Constructing a volume index for hospital services in the Netherlands

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Introduction

The measurement of price and volume for medical services, in particular hospital services, has been a subject of debate for over 20 years. It is agreed on that the method mostly used in CPI 's does not allow for improvements in medical care [1]. Secondly, the input is not a good measure for the output of medical services. However, a good measure for output is hard to define. In theory, the unit of production should be "a treatment". Either the number of treatments or the price per treatment should be recorded. The practical realization of this approach leads to a number of problems like, for example, when does a treatment start and where does it end? And how many types of treatments should be distinguished? What should be done with quality changes?

In 2001 Eurostat published a Handbook on Price and Volume measurement which provides guidelines for the development of price and volume measures for nearly each CPA group (Classification of Products by Activity) [2]. The methods described in the Handbook were adopted in a European Regulation issued in 2002 [3]. The goal of the Regulation is to harmonize the methods of deflation used in the National Accounts of European countries in order to improve the comparability of macroeconomic statistics. The Handbook suggests some feasible methods for the abovementioned measurement problems for hospital care. The Regulation requires that each European country should use at least a so called B-method for deflation of hospital services in the National accounts starting from 2006.

In the Netherlands an integral registration of hospital discharges exists, classified according to the ICD (International Classification of Diseases). A volume index based on the number of discharges per type of treatment could fulfil the aims for a B-method provided "*the diagnoses are recorded at a very detailed level and appropriate cost factors are used*". This paper describes the attempts of Statistics Netherlands to comply with these aims for hospital services (CPA 85.11).

Statistics Netherlands has the ambition to increasingly use existing data in order to reduce the number of surveys. The information used in this study is entirely derived from existing registers managed by organisations other than Statistics Netherlands. To that end, collaborations have been started with several institutions in order to exchange information and knowledge. It appeared that

the use of existing data is mainly hampered by the fact that the information from different sources does not fully match the definitions used in the National accounts. More specifically, the volume index developed does not correspond to the total output of hospital services as defined and published in the National Accounts.

In the following section the information available from the national Hospital Discharge Register (HDR) is discussed and also some of its limitations. The HDR data are provided by an organisation called Prismant. In the HDR individual inpatient treatments are recorded. In the section "Method" the choices we made are reported and the actual calculation procedure is described. Subsequently, the application of the index in the National Accounts is discussed. The next section shows the resulting index. In the discussion section, the method is discussed with respect to heterogeneity within groups of treatments and quality changes over time. Also a few words are devoted to the effect of the volume index on the calculation of labour productivity. Finally, future plans using data on health insurance claims will be outlined.

Data

The HDR data used in this research cover the period 1995-2001. For each year a file was created that contains for each hospital discharge the information shown in table 1. The HDR provides also other information that was not used in this study (see also [4]). It should be noted that the HDR data do not include outpatient treatments.

Table 1 Summary of data per discharged person used for the calculation of the volume index

Date of birth	Number of hospitalisation days	Clinical or day treatment	Diagnosis (ICD-9)	Type of hospital (academic, general or specialized)

The variables shown in table 1 provide the following information. Date of birth enables us to create age classes. The number of hospitalization days reflects the duration of the hospital stay. A clinical treatment lasts at least 24 hours whereas a day treatment lasts shorter than 24 hours. This variable allows discriminating between these two types of treatments. In the HDR data 11,182 ICD codes are distinguished. The last variable shown in table 1 gives the type of hospital.

Since the aim is to develop a direct volume indicator, the volume should be measured integrally. It is not justified to consider the volume development of a part representative for the total. In practice, this means that *(1)* total hospital services of each hospital and *(2)* the service of all hospitals or at least the same group of hospitals should be observed in the register. This is problematic since for example the registration of day treatments is not the same in all hospitals. In addition, the number of specialized hospitals that is included in the register varies over the observed period, and mergers between academic or general hospitals and specialized hospitals have occurred. Adjustments have been made for these changes; however it is clear that the applicability of the HDR data for volume measurement is hampered by these variations over time.

Method

In our approach each discharge counts as a treatment. The individual treatments recorded in the HDR have to be grouped by type of treatment. The number of discharges per type of treatment results in the partial volume indicator per type of treatment. These partial volume indicators are weighted to form one overall volume indicator.

How many groups of treatments?

To compose groups of treatments the following variables can be used: diagnosis, age and sex. For practical reasons we have chosen to use the 3 digit ICD-9 classification to characterize the diagnosis. This results in approximately 1000 diagnosis groups. Individual treatments that belong to one diagnosis group may differ largely for example with respect to hospitalization duration. For most diagnoses “age” and “hospitalization duration” are not independent. Age can be seen as a proxy for the “seriousness” of a certain disease. Detailed study of the dependence of “age” and “hospitalization duration” showed that it is useful to divide treatments belonging to one diagnosis group into 7 age classes (0, 1-14, 15-44, 45-59, 60-69, 70-79, 80+ years). Note that these classes do not have the same size. It proved unnecessary to make an additional distinction into sex. In conclusion, the individual treatments in the HDR are aggregated into 7000 (=1000 diagnoses x 7 age classes) diagnosis/age-groups.

Day treatments and clinical treatments

The partial volume indicator per diagnosis/age group is formed by the number of discharges as compared to the previous year. Both discharges from day treatments and from clinical treatments are recorded in the register. A crucial question is whether day and clinical treatments per diagnosis/age-group should be added or not. From the data it can be concluded that the overall number of day treatments strongly increases whereas the overall number of clinical treatments decreases. Apparently, there is a tendency from clinical towards day treatment. Such a substitution should rather be observed as a price change than as a volume change. As a consequence, day treatments and clinical treatments should be added. Because the choice to add these types of treatments has a substantial impact on the final volume index, we will address this issue in more detail below, in the discussion section of this paper.

Weighting factors

In the Netherlands once every five years a "Cost of diseases" (CoD) study is performed [5]. However, the prices that are provided by this study are, for the following reasons, not suitable as weights for the construction of the overall volume indicator.

Firstly, one of the data sources used in the CoD study is the HRD. In the HRD some medical acts are underreported, most seriously the diagnostic activities. This means that the linking of recorded medical information to fees and subsequently adding these does lead to an underestimation of the total price of a treatment. As a consequence aggregation of these prices does not result in the total output value of inpatient hospital care. In the CoD study this problem was solved by subtracting the total costs that could be assigned to diseases from the total costs of hospital care determined on the basis of data from health insurances. The difference was fully assigned to the costs of lodging. In this way a price per hospitalization day was constructed in which all medical acts not registered in the HRD are included. As a consequence, each hospitalization day has the same price. The resulting prices per treatment appeared to be determined mainly by the price of hospitalization (85% on average).

Secondly, the CoD study is performed once in 5 years and published about two years after the end of the year of review. This means that the study does not provide current prices and does not

allow readjusting of the weights on a yearly basis. This is a problem because for application in the National accounts the volume index has to be available about 1 year after the year of review. And in addition, a Laspeyres chain volume index with annually adjusted weights is preferred.

The facts described above brought us to the conclusion that weighting with the total price of hospitalization days per diagnosis/age group could be a compromise. Note that in this particular case this is the same as weighting with the number of hospitalization days per diagnosis/age group. From the HRD data the number of hospitalization days per treatment is directly available on an annual basis. A sensitivity analysis showed that weighting with information from the CoD and with "days of hospitalization" gave very similar results.

The CoD study also provides a price of a day treatment. This is a uniform price independent of the type of day treatment. Because this price does not include the prices of the performed medical operations, it can be argued that this price is too low. Since detailed information is lacking we have decided to give a day treatment the weight of one clinical hospitalization day.

Calculation

As indicated above a Laspeyres chain index with annually adjusted weights has been compiled. To that end a partial volume index for each diagnosis/age group is calculated, based on the number of discharges in year t divided by the number of discharges in year t-1. For weighting the number of hopitalization days of the particular diagnosis/age group in t-1 is used.

Discharges in year t, no discharges in t-1

The partial index in year t is not defined in case the number of discharges in year t-1 is zero whereas in year t discharges are present. In such cases groups of treatments are aggregated according to the following scheme. The first aggregation step is to join age groups within one diagnosis group. The second aggregation step is to join diagnosis groups that belong to the same diagnosis subgroup and distinguish age. The third aggregation step results in the subgroup without distinction of age.

Application of the volume indicator in the National Accounts

For the application of the volume index in the National accounts a number of problems have to be solved. The volume index applies to the production of hospitals and medical specialists together. However, in the Netherlands a large number of specialists working in the hospital are not employed by the hospital. They are independent entrepreneurs. As a consequence, their output is stated under “services of medical specialists” and not under “hospital services”. On the other hand “hospital services” includes outpatient treatments while the volume index based on the HDR only applies to inpatient treatments. Also some other types of institutes that provide hospital services do not report to the HDR. In conclusion, the value index corresponding to the HDR volume index cannot easily be determined.

In short, the problems mentioned above are solved in the following way. The total value of "hospital services" including outpatient treatments and "services of medical specialists" is determined on an annual basis. The HDR volume index is combined with a volume index for outpatient treatments based on the total number of visits. The resulting value and volume indices yield an implicit price index. This price index is used as a deflator for the output of for example specialized hospitals that are not included in the HDR.

Results

In table 2 the resulting volume indicator based on the HDR is shown. The indicator refers to the output of inpatient medical services by hospitals and medical specialists together. Additionally, the “overall” volume index, the corresponding output value index and the implicit price index are shown. The “overall” volume index can be applied in the National accounts.

The volume index shows an increase of 8% over 6 years. This increase is due to the fact that the number of day treatments strongly increases. In this approach, where day and clinical treatments are added the increase in day treatments leads to an increase of the overall index. If we would have chosen to calculate separate indices for day treatments and for clinical treatments and weight these with costs, respectively about 5% and 95%, the increase of the overall index would be much smaller. As argued above we think it is justified to add day treatments and clinical treatments.

Table 2 Results

year	HDR-indicator[1]	Volume-index[2]	Price index[3]	Output value index[3]
	1995 = 100			
1995	100	100	100	100
1996	102,9	102,2	102,3	104,5
1997	104,8	102,8	106,4	109,4
1998	105,2	104,2	107,1	111,6
1999	105,3	104,3	113,7	118,6
2000	105,3	104,3	120,9	126,0
2001	108,2	108,2	132,2	143,0
2002	*115,0*			

[1]*Laspeyres chain index with yearly adjusted weights based on the HDR data. The index corresponds to the production of inpatient medical services by hospitals and medical specialists together. About 7000 age/diagnosis groups are distinguished and each discharge from clinical or day treatment is counted as a treatment. The number of hospitalization days per diagnosis/age group is used for weighting. "HDR indicator" refers to the index that follows directly from the calculation.* [2] *"Volume index" refers to the index that applies to the total production in CPA 85.11 (see also discussion).* [3]*The last two columns show the corresponding price and value indices.*

Discussion

In this section the limitations of the practical approach that we have chosen are discussed. We point out that one should be aware of the choices made and the consequences of those choices with regard to problems like heterogeneity and quality changes within groups of treatments, and hospital readmissions. An additional matter of concern is the measurement of the labour productivity.

Heterogeneity within groups of treatments

The diagnosis/age groups that are composed in this study are for several reasons not homogeneous. In the first place a diagnosis does not characterize the content of a treatment. In other words treatments that are, from a medical point of view, very different may belong to the same diagnosis group. Secondly, the addition of day and clinical treatments will cause an increase of the heterogeneity. On the one hand, as argued above, this is a desirable effect. However within one diagnosis/age group also clinical treatments exist that never can be replaced by day treatments.

Quality changes

In order to correct for quality changes one should define what determines the quality of a treatment. Is it the difference in quality of life before and after a treatment? Is it the improved medical technique that causes fewer complications? Or is it the quality experienced by the patient? A related question is: where does a treatment start and end? It is clear that a treatment does not begin and finish at the doorstep of the hospital. Ideally also treatments by other institutions before and after hospital stay should be included.

In this study we did not try to determine any measures for quality. The only quality-related change we implicitly have taken into account here is the fact that the shortening of treatments over time is not observed as a volume change.

Hospital readmissions during one treatment

In this study a treatment is approximated by a hospital discharge. However, many medical treatments consist of a series of hospital admissions. Should such a series be recorded as one treatment? In case of for instance chemotherapy, which is clearly a series of admissions corresponding to the treatment of one diagnosis, this seems logical. On the other hand, various chronic diseases like for example varicose veins require also repeated medical treatment. Because the time interval between subsequent treatments will vary and the disease cannot be really cured it seems better to count individual treatments. These examples show that a uniform approach which is "correct" for all types of diseases cannot be settled. In addition, the treatment of certain diseases may cover a period of years while an index should refer to services provided in one year.

Labour productivity

The measurement of labour productivity in hospital care encounters similar problems as described in the previous section. Data that are available on the number of fte's per type of activity cannot be related to the output covered by the HDR. The reason is that data on labour volume are collected per company and not per product group. As a consequence, labour data include the education activities of academic hospitals. In addition, data on medical specialists

cannot be split into a part corresponding to medical services provided by hospitals and a part corresponding to medical practices. The latter category is not included in the HDR.

Due to the problems indicated above the calculation of labour productivity using the HDR volume index is a subject of future study.

Conclusion and future plans

It is possible to construct a volume index based on the information from the HDR and some additional assumptions. In our opinion the index meets the requirements of the European regulation [3]. The main limiting factors can be summarized as follows:

- variations in the register of hospitals covered by the registration;
- lack of data for weighting;
- groups of treatments are, for a part, not homogeneous (enough);
- information on quality changes is not available.

The most appropriate way to deal with these problems seems to be to obtain price information.

Recently, we obtained data on health insurance claims at individual level for a pilot study. In theory, this information can be coupled to the HDR, thus yielding the price per treatment. These prices could be used to calculate better weighting factors. Secondly we will investigate whether it is possible to calculate a price index for some treatments. First results show that it is difficult to attribute claimed costs to individual treatments. This is due, among others, to readmissions, delay between treatment and declaration, and different persons within one family sharing one health policy.

Literature

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