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The cost of a hospital ward in Europe

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Is there a methodology available to accurately measure the costs?

195

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Abstract Costing health care services has become a major requirement due to an increase in demand for health care and technological advances. Several studies have been published describing the computation of the costs of hospital wards. The objective of this article is to examine the methodologies utilised to try to describe the basic components of a standardised method, which could be applied throughout Europe. Cost measurement however is a complex matter and a lack of clarity exists in the terminology and the cost concepts utilised. The methods discussed in this review make it evident that there is a lack of standardized methodologies for the determination of accurate costs of hospital wards. A standardized costing methodology would facilitate comparisons, encourage economic evaluation within the ward and hence assist in the decision-making process with regard to the efficient allocation of resources.

Introduction

Health care costs are rising significantly due to ageing of the population, increasing expectations for health care and application of new technologies. As a result of these changes, the incentive for accurately determining the cost of health care is becoming more important. There is an increasing perception by health care professionals that resources are limited and as a result, strategies are being developed worldwide for limiting health care expenditures. Studies of health care costs may serve as an aid to political and administrative decision making, and economic evaluation is a potential tool to improve economic efficiency (Gyldmark, 1995). Costing health care services has therefore become of major importance, although accounting systems may prove limited when the computation of a cost per individual patient is requested.

Many methods exist for costing patient care and they can be broadly separated into two categories: "top-down" and "bottom-up" costing. Top-down costing starts with the total expenditures and then divides these by a measure of total output (e.g. "per diems" and "case mix" costing). Bottom-up, or micro costing, consists of identifying and costing the resources used by a specific patient.

Managers and hospital accountants have extensively used the "top-down" approach to calculate the approximate spending within the hospital, whereas the "bottom-up" methodology has been used only minimally due to the time consuming nature of



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producing accurate results. Although the top-down approach is relatively straightforward, it is unsuitable for certain types of economic evaluation, as it assumes an equal distribution of resources between patients. More accurate results for individual patients would be obtained by the bottom-up method, even if the process is laborious and expensive.

Activity-based costing is perhaps the most widely used method of bottom-up costing, involving the determination of resource usage by the individual patient according to the "activities of care" delivered to that patient. An activity is a collection of resources, which are combined to perform a service. The costs of each part of the activity, for each individual patient, are summated to form the cost of the activity:

$$\text{Activity cost} = \text{cost of disposables} + \text{cost of drugs} + \text{staff costs} + \text{cost of capital equipment} \\ + \text{costs of hospital infrastructure.}$$

Each activity may be composed of some or all of these components. Thus, if the activities of care delivered to the patient are known, an accurate cost per patient can be calculated.

The aim of the study is to identify a simple international costing methodology which can be applied to any hospital ward.

Literature review

Several studies have been published describing the computation of the costs of hospital wards (Ashford and Cumming, 1991; Chan, 1993; Eisenstein and Bethea, 1999; Garattini *et al.*, 1999; Goeree *et al.*, 1999; Norris *et al.*, 1995; Oostenbrink *et al.*, 2003; Roberts *et al.*, 1999; St Hilaire and Crépeau, 2000; Upda, 1996). They are, however, difficult to compare as they were conducted in different countries with different environments within the hospitals. In addition, the areas of health care studied and the different costing methodologies used varied depending on the objective of the study.

This article will examine the methodologies utilised to try to describe the basic components of a method, which could be applied internationally.

Essentially two types of evaluation methods are described in the literature:

- (1) Economic evaluation methods utilised by economists and clinicians.
- (2) Cost accounting methods utilised by accountants and managers.

The use of different approaches has developed as a result of the different requirements of the users. The confusion as to the respective usefulness of these two approaches to ward costing is unjustified, since both methods address specific problems. Costing from a clinical perspective should preferably be carried out within the framework of economic evaluation, using cost minimisation analysis (also called cost analysis), cost benefit analysis, cost effectiveness analysis or cost utility analysis. These methods are summarised in Table I (Drummond *et al.*, 1997; Kielhorn and Graf van der Schulenburg, 2000).

However, other health care professionals, for example accountants, also require costing data but have different objectives, not related to clinical goals, which imply different methodologies.

	Cost analysis	Cost benefit analysis	Cost effectiveness analysis	Cost utility analysis
Costs	Monetary units (e.g. €, £, \$)	Monetary units	Monetary units	Monetary units
Benefits		Monetary units	Non-monetary or natural units (e.g. year of life saved, change in blood pressure, detected cases)	Health status which incorporates quality of life measures and intermediate measures of morbidity (e.g. quality-of-life-years, healthy year equivalents)
Summary measures	Cost saving	Cost benefit ratio Net monetary gain or loss among alternative programmes	Cost effectiveness ratio (e.g. dollars per year of life saved) Marginal cost effectiveness ratio (e.g. change in dollars spent/change in years of life save)	Cost utility ratio (e.g. dollars per quality adjusted life years) Marginal cost utility ratio (e.g. change in dollars spent/change in quality adjusted life years)

Table I.
Methods to assess economic impact

Different definitions

One of the main problems with interpretation of the studies was the considerable lack of clarity about the terms and the cost concepts described. Nearly all the authors made a distinction between those hospital departments not directly involved and those directly in patient treatment. The former have been named cost centres (Garattini *et al.*, 1999; Norris *et al.*, 1995; Oostenbrink *et al.*, 2003) or support centres (Chan, 1993; Roberts *et al.*, 1999; St Hilaire and Crépeau, 2000) whereas the latter, who directly care for patients, were described as revenue centres (Garattini *et al.*, 1999) or service centres (Roberts *et al.*, 1999; St Hilaire and Crépeau, 2000). The total cost is then obtained by assigning the cost centre's expenses to the service centres using different allocation methods.

A similar confusion relates to direct and indirect costs (Chan, 1993; Garattini *et al.*, 1999; Norris *et al.*, 1995; Oostenbrink *et al.*, 2003; St Hilaire and Crépeau, 2000; Upda, 1996). Direct costs by definition encompass all costs that can be directly ascribed to a patient, whereas indirect costs are those that cannot be attributable. These terms reflect the primary division of costs and then further subdivisions can be defined. For example, both categories can be broken down into fixed costs and variable costs (Drummond *et al.*, 1997; Roberts *et al.*, 1999). Fixed costs do not change over the short term with changes in output, whereas variable costs do. Both types of cost may be susceptible to change over a long-term period.

Intangible costs, marginal costs and overheads are all commonly used terms within the studies but are not clearly defined. Perhaps the most commonly abused term is "overhead costs" as it is defined as any cost that is not ascribable to a particular function. Traditionally this includes costs that cannot be ascribed to patient care, such

as the cost of building maintenance or the cost of the finance department within the hospital.

Characteristics of the studies

The 11 articles reviewed were published between 1991 and 2003 and included both American and European studies. These studies varied widely in methodology and other basic characteristics. Only one was based on international data (Goeree *et al.*, 1999) and only one other (Oostenbrink *et al.*, 2003) utilised data from more than one hospital. Some publications described top-down and others a bottom-up methodology with a broad spread of case mix. The characteristics of the studies are shown in Table II.

There are a number of issues highlighted from the publications relating to cost measurement (or measurement of resource quantities), cost valuation (monetary value assigned to resource quantities) and cost allocation (the way in which hospital overheads and other shared expenses are apportioned to patient services and care areas) that influence variations in unit cost estimates between hospitals. These issues include how costs are valued, how accounts are combined, and how shared and overhead expenses are allocated to other areas of the hospital. All of these influence unit cost estimates (Goeree *et al.*, 1999).

The different approaches to cost calculation

One of the more detailed articles (Garattini *et al.*, 1999) described a cost analysis and derived from this a cost-accounting methodology to evaluate the actual costs incurred by the different hospital departments. The study first identified a top-down framework within which to assess the annual cost related to a hospital ward and, following this, calculated the mean bed day cost for each specialty. The full cost of each ward included inpatient activity costs and the costs of medical staff employed in outpatient activities. To obtain the net cost of hospital stay, the medical staff activities were assessed. To split the whole of the activity, the workloads were divided into inpatient and outpatient activities. A proportion for each activity on the basis of the working hours of medical and paramedical staff was calculated. By applying these proportions to the personnel costs (medical and nursing), the real net cost of each ward was calculated. Then, to estimate the bed day cost per ward the annual ward cost was divided by the days of stay.

Other authors also developed cost analysis methods (Gaynor and Anderson, 1995; Oostenbrink *et al.*, 2003; Roberts *et al.*, 1999) albeit in slightly different ways, yet some studies had different aims (Ashford and Cumming, 1991; Chan, 1993; Eisenstein and Bethea, 1999; St Hilaire and Crépeau, 2000; Upda, 1996). Two studies, for example, compared conventional costing systems with detailed bottom-up activity-based costing system: one discussing the benefits of the latter approach with regard to management of resources (Chan, 1993), the other examining its application to hospitals using current health care practices and procedures such as diagnosis-related groups, patient-activity systems, case management, and critical path analysis (Upda, 1996). The approach to the costing system adopted depended on the purpose of the study.

There can be several different objectives and viewpoints in a cost study (Table III). While some of the studies were explicit about their objective, others were more ambiguous. In addition to the apparent lack of consensus on how costs should be

Author	Country of origin	National or international	Year	Source of cost information	Number of hospitals	Number of patients	Method
Garattini <i>et al.</i>	Italy	National	1996	HS	1	Not stated	Top-down
Oostenbrink <i>et al.</i>	The Netherlands	National	1995-1998	HS	15	(Varied between hospital and type of ward)	Top-down
Roberts <i>et al.</i>	USA	National	1993	AA	1	N/A	N/A
Chan	Canada	N/A	1993	AA	N/A	N/A	Activity based costing
St Hilaire and Crépeau	France	N/A	2000	AA	N/A	N/A	N/A
Eisenstein and Betha	USA	National	1996	HS	1	574	Bottom-up
Goeree <i>et al.</i>	Canada	International	1996	HS, AA	72	5041	Bottom-up
Ashford and Cumming	England	National	1986/7	AA	395	N/A	Bottom-up
Gaynor and Anderson	USA	National	1983-1987	AA	Not stated	N/A	N/A
Upda	California	N/A	1995	AA	N/A	N/A	Activity based costing
Norris <i>et al.</i>	Canada	National	1991-1992	HS, AA	1	386	Bottom-up

Source: Source of costs information: hospital specific (HS), i.e. financial accounts or from information already available; (AA) from existing data or from specific procedures

Table II.
Basic characteristics of
the studies

Author	Type of study	Objective	Methods of cost allocation
Garattini <i>et al.</i>	Cost analysis	To set up detailed and complete hospital cost accounting	Step-down
Oostenbrink <i>et al.</i>	Cost analysis	To provide data about unit costs of inpatient days in The Netherlands	Direct
Roberts <i>et al.</i>	Cost analysis	To determine the relative variable and fixed costs of inpatient and outpatient care	Multiple distribution
Chan	Cost comparison	To present and recommend activity-based costing for hospital cost accounting	Comparison of different methods
St Hilaire and Crépeau	Comparison of different allocation methods	To verify, using hospital utilisation data, whether the choice of an allocation method significantly affects the unit cost of such resource	Comparison of different allocation methods
Eisenstein and Bethea	Cost comparison	To introduce a technique for patient mix-adjusting x charts and compare differences between unadjusted and patient mix-adjusted x chart results	Case mix-adjustment
Goeree <i>et al.</i>	Method of hospital selection	To develop a conceptual framework for selecting hospital for unit cost estimates in national and international multicentre trials and to test the impact of alternative hospital selection on the cost results.	N/A
Ashford and Cumming	Cost comparison	To demonstrate that statistical costing has many advantages over cost accounting	N/A
Gaynor and Anderson	Cost analysis	To reformulate the theory of cost and production to take account of uncertain demand facing a firm	N/A
Upda	Cost comparison	To examine the application of activity-based costing to hospitals	Comparison of different methods
Norris <i>et al.</i>	Cost benefit marginal analysis	To compare the cost of a day spent in an intensive care unit and a day spent on general nursing unit	Direct

Table III.
Studies – general comparison

defined and which costs should be included, there is a multitude of cost allocation methods that have been employed in individual studies, each reporting different results.

It is the allocation of these costs that seems the main obstacle for developing a universal cost model. There does not appear to be a preferred method to apportion these costs but the most common way has been to divide the total running cost of, for example, a hospital, by the number of bed-days, thus calculating the average cost per patient day. This has significant disadvantages if there is a wide spread in the costs incurred.

Methods of cost allocation are usually based on notional accountancy approaches, using previous experience about how particular resources are provided and consumed.

St Hilaire and Crépeau (2000) discussed different cost allocation methods to verify if the choice of one or another of these approaches affects the unit cost of resources. The cost allocation methods described were:

- direct method;
- step down method;
- multiple allocation; and
- simultaneous equation method.

The direct method allocates costs proportionally to the services provided. It does not however, take into account the allocation of costs that are shared by more than one cost centre. The step down method, however, utilises the principle that the cost centre requiring the most services has their costs assigned first. This may well give a better indication of the resources used than the direct method. The multiple allocation method is more complex but similar to the step down method. The difference is that it does not prevent the flow of reciprocal services between cost centres. Thus, the remaining costs of services are assigned in the other cost centres. Finally, the simultaneous equation method uses linear equations, which represent the activity between the cost centres and the support services. Using this method, the total hospital costs are calculated. It is considered the best as it can be programmed and thus should be the most accurate. Despite these different approaches, the authors empirically tested all these methods and found that the difference in the results generated was negligible.

In order to review such disparate studies it is necessary to establish the different viewpoints and methodologies involved in each study. To this end each study has been broken down into its most basic components and been placed in Table III.

Some studies have measured costs specific to their individual hospital, but methodologies of cost sourcing have not been rigorously defined. As a result, these methods vary significantly in their design and use.

The way forward

Cost models could be developed to identify the most significant components of the total costs. It is difficult to get reliable indication of the costs attributable to a general ward from the available literature because of the disparity in which the more important costs components are reported. These components are usually the most expensive items used to treat patients. An important problem is the inclusion/exclusion criteria of some costs categories so that in different studies the costs do not represent the same cost components.

In the introduction to this paper, the basic division of costing methods into a top-down and bottom-up form was made. The concept of bottom up (or individual patient costing) is intellectually appealing, as it would allow significant detailed elucidation about, for example, the cost effectiveness of different procedures. However, whilst this might be possible in areas which have a high proportion of activities that can be ascribed to individual patients, there are many areas where this is not the case, thus making this approach impractical. In addition, the resources required to collect these costs would be out of proportion to the benefits that may be accrued from them. Consequently, it is more realistic to try to define a top-down method that could be

The cost block programme

An effective way of capturing costs in intensive care has been demonstrated in the national cost block programme (Dean *et al.*, 2002), which was nationally introduced in 1999 in the UK as a standardised method for costing ICUs. A multidisciplinary working group, the Critical Care National Working Group on Costing, after reviewing the current literature, felt that the total cost of intensive care could be most valuably described by a top-down approach and that the cost involved could be satisfactorily grouped into "cost blocks".

The cost blocks were divided broadly into costs that were not patient-related (overheads) and those that were directly related to patient care. Six cost blocks ("Current cost of using equipment", "Estates", "Non-Clinical Support Services", "Clinical Support Services", "Consumables" and "Staff") were initially identified, and data collected appropriately according to standard definitions.

It became clear as the study progressed that costs of capital equipment, estates and other non-clinical support services (defined as overhead costs), only accounted for a very small proportion of the total costs (15 per cent), and were deemed extremely difficult to capture accurately. Therefore, these costs were omitted from data collection.

As a result, the cost block method focuses on three areas of resource use:

- (1) Staff:
 - medical;
 - nursing;
 - technical; and
 - administrative.
- (2) Consumables:
 - drugs and fluids;
 - disposable equipment;
 - nutritional products; and
 - blood products.
- (3) Clinical support services:
 - bed therapy;
 - laboratory;
 - radiology; and
 - physiotherapy.

The study has recently been modified in order to try to effectively capture the costs of capital equipment.

The cost block method has been internally validated over a period of four years and has been proven to identify most of the main cost drivers. Whilst the cost block system looked exclusively at intensive care, the subdivisions of cost are applicable to all wards

and specialties. It thus may be an appropriate tool to test whether the studies to date of ward costs capture most of the costs.

How do the papers fulfil these criteria?

In applying the cost block method to the wards and in breaking down the studies in the above manner, it is hoped that their various cost components will become easier to identify and compare. It will also help to clarify the advantages and disadvantages in using this method. Table IV shows how each of the studies has included or excluded these components.

It was not possible to place some of the papers in Table IV because their objectives were different and precluded comparison (Eisenstein and Bethea, 1999; Gaynor and Anderson, 1995; Goeree *et al.*, 1999). The studies by Chan (1993), St Hilaire and Crépeau (2000), Ashford and Cumming (1991) and Upda (1996) were included despite the fact that the above categories were only discussed in comparing different approaches or methods of allocation rather than cost components. The advantage of breaking down the studies into Table IV is that it becomes increasingly clear what costs tend to be overlooked, and in which areas standardised data collection is particularly necessary.

To illustrate, of the 11 studies reviewed, six (Chan, 1993; Garattini *et al.*, 1999; Norris *et al.*, 1995; Oostenbrink *et al.*, 2003; Roberts *et al.*, 1999; Upda, 1996) included all the relevant staff costs. The same six included the use of disposables, whereas only four included drugs and fluids (Chan, 1993; Garattini *et al.*, 1999; Roberts *et al.*, 1999; St Hilaire and Crépeau, 2000) and only three included nutritional and/or blood products. The apparent lack of consensus as to how the costs should be defined and which should be included has caused a multitude of methods to be employed in individual studies, each reporting different results.

Nearly all papers (Chan, 1993; Garattini *et al.*, 1999; Norris *et al.*, 1995; Oostenbrink *et al.*, 2003; Upda, 1996) agree in classifying medical, nursing and technical staff as direct costs. These are a share of costs that are incurred by each department and can be easily related to its activity.

However there is confusion when talking about administrative staff. The Italian paper (Garattini *et al.*, 1999) is the only one that differentiates between administrative staff and administration. This paper classifies administrative staff as direct costs, and administration as an indirect cost, usually ascribed as an overhead. The other papers, for the main part, leave administrative staff under the umbrella "administration", which is usually ascribed as an indirect cost, under overhead, and allocated by different methods, as shown on Table III.

There is the same confusion when classifying which category consumable costs should fall into. When discussing individual consumables such as "drugs and fluids" or "blood products", for example, these are clearly direct costs and are classified as such, but when trying to classify larger categories such as "pharmacy costs" and "transfusion costs" it is unclear into which category they ought to fall.

Each paper also adopts different strategies for consumables costs, some papers viewing them as a direct cost and others as an indirect cost. This is a theme that continues through all the papers and applies to aspects of clinical support services, for example radiology and laboratory.

Table IV.
Cost components
included in the studies

Authors	Staff			Consumables			Clinical support services			
	Medical	Nursing	Technical	Admin.	Drugs and fluids	Dispos. equip.	Nutritional products	Blood products	Bed therapy	Lab. Radiology Physio.
Garattini <i>et al.</i>	×	×	×	×	×	×		×		×
Oostenbrink <i>et al.</i>	×	×	×	×	×	×	×	×		×
Roberts <i>et al.</i>	×	×	×	×	×	×				×
Chan	×	×	×	×	×	×				×
St Hilaire and Crépeau	×			×	×					×
Eisenstein and Betha										×
Goeree <i>et al.</i>										
Ashford and Cumming	×									
Gaynor and Anderson		×								
Upda	×	×	×	×		×	×			×
Norris <i>et al.</i>	×	×	×	×		×			×	×

Finally the classification of capital equipment also causes confusion as to which category it should fall in and as to the exact definition of the term itself. Hospitals define capital equipment in different ways, for example, some may count office equipment and some may not. There are also different views on depreciation methods.

Conclusions

The diversity of costing methods has resulted in poor external validity and inability to compare findings between such evaluations. The methods discussed in this review make it evident that there is a lack of standardized methodologies for the determination of accurate costs of hospital wards.

A standardized costing methodology would facilitate comparisons, encourage economic evaluation within the ward, and hence assist in the decision-making process with regard to the efficient allocation of resources. A standardized methodology is required to measure costs accurately, and also guidelines are needed to decide which method to employ for determining ward costs that would best fit the objectives of the study.

Of prime importance will be the reliability and ease of data collection to propose an easily obtainable and reliable method for costing wards on a national and international basis.

Perhaps, as in Canada, a "cost list" could be introduced. A "cost list" is a list of services and associated standard costs that allows comparability between studies, because it incorporates a common set of uniform costs (Jacobs *et al.*, 2002). In Canada the list is provincial only, but a similar approach could be used as a starting point for the development of an international cost methodology.

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