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**Measurement of Health Output – experiences from the Norwegian  
National Accounts**

Ann Lisbet Brathaug  
Statistics Norway

For additional information, please contact :

Author name(s) : Ann Lisbet Brathaug  
Author adress(es) : Statistics Norway,P.O.B. 8131 Dep, N-0033 Oslo, Norway  
Author E-mail(s) : ann.lisbet.brathaug@ssb.no  
Author fax(es) : (+47) 2109 4996  
Author telephone(s) : (+47) 2109 5258/ (+47) 4500 4959

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# 1. Introduction

In 2001, Eurostat issued a *Handbook in price and volume measures in national accounts* (Eurostat 2001). This handbook came about following a programme that started in 1997 where a Task Force "Volume Measures" showed that at that time the comparability of price and volume data in the EU could be improved. It concluded that differences in choice made by different countries could lead to significant differences in growth rates.

At a meeting of the Working Party on National Accounts in February 1999 it was agreed that there should be a follow-up to the report on non-market services. Regarding health services two types of work should be undertaken. Firstly, all member states should describe and assess the available statistical sources. In particular, they should investigate information derived from hospital administration, social security and insurance records. Secondly, an expert group was set up to continue the methodological work on volume measures for health.

The aim of the expert group (called Task Force II) was to systematically present the recommendations existing so far, to develop further the ideas discussed by the first Task Force, to make proposals for parts of health services that have not yet been covered, and to exchange more recent experience on specific issues. Also information on best practices outside the EU was investigated (Report from the Task Force II, November 2000).

This paper will describe the basic concepts on price and output measurement of health services as it is recommended in Eurostat's Handbook and discuss how the new methods are implemented in the Norwegian National Accounts. It must be underlined that the methods applied in Norway still need to be improved. Especially, the quality dimension of the volume measurement needs more investigation. Certainly, this is a field that will be dependent on the liaison and co-operation between health statisticians, national accountants and health administration.

## 2. Basic concepts

In general, price and volume measurements of all goods and services relate to the decomposition of transaction values in current prices into their price and volume components. In principle, the price components should include changes arising solely from price changes, while all other changes (relating to quantity, quality and compositional changes) should be included in the volume components (Eurostat 2001, chapter 1.2). Normally, one will want to analyse which changes in the aggregates are due to price movements, and which to volume changes. This is referred to as *constant price* measurements, implying the analysis of economic transactions valued at certain fixed prices.

### 2.1 The distinction between price, volume, quantity and quality

The nature of estimates of constant prices is different from that of current prices. Current price estimates can be considered as the aggregation, within an accounting framework, of the transactions that took place and can be evidenced. However, constant price estimates describe an economic situation of a particular year in the prices of another year.

The price of a product is defined as the value of one unit of that product. The price will vary with the size and the unit of the quantity selected. For a single homogeneous product, the value of a transaction ( $v$ ) is equal to the price per unit of quantity ( $p$ ) multiplied by the number of units of quantity ( $q$ ), that is:

$$v = p \times q$$

Since the quantities of different products cannot be aggregated without a weighting mechanism, the term volume is used instead. Price and volume measures have to be constructed for each aggregate of transaction in products within the accounts so that:

Value index = price index x volume index

This means that the change in the value of a given flow must be attributed either to a price change or to a change in volume or to a combination of the two. Changes in quality over time need to be recorded as changes in volume and not as changes in prices. Compositional changes in a transaction flow, resulting from a shift from or to higher quality products, need also to be recorded as changes in volume.

The production of *individual and collective* health services covers both market output and non-market output:

- Market output is sold at market prices. Hence, it is valued at current market prices.
- Non-market output is not sold at a market price. By convention, its value at current prices is the sum of its production costs.

## 2.2 Definition of health output

Health output can be defined as: "*The health output is the quantity of health care received by patients, adjusted to allow for the qualities of services provided, for each type of health care. The quantities should be weighted together using data on the costs or prices of the health care provided. The quantity of health care received by patients should be measured in terms of complete treatments*" (Eurostat 2001).

Two elements of this definition are considered particularly important; adjustment for quality and the notion of complete treatment.

Regarding complete treatments, this requires account to be taken of the whole bundle of complementary services constituting a treatment: medical services, paramedical services, laboratory etc. Implementing the complete treatment framework is in itself rather complicated. For instance, one question is how to take into account shifts among providers. In practice, the feasibility of measuring complete treatments is dependent on the degree of fragmentation of the services making up a treatment.

Due to the data availability - at least in Norway - a practical compromise from our side is to use a narrow concept of treatments, which aims at capturing full treatments only within each of the services distinguished. This means that if a treatment starts in a hospital, but is finished for instance in a rehabilitation institution, we will not be able to capture the complete treatment. Only the treatment within each of the institutions is observable.

An aspect of the complete treatment issue, which continues to be relevant, is the readmission problem in the case of hospitals or the first visit problem in the case of medical and dental practice services. If a patient has to go back to hospital because of the same illness this means that the original treatment has not yet been completed. A second treatment for the same person is only recorded if the patient is sent back to hospital to be treated for a different disease. A kind of readmission problem also exists for medical and dental practices. A patient who is treated by a specialist for a specific disease will often need several consultations. Ideally, all visits (first + continuation visits) related to the same diagnosis should be counted as one treatment. In Norway, data regarding readmissions into hospitals will be available, while we have data limitations regarding first visits to specialists, general practitioners and dentists. However, the large majority of services provided by dentists and physicians are market services, and output at constant prices can be derived from deflating with sub categories indices of the

consumer price index (CPI). It must be underlined that using the CPI does not solve our principal problem on how quality changes should be included in the implicit output measure, see comments in chapter 3.

## 2.3 Estimating health output at constant prices

There is a duality in the measurement of prices and volumes. One can either deflate a current year value with a price index, or alternatively extrapolate a base year value with a volume index to arrive at an estimate in prices of the base year. Therefore, only one of the two possible measures is required. In the case of health services in Norway, most hospital services and long term nursing care is non-market and by definition no market prices exists or the prices are not economically significant. Without prices on output, there are only two options for constant price measurement; i.e. direct volume measurements (output indicator methods) or deflating inputs (input methods). An input method implies that the change in the volume of inputs is representative for the change in the volume of output. According to Eurostat's Handbook input methods should be avoided. When input methods have to be used, as in the case for collective health services, they should estimate the volume of each input separately, taking quality changes of the inputs into account (Eurostat 2001, chapter 3.1.2.3).

An important criterion is that the constant price estimate of market output and non-market output should be consistent. This means that an output price or output indicator method should be used for market output and a unit cost or output indicator method should be used for non-market output. It must be underlined that consistency does not require the methods to be the same providing the definitions of output is the same. However, consistency is lost when an output method is used for market output and an input method is used for non-market output.

## 3. Quality adjustments

As stated in the definition of health output, the quantity of health care should be adjusted for quality changes. Permanent technical improvements and health research advances make the quality changes in health services an important issue. Quality changes should cover both changes in physical characteristics of products and changes in the product mix. Partial quality changes related to product mix are normally captured by a sufficiently detailed product classification. Eurostat's *Handbook in price and volume measures in national accounts* underlines that when output indicators are used, these should be as detailed and homogenous as possible, especially with regards to their unit costs. This will ensure that structural changes within the aggregate will be included in the volume estimate (Eurostat 2001, chapter 3.1.2.2). In addition three approaches to adjust for quality are mentioned:

1. *Direct measurement of the quality of the output itself.* This method is problematic, as it requires special patient experiences surveys where the information will be subjective and probably biased over time.
2. *Measuring the quality of the inputs.* This will imply that quality changes of the inputs automatically leads to quality improvements of the output. But is this the case?
3. *Using outcomes.* The reasoning behind this is that the quality of the output lies in its results, i.e. in the outcome.

Adjusting for quality is a challenge. In Norway, we have so far not been able to find good quality indicators to adjust health output. We see problems with all the approaches. Patient experience surveys are not available, and if they were we are afraid that such surveys will give results that are too subjective to really measure what we want. Using outcome indicators we find problematic, as these to a large extent also are based on subjective information from patients. In addition, such surveys are costly and resource demanding to conduct. Receiving outcome indicators every year for national accounts purposes we find rather unrealistic, and basing quality adjustment on indicators that are

available only occasionally, will not be a good solution. So before we introduce quality adjusted volume indicators into the accounts in Norway, we realise that further investigation is needed. We find this approach in line with the Atkinson Review recommendation (Atkinson Review 20, 6.33 page 92). It is worth noting that in UK work has been carried out testing the feasibility of quality adjusted output indicators for hospital services using a set of outcome indicators as hospital survival rates, quality adjusted life years (health effect), waiting times etc. The results are promising, though challenging regarding data availability (Dawson et al, 2006).

Taking quality changes into account for adjusting output indicators is a difficult task. It must, however, be emphasised that adjusting prices for quality is just as challenging. *Whether the output measure is constructed by direct quantity index or through deflation, the major measurement problem is really the same. If you do it on the price side, you have to make quality adjustments to the prices for improved treatments. If you do it with a direct quantity index, you have to make the quality adjustments to the quantities. The difficult problem of adjusting for quality change is exactly the same in either case* (Triplett 2001).

## **4. Example on direct output measurement**

In Norway, total health expenditure amounted to more than 9 per cent of GDP in 2005. Of this hospital services, included services from psychiatric hospitals and rehabilitation institutions, contribute to nearly 40 per cent of the expenditures, and more than 25 per cent is related to health care for old and disabled people, mainly related to long term nursing homes. In Norway approximately 84 per cent of total health expenditure is funded by public sector.

The Norwegian national accounts are in the phase of introducing direct output methods for non-market health output, priority given to:

- General and special hospital services (inpatients and outpatients, included day care treatments)
- Services from psychiatric hospitals
- Long term nursing care

The new methods will be included in the national accounts this year, the reference year being 2002 or 2003 depending of data availability and quality of data. As already said, no explicit quality adjustments are made, except for what is covered of structural changes by using a detailed breakdown of output.

### **4.1 General hospitals**

For all general and specialised hospital services, excluded psychiatric hospitals, we distinguish between inpatient treatments, which cover both overnight stays and part of day care treatments, and outpatient treatments. For in-patient activities the volume indicator is based on the DRG system (diagnosis related groups) adjusted for readmissions. We calculate government owned hospitals and private non-profit hospital separately. Both government owned hospitals and private non-profit hospitals are included in the DRG system and thus, the same method is applied for both categories of hospitals. Information about DRG at a detailed level is obtained from the Norwegian Patient Register (NPR).

Diagnosis related groups (DRG) are a system classifying in-hospital patients into categories with similar resource use. The grouping is based on diagnoses, procedures performed, age, sex, and status at discharge. Historically the DRG system is based in the Health Care Financing System (HCFA) from US Department of Health and Human Services. The first HCFA-DRG was published in 1983 and later revised. The Nordic countries have introduced a Nordic version of the DRG system (NordDRG). The version follows the same structure as HCFA, but has some additional features. Further, a Norwegian

version of NordDRG has been developed, called NorskDRG. This version includes a separate group for paediatrics and new-borns. The cost weights used in the Norwegian DRG system is based on a cost survey among a representative number of hospitals, and the weights are calculated as the average cost per hospitalisation and per DRG.

Table 1

<b>Different output measures for inpatients in government hospitals. Per cent growth from previous year</b>		
	<b>2003</b>	<b>2004</b>
Discharges	4.1	1.6
DRG – no adjustment for readmissions	4.5	1.7
DRG adjusted for readmissions	4.4	1.8

As can be seen from table 1, whether we base the volume indicator on DRG adjusted for readmissions or not, will not give very different results, at least not for 2003 and 2004. The table also shows the annual growth rate of discharges. As can be observed, the discharges have a lower percentage growth than the DRGs.

Table 2

<b>Total output from government hospitals. Per cent growth from previous year</b>		
	<b>2003</b>	<b>2004</b>
Inpatients (DRG adjusted for readmissions)	4.4	1.8
Day cases (number of consultations)	14,8	7.3
Outpatients (number of consultations)	5.4	4.2
<b>Total output growth for government hospitals</b>	<b>5.6</b>	<b>2.8</b>

The volume growth for inpatients, outpatients and day cases have been weighted together using cost weights from hospital accounts. From 2002 the hospital accounts are available at a detailed level for all government owned hospitals and all private non-profit hospitals. However, it is a problem that the costs cannot be separated on inpatients and outpatients respectively. We have therefore, been forced to estimate necessary cost weights based on alternative information. The assumption is that the costs for outpatients equal the hospitals income related to outpatients. Research has shown that the reimbursement for outpatient treatments from the government plus the out of pocket payments from the households (income sources) are too low to cover all costs on treating outpatients, and thus, to achieve a better estimate of the costs the sum of income is multiplied by 1.5 (as is an "agreed" grossing up procedure among health economists). A future goal will be to improve the cost weights.

The new figure for growth in government hospital output for 2003 is significantly higher than the estimate that is previous published for government hospital output based on deflation of inputs.

## **4.2 Psychiatric hospitals/institutions**

The DRG system is not designed for mental hospitals/psychiatric services. We have however different other output indicators as the number of bed days (occupation days), outpatient consultations and day cases. The indicators are separated on adults and on children/adolescents. As can be seen from table 3, the different output indicators seem rather volatile. For instance, it will be necessary to look further into the figures for 2005 regarding children and adolescents, as the figures indicate there have been

some changes in the way of reporting outpatient consultations and day cases. In the period 2000 to 2004 the share of outpatient consultations related to children and adolescents increased from 24 per cent to 28 per cent of the total number of outpatient treatments. In 2005 the share had increased to 33 per cent.

Table 3

<b>Psychiatric hospitals. Per cent growth in output from previous year</b>						
	<b>2000</b>	<b>2001</b>	<b>2002</b>	<b>2003</b>	<b>2004</b>	<b>2005</b>
<b>Adults</b>						
Bed-days	-2,7	-4,3	-1,3	-3,5	-4,4	-1,6
Outpatients (consultations)	4,8	5,2	11,4	14,8	6,7	17,3
Day cases	-7,7	-5,3	-25,9	-12,3	-8,0	-5,5
<b>Children and adolescents</b>						
Bed-days	-3,2	1,3	7,6	10,8	-2,4	0,6
Outpatients (consultations)	3,8	7,3	21,2	24,0	9,3	47,6
Day cases	7,3	-2,1	10,9	2,6	-20,9	-33,5
<b>Weighted output indicator</b>			<b>0,3</b>	<b>2,0</b>	<b>-1,4</b>	<b>4,8</b>

An indicator based on the number of bed-days is primitive, but presently, this is the only available indicator. The indicator would be acceptable if one could assume that the costs related to a bed-day are equal for all patients and independent of the treatment you receive. Such an assumption seems rather unrealistic. Another problem we are facing is the historical cost weights. Even though we have detailed specification of the costs for all psychiatric hospital/institutions, the costs are not possible to separate on inpatient and outpatient up to 2004. From 2005, new functions are included in the hospital accounts, which allow us make rather good estimates of the costs related to inpatients, outpatients and day treatments. In lack of historical data, we have used the costs weights from 2005 also for the years back to 2002. As about 65 to 70 per cent of the costs are related to inpatients - and the number of bed-days has decreased over the years - this will influence the weighted output indicator. Especially for the years 2002 and 2003 the output indicator is probably underestimated, giving too low weights to the increase in inpatient treatments. This results in a high growth in the implicit price components that can be derived.

### 4.3 Long term nursing care

In Norway, the municipalities have the responsibilities for services rendered to old and disabled people. The services can be split between long term nursing homes, old people's homes and combined nursing homes and old people's homes, home nursing and home help. The example given in this paper, covers only long term nursing homes.

In the period 1997-2002 there was a political action plan focusing on improving the services related to aged and disabled. This led to extra resources put into these services. For instance, one aim has been to organise the services so that people can live in their homes as long as possible; i.e. the services - either home nursing or home help - should be provided in the client's home. Another goal has been that everybody living in an institution should have access to a single room. The latter goal has led to a strong increase in the share of single rooms, i.e. from a share of 83 per cent in 1997 to 95 a share of per cent in 2005.

For services from long term nursing homes, occupant days by type of institution (proxy for level of care) can be an acceptable indicator. In Norway, we do not have the exact number of occupant days. Only the number of beds available and the number of patients during a year is registered. From this we estimate the number of occupant days. Regarding type of institution, we assume that the services

rendered will be more or less similar for all institutions. The number of occupants days have increased by 1,4 per cent on average from 2000 to 2004. We have problems with how to take quality changes into account. For instance, is the increased share of single rooms a quality change, and how should this possibly be included in the output indicator.

In Norway, we are presently in a phase of establishing a new health register (IPLOS) covering all individuals who apply and receive nursing and social care services in the municipalities. The data in the register will contain individual information on the person's situation and needs, and in addition information on which (and how much) services are provided. The register will be valuable for statistics about the supply and use of nursing and social care services, and hopefully this register can give better information on output indicators in the future. Until the register is fully developed, the number of occupant days will be used as an output indicator for long term nursing homes.

## **5. Conclusion**

So far, no explicit quality adjustments are made on the health output indicators, except for what is covered of structural changes by using a detailed breakdown of output. This may lead to an underestimation of output.

Regarding general and specialised hospitals, using a DRG based index gives a reasonable result, even though we have some problems related to the cost weights used. For psychiatric hospitals/institutions, the output results seem of less good quality. The reason for this is partly due to the rather rude indicators used, partly to the lack of relevant cost weights, and partly to the lack of quality adjustments of the output indicators. Further research of alternative indicators and cost weights should be undertaken. It must be underlined, that general hospitals contribute to approximately 75 per cent of the total output from hospitals/institutions.

For long term nursing homes we will use occupant days to extrapolate output at constant prices, but the new health register, IPLOS, will be examined thorough. Hopefully we can improve our output indicators both regarding long term nursing homes, old people's homes, home nursing, and home help in the years to come.

The methods applied in Norway still need to be improved. Especially, the quality dimension of the volume measurement needs more investigation.

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