population health outcomes and costs, in addition to the longer-term effect (Lightwood *et al.* 1997).

271. As an indication of the recent success of countries in lowering population risk from smoking, the percentage reduction in the proportion of male and female smokers between 1990 and 1995 was used as

[12] A summary of treatment variations, including use in different countries, is given in Box 4.1.

the basis of the qualitative grouping of countries included in Box 4.1. 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 (Box 3.1 includes information on population levels of smoking). The other Nordic countries in the study (Norway and Sweden), Australia, Canada, the UK, 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 Netherlands, making this risk factor a significant policy issue for these countries.

272. An important physiological risk factor for stroke is high blood pressure, thus effective control of high blood pressure is an important component of stroke prevention, with drug treatment a major focus of this aspect of care. Of the limited number of countries able to supply information on use of antihypertensives for this study, Australia, Italy, Sweden and Denmark had relatively high use. The Netherlands had the lowest use compared to the other countries, while Norway and Greece had moderate use. Here antihypertensives are defined as a broad group of drugs used to treat hypertension, which includes diuretics, beta blockers, calcium channel blockers and ACE inhibitors.

273. In all these countries, use of these drugs has risen substantially in recent years with no sign of levelling off, which highlights a potential source of further increases in drug expenditure in the future. Much of this increase is believed to have come from increased use of the newer drugs such as ACE inhibitors. Data from Norway illustrate this clearly (see Figure 4.9). Currently, countries with relatively high use of ACE inhibitors (measured as use of ACE inhibitors as a percentage of total antihypertensive use) are Australia, Greece and Italy, two of which are also the highest utilisers of antihypertensives amongst these countries.

Organisation of care

274. A key policy issue for the care of stroke patients is the organisation of care, notable with the use of inpatient stroke units, with the general characteristic being specialised, multidisciplinary care in a dedicated setting. A major focus in the recent research literature in relation to stroke highlights the effectiveness — and cost-effectiveness — of stroke units [Cochrane Review 2002, Stroke Unit Trialists' Collaboration 1997a, Jorgenson *et al.* 1995, Grieve *et al.* 2000]. In relation to inpatient care, the use of stroke units has been shown to reduce mortality and disability for a wide range of patients. The studies contributing to this issue in the research literature includes the European countries (particular the UK and Scandinavian countries), the United States, Canada and Australia.

275. Unfortunately, the availability of data on the use of stroke units in different countries is currently quite limited. For this study, information was available for seven countries, though not using a standard measure nor necessarily a standard definition of a stroke unit. This information is displayed in Figure 7.2, showing that the Nordic countries appear to use stroke units to a larger extent that the other four countries with data available. These countries generally have explicit policies and/or guidelines encouraging the use of stroke units (see Chapter 2). The Netherlands and the UK also have specific policies, though at least in the UK policies targeting stroke units is relatively recent. It is also not surprising that the countries with available information on stroke units are also those with a policy focus in this area.

276. Also relevant to the organisation of care is the use of hospitalisation in relation to stroke. As shown above, there appears to be quite a strong link between hospitalisation for ischaemic stroke and the corresponding incidence rate. However, we expect that there may be more of a discretionary element around the decision to admit patients with TIAs (a 'temporary' stroke event) to hospital. Therefore it is

likely that different approaches in relation to hospitalising TIA patients may reflect differing policies and incentives between countries.

277. 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 7.3 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) are also expected to have relatively high incidence of 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 estimated regression line.

278. 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. 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 UK, 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 IHD component of the ARD study.

Technology use

279. Compared to the other diseases studied as part of the ARD project, ischaemic stroke treatment relies less on high technology. However, technology use is still important in the diagnostic phase and, for a small subset of patients, the possibility of a surgical procedure exists.

280. Two relatively commonly used diagnostic tests for stroke patients are CT scans and the newer procedure MRI/MRA. While we know that the level of use of these procedures does vary between countries, precise data are not widely available through administrative data collections. However, in some cases data are available through administrative hospital data collections, and these have been included in this report. When interpreting these results, it is important to note that there are limitations on the precision of the data available for this study. In the ARD study, we have found that good data exist drawn from hospital data collections for major procedures such as coronary artery bypass grafts and surgery for breast cancer. This is not the case in all countries in relation to more minor procedures, including diagnostic tests such as CT scans and MRI/MRA.

281. The relationship between use of these diagnostic tests and the supply of the relevant machines is shown for younger male patients (40-64 years) in Figure 7.4. Note that the machines counted here are not specifically used for stroke patients, but are all CT scanners and MRI/MRA machines (separately). A relationship is suggested for stroke patients between the supply of CT machines and use of the procedure for these patients. However, the relationship does not hold for the case of MRI/MRA. A similar situation appears to exist for other age groups (data not shown). Again, while a general relationship is suggested, the data limitations expressed above require some caution in interpreting the importance of this relationship. Related to this issue, the IHD component of the ARD study found a relationship between the supply of resources and utilisation.

282. Carotid endarterectomy (CE) is a surgical procedure used for only a very small proportion of stroke patients. The measure of CE 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 between countries, thus resulting in differing levels of medical 'need' for the procedure. Therefore, it is surprising 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 (see Table A2.7). 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 medical 'need' or economic incentives. It could be that practice variation exists between countries, with physicians in some countries more likely than those in other countries to use surgical intervention.

7.2 Link between treatment variations, health outcomes and costs

283. In Section 7.1, treatment variations for stroke patients were discussed in the context of differing policy approaches. A vital aspect of the assessment of treatment variations is to examine whether these different treatment approaches appear to impact on health outcomes and costs. This study is neither a clinical study able to determine at the *individual level* the effectiveness of different treatments, nor are data available that enable a cost-effectiveness analysis. Nevertheless, there are a number of observations that can be made at the *population level* about the effect of treatment variations on costs and outcomes.

Health outcomes

284. Health outcomes are the change in health status which is at least partly attributable to an intervention(s). The focus of health outcomes for the stroke study is in relation to health system interventions. The most direct available measures of this are hospital and case fatality rates (see Chapter 5 for details). More broadly, stroke population mortality rates provide a larger perspective on health outcomes, reflecting to some extent both health system interventions and wider population health characteristics and interventions. Both of these two types of measures are discussed in more detail below.

285. In this study, we have collected information on **hospital fatality rates** and **case fatality rates** for 11 of the countries included in the study, though not all of these countries were able to supply information for both of these types of measures (see Box 5.1 for a summary). These fatality rates are expressed as the percentage of ischaemic stroke cases that died within certain time periods (7 days, 30 days, one year). These data are not available in a consistent manner for a substantial proportion of these countries for any of the four measures. This severely restricts the quantitative analysis that is possible with these data, particularly as a full panel of consistent treatment data is also not available. Nevertheless some general observations are made here.

286. Using the hospital and case fatality information for ischaemic stroke patients that were available for this study based on specified definitions, the 11 countries can be qualitatively grouped as follows:

Low fatality rates:	Denmark, Sweden, Switzerland, Japan[13]
Medium fatality rates:	Norway, Unites States, Australia, Canada, Italy, Spain
High fatality rates:	United Kingdom

287. Data were not available for the following countries:

Portugal, Hungary, Korea, Mexico, Netherlands[14], Greece.

[13] For a subset of tertiary-level hospitals only.

288. Note that this measure does account for differing incidence and prevalence rates, and therefore can be viewed as a general measure of effectiveness. Importantly however, these measures do not account for differences in the severity of stroke cases. Therefore, if the casemix for any country is more severe than in others, this is not controlled for in the results presented here.

289. A recent multi-centre study that examined stroke outcomes (mortality and disability) in 12 sites and 7 European countries reports results relevant to our discussion (Wolfe *et al.* 1998). The first aspect to note is that the ranking of health outcomes measures in Wolfe *et al.* match those found in the ARD study (for the overlapping countries). Further however, the study by Wolfe *et al.* was also able to adjust for casemix (severity) differences. It was found that there were significant differences in severity between centres, though it is not apparent whether this was due to differing hospital admission practices, or differences in the sub-types of stroke (as the study included ischaemic and haemorrhagic stroke, as well as subarachnoid haemorrhage). The study controlled for severity using a number of variables. From their analysis, the authors conclude that there are true differences in outcomes after controlling for severity, but that the aspects of care that need to be altered in order to realise the residual potential for health gain are not clear.

290. The second group of outcomes indicators discussed here are general **mortality rates** for ischaemic stroke. That is, the number of deaths per 100 000 population. By limiting the definition of the disease to ischaemic stroke, we have a fairly targeted measure of outcomes compared to if we had used the more general definition of all cerebrovascular disease. In comparison to the discussion above that focussed on hospital and case fatality, these data on ischaemic stroke mortality rates are more effected by factors outside direct health care. Most importantly, they are influenced by variations in underlying disease rates. In addition, they are also effected by health system influences not reflected in hospital and case fatality, such as emergency care prior to hospitalisation, and prevention policies for example.

291. While it is recognised that the influences on ischaemic stroke mortality rates are multi-faceted and complex, nevertheless a striking relationship with levels of smoking in the various populations is apparent (Figure 7.5).[15] The relationship is particularly strong using the lagged data; that is, population smoking levels in 1970. This pattern is also found for other diseases strongly linked to tobacco smoking, including lung cancer mortality rates (OECD 2001a). This strong relationship is again suggestive of the importance of a broad-based policy for stroke care, that includes a focus on prevention as well as the treatment phase.

292. The final issue in relation to health outcomes is their relationship to treatment 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 small amount of available data on stroke units. In addition, 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.

[14] Fatality measures are available in Evers *et al.* (2002). However, these results were not available in the same form as for other countries.

[15] Note that in a small number of cases, ischaemic stroke mortality have been estimated based on the corresponding mortality rates for all cerebrovascular disease.

Costs and outcomes

293. The amount different countries spend on health care is known to vary widely, whether an absolute or relative measure is used. As part of this study, we were able to collect some information related to health care expenditure, though not for all countries.

294. 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 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.

295. The critical relationship we wish to examine is between expenditure and health outcomes. Figure 7.6 displays this relationship using length of stay against 7-day and 30-day hospital fatality rates. From these graphs there appears to be a relationship, with increasing length of stay being associated with lower fatality rates. The UK is the very prominent exception, having much higher fatality rates given the level of expenditure proxied by length of stay. Even if the actual expenditure level in the UK were much lower than proxied by length of stay, the UK would still be 'above the line', indicating relatively high fatality rates per unit expenditure.

296. Note that the regression line has been estimated using all the data points, including the UK. Another data point that appears very influential to the estimation procedure is Japan, where very long length of stays were observed. To test the robustness of the regression line, both the UK and the Japanese data points were removed for the second estimation exercise. When this was undertaken, the relationship for the younger age groups remained, but it did not for the older age groups. In fact for the older age group, the second estimation resulted in increasing length of stays being associated with increasing fatality rates. This may reflect the influence of the general health of the older patients, with the impact of co-morbidities likely to have an impact. Thus, although a relationship is suggested between the use of resources and health outcomes for younger patients, confounding factors in these data make it difficult to assess the relationship between resource use and outcomes for older patients.

297. Another perspective on the relationship between costs and outcomes comes from a multi-country European study undertaken by Grieve *et al.* (2001). 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. This study used health outcome measures taking into account both the death and disability components of health outcomes. The main exception to the observed relationship was again in the UK. 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.

298. 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.

7.3 Implications for health system monitoring

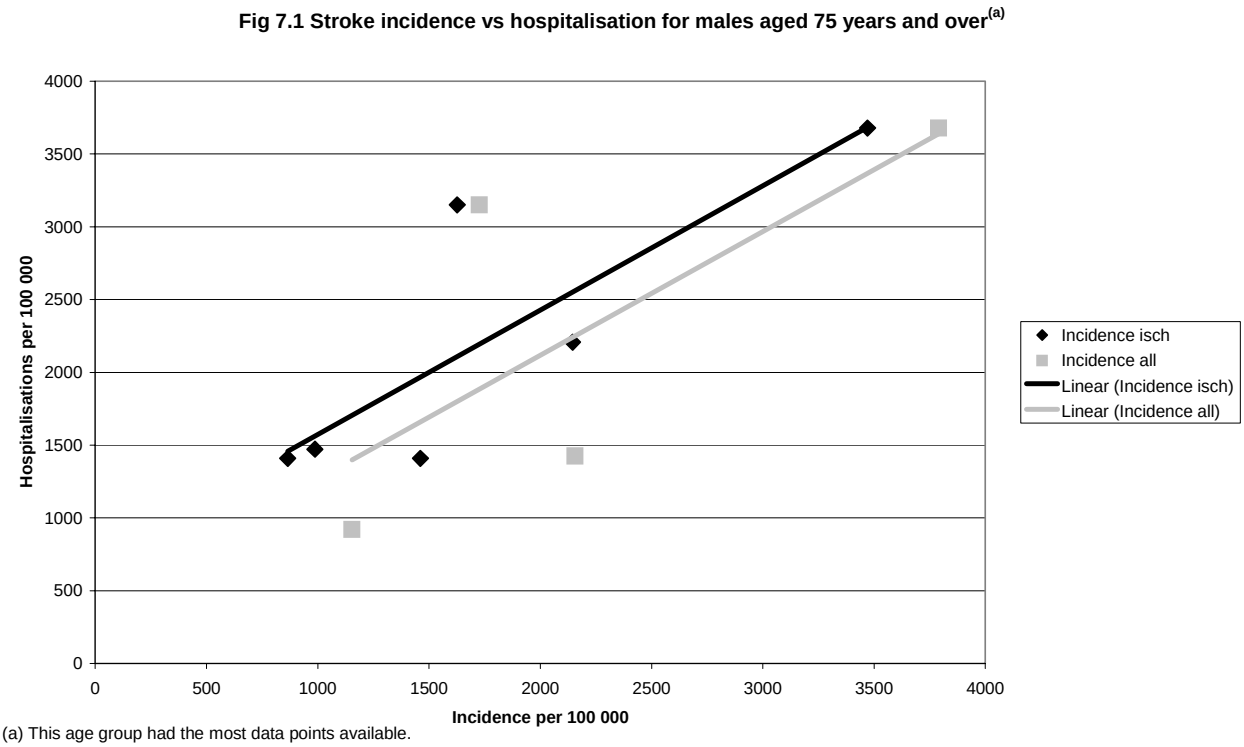
299. The quantitative component of this study has been built largely on the availability of routinely collected health information. The main types of data collections used have been hospital data collections, mortality data and some disease registers. Also very valuable were some periodic data collections in relation to health expenditures. Many of these data collections were particularly valuable because they enabled identification of the subset of stroke patients that were the primary focus of this study — those with ischaemic stroke.

300. There were two aspects of health data collections that distinguished the most valuable information from the adequate information. Firstly, data collections that were able to measure health outcomes (for this study hospital and case fatality rates) provided vital information on what health systems are getting for their money. Secondly, health data systems able to track patients over time provided higher quality information on both the treatment received (for example whether the patient received a CT scan during the treatment episode versus the number of CT scans given in hospital) and the resulting health outcome (for example one year case fatality rates).

301. In addition to the two desirable aspects of health data collections identified above, a further two notable areas for improvements were apparent during the course of undertaking this study. The first of these results from the lack of disability information as a health outcome measure. The mortality information available was quite extensive. However, particularly for a disease such as stroke where the disability burden is high, better disability information would greatly enhance the current health information.

302. The final issue highlighted through this study is that there is still room for improvement in the information available on the different treatments provided to stroke patients. The accuracy of recording the diagnostic test in hospitals varied greatly between countries for example. In addition, very little information was available on the important issue of the organisation of care, notable in relation to stroke units.

Figure 7.1



(a) This age group had the most data points available.

Figure 7.2

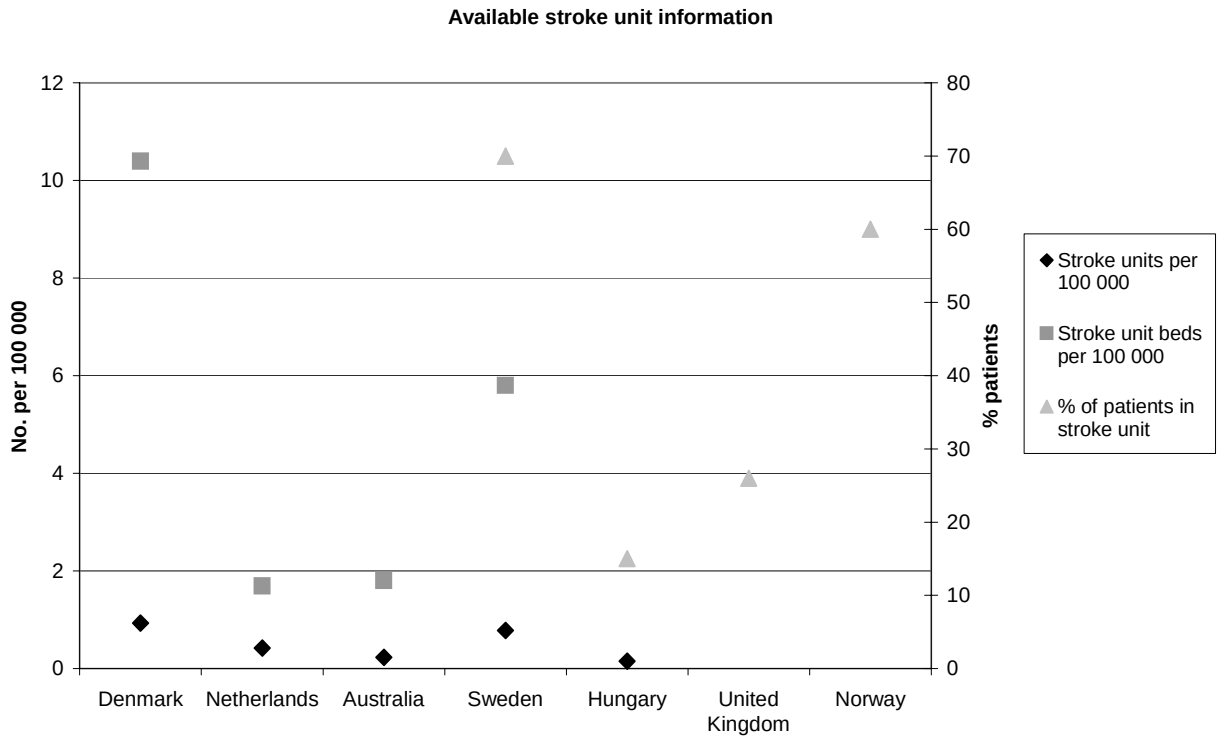
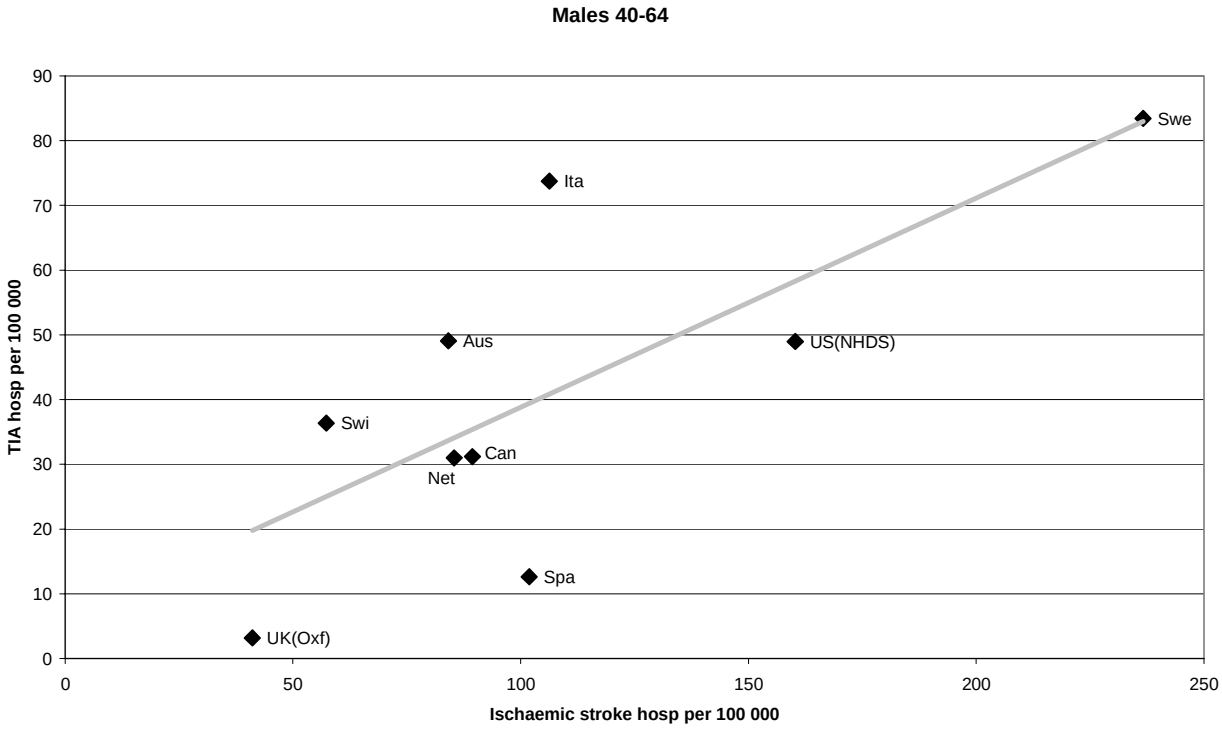


Figure 7.3 Hospitalisations for ischaemic stroke and TIA



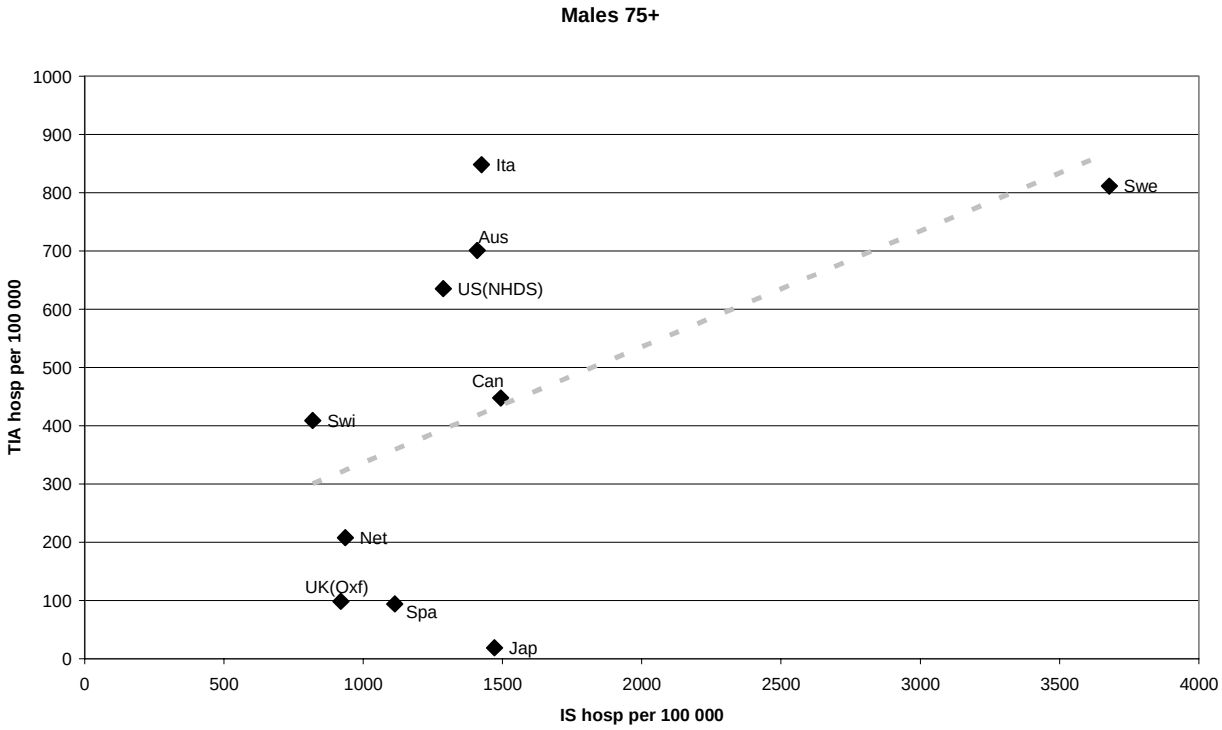


Figure 7.4 Use of diagnostic tests and supply of machines, males aged 40-64 years

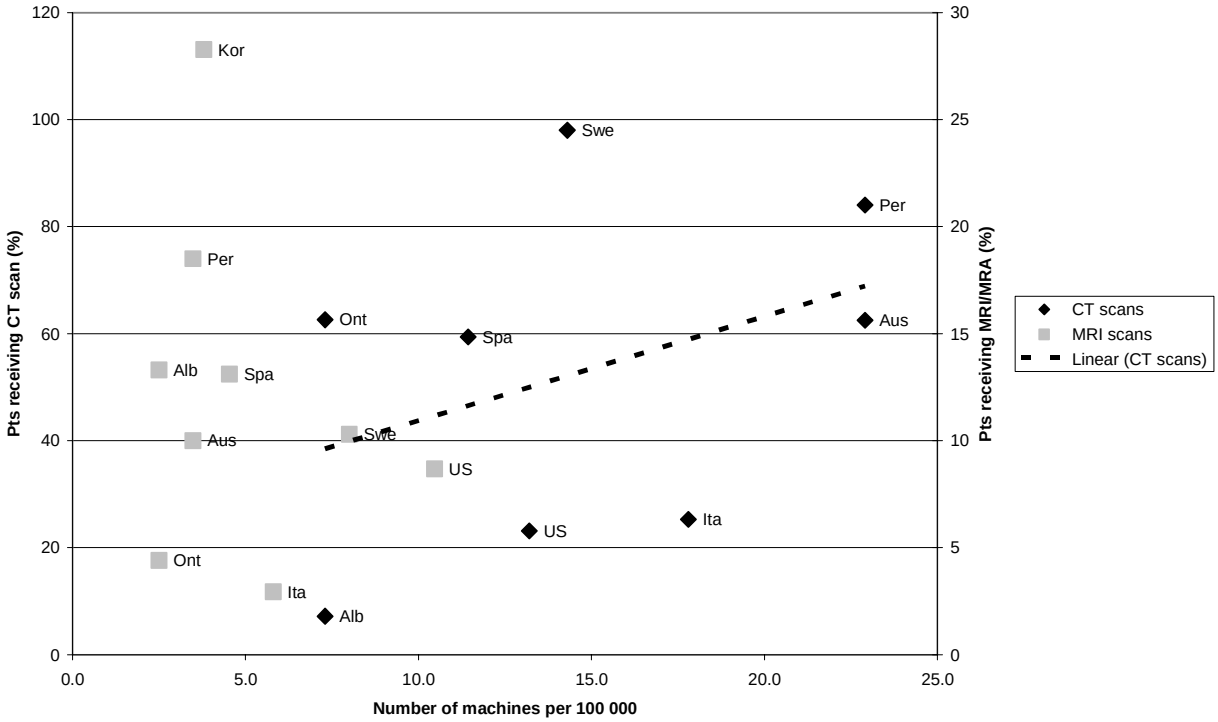
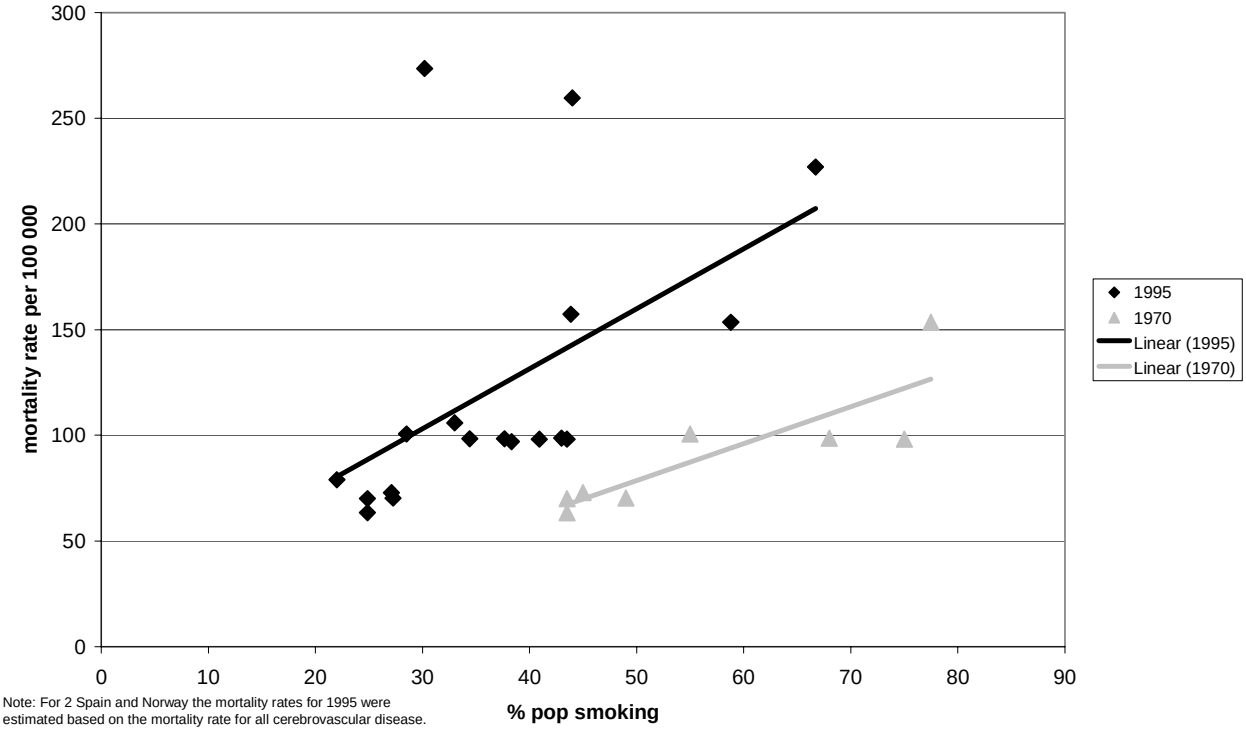
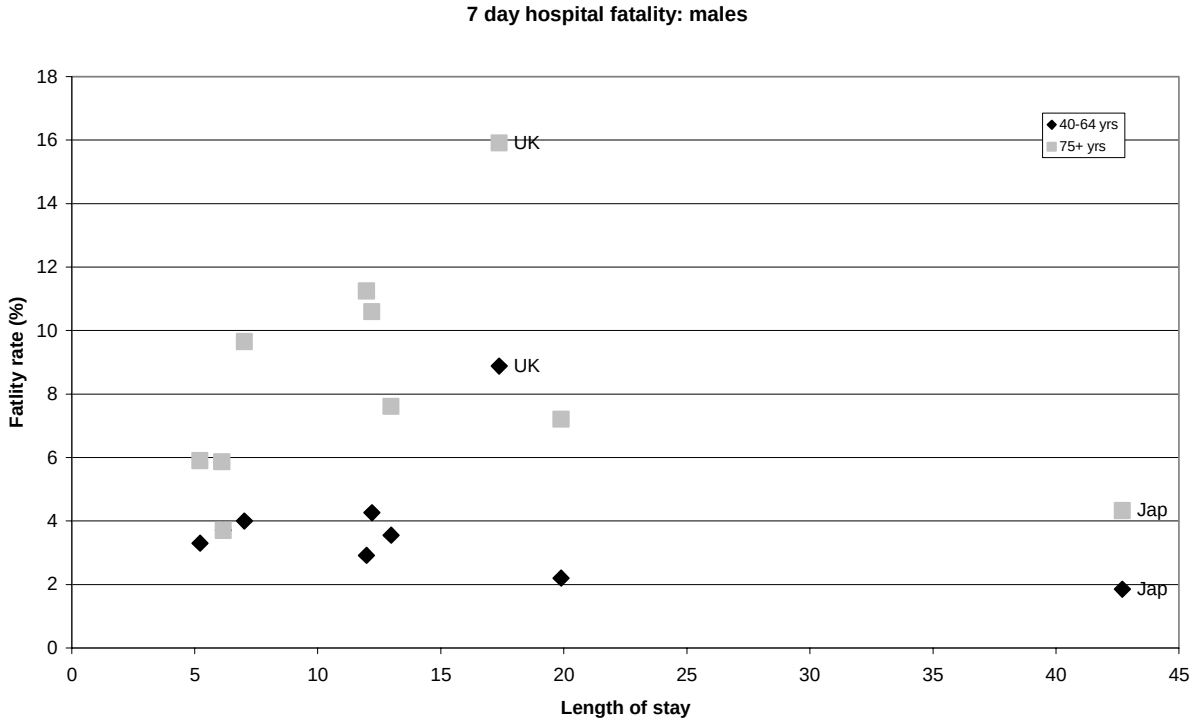


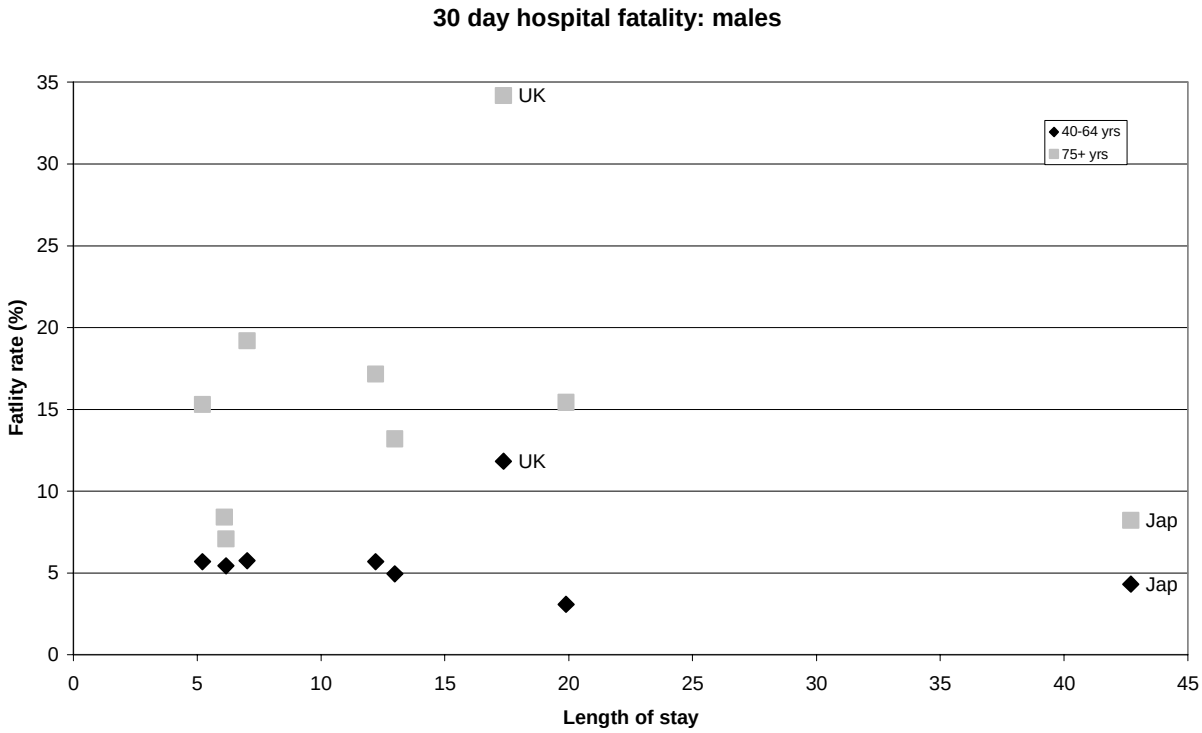
Figure 7.5 Ischaemic stroke mortality to pop smoking levels: males



Note: For 2 Spain and Norway the mortality rates for 1995 were estimated based on the mortality rate for all cerebrovascular disease.

Figure 7.6 Length of stay to 7- and 30-day hospital fatality: males





REFERENCES

ADAMS, H (1991)
"Investigation of the patient with ischemic stroke", *Cerebrovascular disease*; Vol. 1 Suppl. 1: pp. 54-60.

ADAMS, H *et al.* (1994)
"Guidelines for the management of patients with acute ischemic stroke". *Stroke*, Vol. 25: pp. 1901-1914.

ALBERTS, M.J., *et. al*.(1996)
"Hospital charges for stroke patients", *Stroke*, Vol. 27 (10), pp. 1825-8.

ANDERSON CS., *et al.* (1993)
"Ascertaining the true incidence of stroke: experience from the Perth Community Stroke Study, 1989-1990". *Med J Aust*, Vol. 158, pp. 80-84.

ANDERSON *et al.* (2000)
"Home or hospital for stroke rehabilitation? Results of a randomized controlled trial", *Stroke*, 31:1024-1031.

ANDERSON NE, BONITA R, BROAD JB. (1997)
"Early management and outcome of acute stroke in Auckland." *Aust N Z J Med*, Oct;27(5), PP. 561-7

ANTIPLATELET TRIALISTS'COLLABORATION (1994)
"Collaborative overview of randomised trials of Antiplatelet therapy Prevention of death, myocardial infarction, and stroke by prolonged antiplatelet therapy in various categories of patients" *British Medical Journal*, Vol. 308, pp. 81-106.

ASPLUND, K *et al.* (1995)
"Multinational Comparisons of Stroke Epidemiology", *Stroke*, Vol. 26, pp. 355-360.

AUSTRALIAN INSTITUTE OF HEALTH AND WELFARE (AIHW) 2001a.
Heart, stroke and vascular diseases – Australian facts 2001. AIHW Cat. No. CVD 13. AIHW: Canberra.

AUSTRALIAN INSTITUTE OF HEALTH AND WELFARE (AIHW) 2001b.
National Health Data Dictionary Version 10. AIHW Cat. No. HWI 30. AIHW, National Heart Foundation of Australia, National Stroke Foundation of Australia: Canberra.

BARER ML, STODDART GL (1991)
"Toward Integrated Medical Resource Policies for Canada", Report prepared for the federal/provincial and territorial conference of deputy ministers of health, June.

BATH *et al.* (2000)
"Acute stroke". British Medical Journal; 320:920-923.

BEECH R, RATCLIFFE M, TILLING K & WOLFE C (1996)
"Hospital services for stroke care: a European perspective". *Stroke*, Vol. 27, pp. 1958-1964.

BERGMAN, L. (1995)
"Costs of medical care after first-ever stroke in The Netherlands", *Stroke*, Vol. 26 (10), pp.1830-6.

BHALLA A, DUNDAS R, RUDD AG, WOLFE CD. (2001)
"Does admission to hospital improve the outcome for stroke patients?:, *Age Ageing*, 30(3), pp. 197-203

BONITA, R. (1992)
"Epidemiology of Stroke", *Lancet*, Vol. 339, pp. 342-344.

BONITA, R. *et al.* (1990)
"International trends in stroke mortality: 1970-1985", *Stroke*, Vol. 21, pp. 989-992.

BONITA, R. *et al.* (1992)
"Changes in stroke incidence and mortality: the Framingham study" *Stroke*, Vol. 23, pp.1551-1555.

BONITA, R. *et al.* (1992)
"Monitoring stroke: An international challenge" *Stroke*, Vol. 26, pp. 541-2.

BONITA, R., *et al.* (1993)
"Changes in stroke incidence and case-fatality in Auckland, New Zealand, 1981-91" *Lancet*, Vol. 342, pp. 1470-1473.

BONITA, R. AND R. BEAGLEHOLE (1993)
"Explaining stroke mortality trends", *Lancet*, Vol. 341, pp. 1510-1511.

BROWN, R., *et al.* (1999)
"Use of nursing home after stroke and dependence on stroke severity", *Stroke*, 30:924-929.

CANTO JG, *et al.* (2000)
"Payer status and the utilization of hospital resources in acute myocardial infarction: a report from the National Registry of Myocardial Infarction 2", *Archives of Internal Medicine*, Mar., 27 160(6): 817-823.

COCHRANE REVIEW. 2002
Organised inpatient (stroke unit) care for stroke (Cochrane Review). Cochrane Database Syst Rev. 2002;:CD000197.

COLLINS, R *ET AL*. (1990)
"Blood pressure, stroke, and coronary heart disease: short term reductions in blood pressure : overview of randomised drug trials in their epidemiological context", *Lancet*, Vol. 335, pp. 827-838.

DICKSON M AND JACOBZONE S (IN PRESS)
Pharmaceutical use and expenditure for cardiovascular disease and stoke: a study of 12 OECD countries. OECD: Paris.

DONNAN, GA (1992)
Investigations of patients with stroke and transient ischemic attacks. *Lancet*; Vol. 339, pp. 473-477.

DONNAN, GA *ET AL*. (1993)
"Smoking as a risk factor for stroke", *Cerebrovascular Disease*; Vol. 3, pp.129-138.

DU X, SOURBUTTS J, CRUICKSHANK K, SUMMERS A, ROBERTS N, WALTON E, HOLMES S. (1997)
"A community based stroke register in a high risk area for stroke in north west England.", *J Epidemiol Community Health*, Oct;51(5), PP. 472-8

ELLEKJAER H, HOLMEN J, KRUGER O, TERENT A. (1999)
"Identification of incident stroke in Norway: hospital discharge data compared with a population-based stroke register" *Stroke*, Vol. 30(1), pp. 56-60.

EUROPEAN CAROTID SURGERY TRIALISTS COLLABORATIVE GROUP (1991)
"MRC European Carotid Surgery Trial: Interim Results for Symptomatic Patients with severe or with mild carotid stenosis" *Lancet*, Vol. 337, pp. 1235-1243.

EVERS, S., G. ENGEL AND A. AMENT (1997),
"Cost of stroke in the Netherlands from a societal perspective", *Stroke*, Vol. 28, pp. 1375-81.

EVERS, S., A. AMENT AND G. BLAAUW (2000),
"Economic evaluation in stroke research: a systematic review", *Stroke*, Vol. 31, pp. 1046-1053.

EVERS, S., M. GOOSSENS, A. AMENT AND J. MAARSE (2001),
"Economic evaluation in stroke research: an introduction", *Cerebrovasc dis*, Vol. 11:2, pp. 82-91.

EVERS S, STRUIJS J, AMENT A, VAN GENUGTEN M, JAGER J AND VAN DEN BOST G (2002)
The disease impact, health care management, and costs of stroke in the of Netherlands. Country report to the OECD Ageing-Related Diseases study on stroke treatment, costs and outcomes.

EXECUTIVE COMMITTEE OF ASYMPTOMATIC CAROTID ATHEROSCLEROSIS STUDY (1995)
"Endarterectomy for asymptoimatic carotid artery stensosis", *JAMA*; Vol. 273: pp. 1421-8.

FEINBERG, WM *et al.* (1994)
"Guidelines for the management of transient ischemic attacks", *Stroke*, Vol. 25, pp. 1320.

FEINLEIB, M *et al.* (1993)
"Time trends, cohort effects, and geographic patterns in stroke mortality: the United States", *Ann Epidemiol*, Vol. 3, pp. 458-465.

GILMAN, B.H. (1999)
"Measuring Hospital Cost-Sharing Incentives under Refined Prospective Payment", *Journal of Economics and Management Strategy*, 8:3, pp. 433-452.

GRIEVE, R., V. PORSDAL, J. HUTTON AND C. WOLFE (2000),
"A comparison of the cost-effectiveness of stroke care provided in London and Copenhagen", *Int J Technol Assess*, Vol. 16:2, pp. 684-95.

GRIEVE, R. *ET AL*. (2001),
"A comparison of the costs and survival of hospital-admitted stroke patients across Europe", *Stroke*, Vol. 32:7, pp. 1684-91.

GRIEVE, R., R. DUNDAS, R. BEECH AND C. WOLFE (2001),
"The development and use of a method to compare the costs of acute stroke across Europe", *Age and Ageing*, Vol. 30, pp. 67-72.

GUSTAFSSON, C., *et. al.* (1992)
"Cost effectiveness of primary stroke prevention in arterial fibrillation: Swedish national perspective", *British Medical Journal*, Vol. 305 (6867), pp. 1457-60.

HADLEY J, *et al.* (1991)
"Comparison Of Uninsured And Privately Insured Hospital Patients. Condition On Admission, Resource Use, And Outcome", *Journal of the American Medical Association*, 265(3): 374-379.

HART C, HOLE D & DAVEY-SMITH G (2000)
"Influence of socioeconomic circumstances in early and later life on stroke risk among men in a Scottish cohort study", *Stroke*, Vol. 31(9), pp. 2093-…

HASKELL WL *et al.* (1992)
"Cardiovascular benefits and assessment of physical activity and physical fitness in adults", *Med Sci Sports Exerc*, Vol. 24(6 Suppl), pp. S201-S220.

HODGSON, T. AND A. COHEN (1999),
"Medical care expenditures for selected circulatory diseases", *Medical Care*, Vol. 37:10, pp. 994-1012.

HURST, J (2002)
"Performance measurement and improvement in OECD health systems: overview of issues and challenges", in *Measuring up: improving health system performance in OECD countries*, OECD: Paris.

INDREDAVIK, B., F. BAKKE, S. SLORDAHL, R. ROKSETH AND L. HAHEIM (1999),
"Treatment in a combined acute and rehabilitation stroke unit: which aspects are most important?", *Stroke*, Vol. 30, pp. 917-923.

INDREDAVIK, B., *et al.* (1997),
"Stroke unit treatment: long-term effects", *Stroke*, Vol. 28, pp. 1861-1866.

INSTITUTE OF MEDICINE (2001)
Coverage Matters: Insurance and Health Care, Institute of Medicine, Washington, D.C., USA.

INSTITUTE OF MEDICINE (2002)
Care without coverage: too little too late, Institute of Medicine, Washington, D.C., USA.

JEE-HUGES, M. AND S. JACOBZONE (2002),
Cross-national differences in the treatment, costs and outcomes of breast cancer, OECD Health Occasional Papers, Paris.

JØRGENSEN H; KAMMERSGAARD L, NAKAYAMA H *et al.* (1999)
"Treatment and rehabilitation on a stroke unit improves 5-year survival", *Stroke*, Vol. 30, pp. 930-933.

JORGENSEN, H. *et al.* (2000),
"Who benefits from treatment and rehabilitation in a stroke unit?", *Stroke*, Vol. 31, pp. 434-439.

JORGENSEN, H., H. NAKAYAMA, H. RAASCHOU, K. LARSEN, P. HUBBE, T. OLSEN (1995),
"The effect of a stroke unit: reductions in mortality, discharge rate to nursing home, length of hospital stay, and cost", *Stroke*, Vol. 26, pp. 1178-1182.

JORGENSEN, H., J NAKAYAMA, H. RAASCHOU AND T. OLSEN (1997),
"Acute stroke care and rehabilitation: an analysis of the direct cost and its clinical and social determinants", *Stroke*, Vol. 28, pp. 1138-1141.

JUEL K. (2000)
"Increased mortality among Danish women: population based register study." BMJ. Aug 5;321(7257):349-50.

KODAMA, K (1993)
"Stroke trends in Japan", *Ann Epidemiol*, Vol. 3, pp.524-528.

KUNST A, DEL RIOS M, GROENHOF F *et al.* (1998)
"Socioeconomic inequalities in stroke mortality among middle-aged men: and international overview", *Stroke*, Vol. 29, pp. 2285-2291.

LANGHORNE, P AND P. DUNCAN. (2001)
"Does the organization of postacute stroke care really matter?", *Stroke*, 32(1): 268-74.

LANGHORN, P., *et al.* (1993)
"Do stroke units save lives?", *Lancet*, Vol. 342, pp. 395-398.

LARRE B., BONTURI M. (2001)
Public Spending in Mexico: How to Enhance Its Effectiveness, OECD Economics Department Working Paper No. 14, ECO/WKP(2001)14.

LIGHTWOOD JM, GLANTZ SA. (1997)
"Short-term economic and health benefits of smoking cessation: myocardial infarction and stroke." *Circulation*. 1997 Aug 19;96(4):1089-96.

MAHESWARAN R, ELLIOTT P & STRACHAN D (1997)
"Socioeconomic deprivation, ethnicity, and stroke mortality in Greater London and south east England", *Journal of Epidemiology and Community Health*, Vol. 51(2), pp. 127- .

MAKOMASKI-ILLING EM, KAISERMAN MJ (1999)
"Mortality Attributable to Tobacco Use in Canada and its Regions, 1994 and 1996", *Chronic Dis Can*; 20(3), pp. 111-117

MATHERS, C. AND R. PENM (1999),
Health system costs of cardiovascular disease and diabetes in Australia 1993-94, AIHW, Canberra.

MATHERS C, VOS T, STEVENSON C (1999)
The burden of disease and injury in Australia. AIHW cat. no. PHE 17. Canberra: AIHW.

MAYBERG MR *et al.* (1991)
"Carotid endarterectomy and prevention of cerebral ischemia in symptomatic carotid stenosis", *JAMA*, Vol. 266, pp. 3289-94.

MCGOVERN, PG. *et al. (*1992)
"Trends in mortality, morbidity, and risk factor levels for stroke from 1960-1990: the Minnesota Heart Survey", *JAMA*, Vol. 268, pp. 753-759.

MCGOVERN, PG. *et al.* (1993)
"The role of stroke attack rate and case fatality in the decline of stroke mortality: the Minnesota Heart Survey", *Ann Epidemiology*, Vol. 3, pp. 483- 487.

MCKINSEY HEALTH CARE PRACTICE (1996),
Health care productivity, McKinsey Global Institute, Los Angles.

MCCLELLAN M. (1997)
"Hospital Reimbursement Incentives: An Empirical Analysis", *Journal of Economics and Management Strategy*, 6:1, PP. 91-128.

MACMAHON, S. *ET AL.* (1994)
"Blood pressure, anti-hypertensive treatment and stroke risk", *Journal of Hypertension*, Vol. 12 (suppl.10), pp.S5-14.

MOISE, P. AND S. JACOBZONE (2002)
OECD study of cross-national differences in the treatment, costs and outcomes of ischaemic heart disease, OECD Health Occasional Papers, Paris.

MOORE, R., Y. MAO, J. ZHANG AND K. CLARKE (1997),
Economic burden of illness in Canada, 1993, Health Canada, Ottawa.

MORIKAWA *et al.* (2000)
"Trends in stroke incidence and acute case fatality in a Japanese rural area", *Stroke*, 31:1583-8.

THE NATIONAL INSTITUTE OF NEUROLOGICAL DISORDERS AND STROKE RTPA STROKE STUDY GROUP (1995)
"Tissue plasminogen activator for acute ischemic stroke", *New England Journal of Medicine*, Vol. 333, pp. 1581-1587.

THE NORTH AMERICAN SYMPTOMATIC CAROTID ENDARTERECTOMY TRIAL COLLABORATORS (1991)
"Beneficial effect of carotid endarterectomy in symptomatic patients with high-grade carotid stensosis", *New England Journal of Medicine*; vol. 325, pp. 445-453.

TUOMILEHTO J, BONITA R, STEWART A, NISSINEN A, SALONEN JT. (1991)
"Hypertension, cigarette smoking, and the decline in stroke incidence in eastern Finland", *Stroke*. Jan;22(1), pp. 7-11

OECD (1999),
A caring world: The new social policy agenda, OECD, Paris.

OECD (2001a)
Health at a Glance. OECD: Paris.

OECD (2001)
OECD Health Data 2001, Paris.

OSTER, G., *et.al*. (1994)
"Cost-effectiveness of ticlopidine in preventing stroke in high-risk patients", *Stroke*, Vol. 25 (6), pp. 1149-56.

PAYNE, N. AND C. SAUL (1997)
"Variations in use of cardiology services in health authority: Comparison of coronary artery revascularisation rates with prevalence of angina and coronary mortality", *British Medical Journal*, Vol. 314, pp. 257-261.

PERRY JR, *et al.* (1997)
"Consensus against both carotid endarectomy and routine screening for asymptomatic carotid artery stenosis", *Archives of Neurology*; Vol. 54, pp.25-28.

PORSDAL, V. AND G. BOYSEN (1999),
"Costs of health care and social services during the first year after ischaemic stroke", *Int J Technol Assess Health Care*, Vol. 15:3, pp. 573-84.

RUDD A, GOLDACRE M, AMESS M *et al.* (1999)
Health outcome indicators: stroke. Report of a working group to the Department of Health. National Centre for Health Outcomes Development: Oxford.

SADA MJ, *et al.* (1998)
"Influence of Payor on Use of Invasive Cardiac Procedures and Patient Outcome after Myocardial Infarction in The United States. Participants in the National Registry of Myocardial Infarction", *Journal of the American College of Cardiology*, June;31(7):1474-80.

SARTI C, RASTENYTE D, CEPAITIS Z AND TUOMILEDHTO J (2000)
"International trends in mortality from stroke, 1968 to 1994", *Stroke*, Vol. 31(7), pp. 1588- .

SHINTON R *et al.* (1989)
"Meta analysis of relation between cigarette smoking and stroke", *Br Med J*; Vol. 298, pp. 789-94.

SLADE E.P., ANDERSON G.F. (2001)
"The relationship between per capita income and diffusion of medical technologies," *Health Policy*, Oct. 1;58:1-14.

SMURAWSKA, L.T., *et. al*. (1994)
"Cost of acute stroke care in Toronto, Canada", *Stroke*, Vol. 25 (8), pp. 1628-31.

STEGMAYR, B *et al.* (1994)
"Trends in incidence, case-fatality and severity of stroke in northern Sweden, 1985-1991", *Stroke*, Vol. 25, pp. 1738-1745.

STEGMAYR B, ASPLUND K, KUULASMAA K *ET AL.* (1997)
"Stroke incidence and mortality correlated to stroke risk factors in the WHO MONICA project", *Stroke*, Vol. 28(7), pp. 1367-1374.

STROKE UNIT TRIALISTS' COLLABORATION (1997a),
"Collaborative systematic review of the randomised trials of organised inpatient (stroke unit) care after stroke", *BMJ*, Vol. 314, pp. 1151-59.

STROKE UNIT TRIALISTS' COLLABORATION (1997b),
"How do stroke units improve patients outcomes?", *Stroke*, Vol. 28, pp.2139-2144.

TAYLOR, T.N., ET. AL. (1996)
"Lifetime cost of stroke in the United States", *Stroke*, Vol. 27 (9), pp. 1459-66.

TERENT, A., *et al.* (1994)
"Costs of stroke in Sweden. A national perspective", *Stroke*, Vol. 25 (12), pp. 2363-9.

THOM JT (1993)
"Stroke mortality trends: an international perspective", *Ann Epidemiol*, Vol. 3, pp. 509-518.

THORVALDSEN, P. *et al.* (1997)
"Stroke trends in the WHO Monica Project" *Stroke*, Vol. 28, pp. 500-506.

THORVALDSEN P. *et al.* (1995)
"Stroke incidence, Case Fatality and Mortality in the WHO Monica Project", *Stroke*, Vol. 26, pp. 361-367.

TU J, HANNAN E, ANDERSON *et al.* (1998)
"The fall and rise of carotid endarterectomy in the United States and Canada", *New England Journal of Medicine*, Vol. 339(20), pp. 1441-7.

TUOMILEHTO, J *et al.* (1993)
"Trends in stroke mortality and incidence in Finland in the 1970s and 1980s", *Ann Epidemiol*, Vol. 3, pp. 519-523.

VAN ROSSUM C, VAN DE MHEEM H, BRETELER M *et al.* (1998)
"Socioeconomic differences in stroke among Dutch elderly women", *Stroke*, Vol. 30, pp. 357-362.

VAN STRATEN A, VAN DER MEULEN JH, VAN DEN BOS GA, LIMBURG M. (1997)
"Length of hospital stay and discharge delays in stroke patients". *Stroke*;28, pp.137-40.

WANNAMETHEE G *et al.* (1992)
"Physical activity and stroke in British Middle aged men", *Br Med J*, Vol. 304, pp. 597-601.

WENNEKER MB, *et al.* (1990)
"The Association of Payer With Utilization of Cardiac Procedures in Massachusetts", *Journal of the American Medical Association*, 264(10): 1255-1260.

WORLD HEALTH ORGANISATION (WHO) (1978)
Cerebrovascular disease: a clinical and research classification. WHO Offset Publication No. 43.

WORLD HEALTH ORGANISATION (WHO) (1994),
Cardiovascular Disease Risk Factors. New Areas for Research, Report of a WHO Scientific Group, Geneva.

WORLD HEALTH ORGANISATION (WHO) (1999)
World statistics annual (online version). WHO: Geneva.

WORLD HEALTH ORGANISATION (WHO) (2000)
World health report 2000. WHO: Geneva.

WORLD HEALTH ORGANISATION (WHO) EUROPE (2000)
Health Care Systems in Transition: Switzerland 2000, European Observatory on Health Care Systems, WHO Regional Office for Europe.

WORLD HEALTH ORGANISATION (WHO) MONICA PROJECT (1996)
"Multinational Comparison of Diagnostic Procedures and Management of Acute Stroke : the WHO Monica Study", *Cerebrovascular Disease*; Vol. 6 : pp. 66-74.

WILSON, *et al*. (2001)
"Creating a Canadian stroke system", *CMAJ*, 164(13): 1853-1855.

WINSLOW, CM *et al.* (1988)
"The appropriateness of carotid endarterectomy". *New Eng J Med*, Vol. 318, pp. 721-7.

WOLF, P.A., *et. al*. (1992)
"Secular trends in stroke incidence and mortality: the Framingham Study", *Stroke*, Vol. 23, pp. 1551-1555.

WOLFE CD, TAUB NA, WOODROW J, RICHARDSON E, WARBURTON FG, BURNEY PG. (1993)
"Patterns of acute stroke care in three districts of southern England.:, *J Epidemiol Community Health*, Apr;47(2), pp. 144-8

WOLFE C, TILLING K, BEECH R *et al.* (1999)
"Variations in case fatality and dependency from stroke in Western and Central Europe", *Stroke*, Vol. 30, pp. 350-356.

WOLFE, C. (2001)
"Taking acute stroke care seriously", *BMJ*, 323: 5-6.

ZETHRAEUS, N., T. MOLIN, P. HENRIKSSON AND B. JONSSON (1999),
"Costs of coronary heart disease and stroke: the case of Sweden", *J Intern Med*, Vol. 246:2, pp. 151-159.

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