

THE UNIVERSITY *of York*



**The main methodological issues
in costing health care services**

A literature review

CHE Research Paper 7

HEALTHBASKET

A comparative EU project

**The main methodological issues in costing
health care services**

A literature review

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Executive summary

Aims and objectives

Aims and objectives of the project

The Healthbasket project seeks to offer evidence on the basket of services offered by the health system in nine member states, and the costs and prices associated with those services. A specific objective of the project is “to identify what are the existing possibilities for and limitation to [cost] comparison and recommend the minimum data required to furnish meaningful international comparison in the future.” To that end, work programme WP7 assesses the costing methodologies for inpatient and outpatient health services at the micro-level.

Aims and objectives of this subproject

The aim of the WP7 subproject is to provide a comprehensive review best practice in cost assessment by examining the scientific literature on methodologies for calculating health service costs. This review examines published scientific literature about the methodologies used to estimate the costs associated with the delivery of a particular service at the micro-level in both in-patient and out-patient settings. In addition, the review summarises the scientific literature on methodologies used in international comparative studies of health service costs at the micro-level, including in-patient and outpatient settings.

Methods

A research protocol was developed which comprises a literature search strategy, inclusion and exclusion criteria, data extraction and synthesis methods. Studies were identified through electronic search of several databases, local library files and reference lists of published articles, as well as books. The literature search was extended to Internet websites of governments, academic institutions and large insurance companies’ in order to include unpublished online information. The literature review focuses on publications between 1986 and 2005, and only English language literature was included. Publications were critically appraised using preset quality criteria.

Results

UNIT COST MEASUREMENT

Shared principles

The accounting and economic literature agree on the basic principles of costing. Costing exercise starts with the (a) formation of a well-defined decision problem, including the objectives of costing, the perspective of costing, and the time horizon, as well as (b) the description of a particular service (cost object). After the service for costing has been defined in detail, the costing methodologies follow three distinctive steps: (c) the identification of resources used to deliver the service, (d) the measurement of resource utilization in natural units, and (e) attaching monetary value to resource use. In addition, there is a consensus that the robustness of the result should be addressed by (f) sensitivity analysis and statistical tests.

There are several ways to calculate unit costs, although most methods follow the full absorption cost principles. This means that all costs (direct and indirect) relating to the provision of a particular service are included in the cost calculation. There is a consensus about the fundamental principles of cost allocation. Ideally, costs should be traced directly if it is possible in an economically feasible way. Indirect costs (overheads) should be allocated to service areas based on actual utilisation or cause-and-effect bases.

In the identification phase, all relevant resource items should be identified, regardless of their expected impact on the total costs and of their measurability. 'Relevance' will be determined by the perspective of the study, which might be narrow and organisational or broad and societal. Ideally, resource utilisation measurement should be comprehensive, reliable, valid and representative. In principle, micro-costing (activity based costing or the bottom-up approach) is the preferred resource use measurement approach, in part because it is more reliable, accurate and flexible than more macro approaches.

In assigning monetary value to resource utilisation, the general principle is that costing should be aligned with the perspective of the study, and the sources of estimates of monetary value may therefore depend on the study perspective adopted.

Uncertainties should be addressed by using either (a) statistical analysis or (b) sensitivity analysis. These methods, however, have complementary roles. In sensitivity analysis, the selected range, across which parameters will be varied, should be clinically meaningful, as well as economically plausible. Because the distribution of cost data can be highly skewed, non-parametric tests, log-normal parametric test and bootstrapping may be used to test the cost difference between sites.

Selection of costing method	<p>In practice, costing studies use five general ways to value resources: (a) direct measurement of costs, (b) cost accounting methods, (c) standard unit costs, (d) fees, charges and/or market prices, and (e) estimates/extrapolations. All have their advantages and disadvantages, and the 'best practice' choice will be guided by a number of criteria that include (a) the purpose of costing (the decision problem), (b) the perspective of the study, (c) the type and complexity of health service / health technology, (d) the precision required (e) the requirements of generalisability and representativeness, (f) the cost-accounting method used by the institution, (g) the availability of reliable and valid data, (h) the feasibility and costs of measurement (e.g. existing information/activity recording systems), and (i) the type of service users, as well as (j) the number and range of different service activities.</p>
Practical challenges	<p>In practice, the most fundamental trade-off is between information accuracy and the costs of securing that information. Analysts and decision-makers must consider whether the benefits of more accurate and detailed cost information justify the additional costs incurred in obtaining that information. In particular, the opportunity cost concept is in principle the preferred way of estimating costs in most contexts. However, estimating opportunity costs is often costly and time consuming. In contrast, accounting costs can often provide reasonably accurate estimates of opportunity costs relatively cheaply and quickly. However, there are circumstances in which reliance on accounting data can give rise to seriously misleading inferences, especially if heavy reliance is placed on traditional accounting measures of capital consumed.</p>
Disagreement on best practice	<p>The review found two types of disagreement: (a) disagreement on best practice principles and (b) disagreement on application or non-compliance with agreed principles in practice.</p>
Disagreements on best practice principles	<p>Current methodological guidelines' recommendations vary partly due to non-compliance with fundamental economic and accounting concepts. For instance, guidelines disagree about (a) the best way to attach monetary value to resource use, including fixed assets, (b) the recommended perspective of the study, (c) the appropriate measurement and valuation method of informal caregiver time, (d) the measurement and valuation of productivity costs, (e) the cost incurred in added years of life and (f) the best technique to use to allocate support centres costs to operational units. Furthermore, there is no consensus in the literature on (g) the most appropriate way to deal with uncertainties.</p>
Disagreement on practice	<p>Even where there is agreement on the fundamental theoretical issues, the guidance on how to translate these principles into practice is often inadequate. This gives rise to considerable variations in costing methodologies in practice.</p> <p>Recommended methodologies are found to vary, or to be ambiguous or insufficiently detailed on several technical issues, such as resource use measurement, cost allocation methods, capacity utilisation and shadow price.</p>

Moreover, there is often no clear guidance on how to calculate the useful lifetime of fixed assets. Some guidelines recommend a “gold standard” that may be expensive and/or infeasible to implement in practice, whilst others recommend practically useful methods without discussing their validity relative to any gold standard.

Studies assessing compliance to methodological guidelines often conclude that it is difficult to assess the overall degree of compliance due to the “poor reporting quality” of the results. However, it is likely that costing studies and economic evaluations often do not comply with (a) all the basic economic / accounting principles, and/or (b) methodological guidelines of costing. This non-compliance with established methodological guidelines, coupled with the disagreements and ambiguities noted above, give rise to significant variation in costing methods used in published studies.

(INTERNATIONAL) COST COMPARISON

Agreement on
basic principles

Cost comparison seeks to estimate the resources used in different organisations for the delivery of a comparable product or service. Costing studies must therefore assume that the services being compared will have identical consequences (health benefits and disbenefits). Consequently, valid comparison can be made only between different organisations, if the eventual cost object, as well as any intermediate cost objects, are the same or very similar. Therefore, the *sine qua non* of comparative cost analysis is the detailed description of the particular service, including the case mix of the target population, the organizational settings, and where relevant the financial arrangements..

In addition, there is a widely held agreement in the literature that cost comparison can be meaningful only if costs are measured in the same way (using standardised costing methodology and reasonably good compliance to it). Likewise, international cost comparison should follow agreed costing principles. For example, (a) resource utilization should be measured accurately and comprehensively (costs are calculated on the full absorption basis), (b) overheads (indirect costs) should be allocated and apportioned fairly, when possible charging directly, and (c) cross subsidisation should be avoided.

Furthermore, costing methods should be transparent, and data should be reported in a disaggregated, well-tabulated form to promote transparency, to allow further analysis from other perspectives and to allow application of different assumptions.

However, standardisation of the basic scientific principles is not enough on its own to ensure comparability. Other type of biases can arise, such as scale bias, case mix bias or site selection bias, and where salient these should also be controlled for.

Lack of consensus	There is currently little guidance on the best way to select providers (sites) for cost comparison and how to deal with missing data. There is also no agreement on the best method for handling variations in input prices, or converting cost estimates into the same currency.
Applied costing methodology	A top-down approach could be useful and reasonably accurate in those cases where marketed health technologies (pharmaceuticals, medical devices and other consumables) are responsible for most of the resource use. In these cases, a bottom-up approach (micro-costing) will often yield a very similar result, but may be more expensive and time consuming to undertake. However, in those cases where service provision is based on complex organisational arrangement (input mix could vary significantly), and human resource costs and overheads are responsible for a large portion of the total costs, the inaccuracies introduced by a top-down approach become important, and a bottom-up approach is to be preferred.
Practical difficulties	<p>Numerous practical difficulties apply specifically to international comparison of health service costs. These include (a) lack of clarity of cost concepts and technical terms used in the studies, (b) discrepancies between the interpretation and usage of technical terms and methodological principles (e.g. intangible costs, overhead costs, marginal costs, etc), (c) differences in classification of different cost items, (d) variations in the inclusion and exclusion of cost items, and (e) insufficient details of the methodology used, and (f) variations in treatment of joint costs overhead allocation. In addition, cost comparison could be challenging, in part because (a) studies may have different objectives, (b) apply different analytical perspectives, and (c) consequently include different resource (cost) items.</p> <p>These difficulties can be exacerbated by (a) the differences in accounting systems used, (b) the differences in recommendations of (national) guidelines, (c) the differences in health systems including payment systems, (d) the lack of comprehensive cost databases, and (e) the need to determine a feasible approach to currency conversion.</p>

General Recommendations

A standardised costing methodology is essential if providers, purchasers and policy makers are to make informed decisions about health care. Accurate costing can contribute to the efficient allocation of resources within the health system, and identify where cost reduction is feasible and justifiable. Conversely, misleading or absent cost data can lead to unfair comparisons and flawed policy choices.

The prerequisites of international cost comparison are mutually accepted methodological guidance (a standard costing method) and reasonably good compliance with it. In determining the guidance, a central consideration must

be what is feasible given the information resources currently in place. The objective should be to take advantage of the common data that do exist, and to minimise the importance of divergences.

Consensus on the basic scientific principles will not be enough to ensure meaningful comparability. Many fundamental instruments of cost comparison should be harmonised, such as resource use measurement, capacity utilisation, cost allocation methods and valuation methods. The common guidelines should provide detailed instructions on how to deploy these fundamental instruments.

The harmonisation of costing methodologies is necessary, but may not be sufficient to ensure meaningful comparability. It is also important to determine in some detail the perspective of the cost comparison (organisational or societal) and the final cost object, which should be common to all providers being compared. It is moreover important to specify the same set of potential intermediate cost objects to ensure that agreement on the definition of all important dimensions of the particular service being compared is secured.

Recommendations for the HealthBasket Project

Choosing vignettes

case

The selection of different health services or patient care episodes for costing can highlight different methodological and technical problems, as well as different practical obstacles. Also, different inpatient and outpatient services, as well as medical conditions, may vary in their usefulness to policymakers. Moreover, the choice of conditions should be relevant to health care purchasers and providers. Consequently, it is important that criteria are developed for the selection of case vignettes. For example:

- Public health priorities
 - Common medical condition (e.g. the first ten leading burden of disease in developed countries, such as (a) ischaemic heart disease, (b) unipolar depressive disorders, (c) cerebro-vascular disease, (d) alcohol use disorders, (e) hearing loss, adult onset, (f) chronic obstructive pulmonary disease, (g) road traffic accidents, (h) trachea, bronchus, lung cancers, (i) Alzheimer and other dementias, (j) self-inflicted injuries).
 - Can be subject to cross-border care (e.g. surgical interventions, cancer care, and rehabilitation services)
 - Relatively expensive service (large tickets)
 - Apparently large variations in resource utilisation.
- Priorities from costing methodology point of view
 - Targeting different costing problems (e.g. (a) highly complex medical service in the hospital (multi-product firm), (b) relatively complex care in a single product firm (e.g. specialised community or hospital care, such as dialysis in satellite centre), (c) non-complex service in the community (e.g. pharmacy service, or outpatient specialist care), (d)

services where marketed health technology is the single biggest cost driver (e.g. hearing aid or some cancer treatments), (e) health services with high practice variation (e.g. diagnostic services or cardiac catheterisation), and (f) services where informal care can have significant role (e.g. home care for dementia)

- Representativeness and generalisability regarding site selection (e.g. district, non-teaching hospitals may be more representative compared to large tertiary care teaching hospitals).

Choice of costing methodologies

The likelihood is that the costing methods used in the project will be highly conditional on the information available in each of the participating countries, and the limited resources available to undertake the analysis.

Current experience shows that the top-down approach could be useful and reasonably accurate, especially in those cases where marketed health technologies are responsible for most of the resource use. The bottom-up approach may be more accurate in those cases where service provision is based on complex organisational arrangement, but it can be more expensive. Therefore, this project might adopt the following strategy: the top-down approach is used as a first choice and in those cases where this approach is not feasible (e.g. data are not available), a mixed approach will be used, to the extent that resources permit.

It will be infeasible to set out a full costing methodology for the study. However, we suggest that some general costing principles should be drawn up to assist participants in undertaking vignette costing. These should include:

- The perspective taken (provider)
- Choice of providers
- The role of prices
- The time horizon
- Allocation of overheads
- Rules for what constitutes 'material' expenditure

Introduction

Public resources are scarce, but the demand for health care is increasing steadily. Ethical, socio-political and economic imperatives make it necessary to use resources efficiently. Cost information is essential to improve the economic efficiency of health care in any EU member state. Decision space, however, is usually limited in any member states. Therefore, appropriate costing methodology is vital to reduce the negative impact of ill-informed decisions. Cost, however, have several different meaning, and costs of any health services depend on the purpose for which they are to be used (Ellwood 1996). For instance, the aim of costing in economic evaluation is to maximise the benefit of resource utilisation according to the ethical value of the society, and not to save money. However, there are several other approaches for costing such as costing for pricing decision or cost of illness studies as part of the priority setting exercise (Gyldmark 1995, Kernick 2000). However, there is a consensus in the literature that costing exercises should preferably be undertaken within a decision-making framework.

Rationale for the study

Why would we like to compare the costs of health services in the EU?

The first, and often the most difficult, question at the beginning of any research project is what would we like to know? How, and in what way, can the new information be generated by the comparative analysis, and how this new information can help to solve an existing problem, or help to achieve our goals/objectives?

The European Union's health policy may pursue four objectives:

- Ensuring universal access to health care
- Comprehensiveness of a publicly funded benefit package
- Long term sustainability / affordability
- Portability across borders (basic requirement for free movement of human resources)

At the same time, the European Union may pursue other policies, such as health industry or insurance industry policies. Later policies partly focus on

parallel trade, pricing policy, competition regulation, and free movement of goods and services.

According to the aforementioned objectives, comparative costing studies may address three different questions and adopt three perspectives:

Q1: Do the total costs of the management of a particular health problem differ significantly from member state to member state? If yes, what is the major factor behind the differences? The recommended perspective is societal (and purchaser).

The answer to this question will help governments to reconsider their regulatory and/or cost-containment policies. E.g. a significant difference in the total costs of stroke or schizophrenia management in member states could highlight inappropriate practices, cost-shifting and/or poor value for money purchasing.

Q2: Do the costs of a particular service differ significantly from member state to member state (from region to region)? The recommended perspective is purchaser / governmental or provider.

Applying purchaser perspectives in the answer to this question will help public purchasers (insurance companies) to manage cross border care or re-evaluate their purchasing policies. For instance, the costs of same quality hip replacement or equally effective IVF treatment could be substantially more expensive in one region or country. This information would be vital for public purchasers to improve their purchasing practice.

The answer to the aforementioned question from a provider point of view can help providers to improve their technical efficiency and /or their local delivery system. At the same time, governments can use the information to revisit their standards, minimum requirements, policies, etc.

Q3: Do patients' private expenditures for a particular service differ significantly from member state to member state? This question compares cost-sharing policies as a financial barrier to access to services. The recommended perspective is that of the patient.

The answer to this question will help governments and the EU to improve equity in access, and reduce moral hazard, as well as ensure free movement of labour policy. Cost comparison could also be useful, for instance, in the case of dental care, diabetes, mental disorders or invasive interventions where long waiting lists (lack of capacity) or discretion of health professionals are paramount. This question could also address informal payments and cost-shifting issues.

This review will focus on the second question, applying predominantly purchaser and provider perspectives. A scientifically sound costing methodology, as well as the compliance to the methodology, is the prerequisite for a reliable answer to this question. In order to develop good practice guidance in comparative costing methodology, this paper will review the

available English language scientific literature with special emphasis on international comparative costing methodology.

Why we need good practice guideline in costing

Despite decades of experience in comparative costing studies and the growing harmonization of cost-accounting practices in the EU, costing of health services continues to raise both practical and methodological issues (Adam 2003, Balas 1998, Byford 1998, Halliday 2003, Jacobs 1996, 2005, Knapp 2002, Neumann 2000, Stone 2000, Thompson 2004, Young 1988)

What are the objectives of the Health basket project?

According to the project description, one of the overall aims of the project is “to identify what are the existing possibilities for and limitation to [cost] comparison and recommend the minimum data required to furnish meaningful international comparison in the future.” However, different barriers and/or limitations could exist depending on the decision problem selected.

This project would like to inform public purchasing decision makers about costs and prices of health services in different regions and members states in the EU. Therefore one subproject will assess costing methodologies for a well defined inpatient and outpatient health service at micro-level.

Part of this assessment is a comprehensive literature review of theoretical (academic) approaches to estimating the costs of individual services, with special emphasis on the methodologies for international comparisons. The aim of this review is to identify the practice of excellence in costing methodology at the micro level for cost comparison between countries as well as regions / institutions.

Objectives of working programme 7 (WP 7)

The aim of the WP7 is a systematic review of the scientific literature on costing methodologies of health services. The objective is to review the current published scientific literature about costing methodologies used to estimate the costs associated with the delivery of a particular service at micro-level in both in-patient and out-patient settings. In addition, the review will summarise the scientific literature on costing methodologies used in international comparative studies of health service costs at micro-level, including in-patient and outpatient settings. In order to do so, a research protocol comprising a literature search strategy, inclusion and exclusion criteria, data extraction and synthesis methods was developed as part of the review.

Structure of the review

This paper is structured in the following way:

Chapter 2 will summarise the research proposal. Chapter 3 discusses the theoretical foundation of costing in details. The following chapter (chapter 4) highlights the main steps of costing, and discusses the fundamental theoretical challenges in costing health services. In order to assess the feasibility of “theoretical best practice” the next chapter (chapter 5) critically reviews the existing practice by examining how published English language costing studies apply the methodological principles in practice. In addition, the next chapter (chapter 6) reviews some of the health service specific costing problems. Chapter 7 sheds light on the most important key principles of international cost comparison and discusses several practical problems. In order to form recommendations for researchers and policymakers, Chapter 8 assesses the quality of methodological guidelines, compliance to these guidelines and the quality of reporting the result of costing exercises. Before the paper finish, chapter 9 argues that trade-offs may be unavoidable in the development of guidance for best practice. The review concludes with a concise summary of best practice in conducting a (comparative) costing exercise at micro level with special emphasis on methodological issues. It will close with recommendations for policymakers and researchers, as well as a short discussion about the limitation of the study.

Research protocol

Objectives of the literature review

The overall objectives of the literature review

The overall objectives of the literature review are the followings:

- To summarise the costing methodologies applied at micro-level;
- To identify methodological issues concerning comparative costing and cost analysis inside the European Union.
- To classify methodological issues into those
 - where there is general agreement/consensus
 - where current practice is debated / controversial
 - Where further research / empirical testing / comparative studies should be conducted to develop an optimal methodological solution.
- To assess how existing data can be used to conduct comparative analysis.
- To develop a methodological guideline / framework to comparative costing studies.

Literature review strategy

Studies were identified through an electronic search of the Cochrane Library, EconLit, the HTA databases, Ingenta, Medline (Pubmed and OVID), NHS EED, Science Direct, library files and reference lists. In addition, the literature search was extended to the Internet, to DFID, World Bank, OECD, ILO, USAID, WHO and European Observatory websites, as well as government, academic institutions and large insurance companies' web pages for

unpublished online information. For the extended Internet search, the Google search engine was used.

In the Ovid Medline search MESH subject headings and subheadings, and filters (e.g. English language) were used. Moreover, online journals, websites and PubMed were also searched for relevant articles. In this case, beside text word search “related articles”, “similar article” and “cited by” functions were also used if these function were offered by the site. Furthermore, local library catalogues were searched, and a manual search was performed using reference lists from relevant articles and book chapters. In addition, researchers of the field were contacted for relevant published and unpublished literature. Due to the fact, that costing and accounting practice in the European Union has been changed and new financing mechanisms such as DRG implemented, the literature review focused on publications, which were published between 1986 and 2005. Only English language literature was included.

Inclusion and exclusion criteria

Inclusion /
exclusion by the
scope of
publication

Relevant literature can be classified into seven groups:

- 1, primary (health) economics literature (books/periodicals)
- 2, primary cost accounting literature (books/periodicals)
- 3, applied (health) economic literature (books/periodicals)
- 4, health care specific cost accounting literature (books/periodicals)
- 5, medical / public health literature (books/periodicals)
- 6, project reports
- 7, published official methodological guidelines

Good quality costing studies focusing on any EU member state or North America were included. On the other hand, management and financial accounting literature were excluded from the study. Furthermore, costing studies focusing on Africa, Asia, Australia, Latin America and the Middle East were excluded.

Quality criteria for
inclusion and
exclusion

The following quality criteria were used to include a study:

- Clear description of the purpose of the study (e.g. research question, aims and objectives of costing),
- Clear description of the study methodology (e.g. literature review methodology, assumptions applied, costing methodology, etc.),

- Clear description of costing methodologies (perspectives, resource measurement, valuation, dealing with uncertainties, etc.)
- Clear description of the source of data/information regarding unit costs and resource use.
- Clarity and details of the description of the study results.
- Generalisability/transportability of the results to the European Union member states

Literature search strategy

The following search terms (key words) were used during the search of the aforementioned databases and catalogues and Internet sites.

- Cost\$ and method
- Costing
- Costing methodology
- Cost methodology
- Costing method\$
- Cost\$ and EU and comparison
- Cost\$ and Europe and comparison
- (Cost* in TI) and method* and comparative
- (“Cost and cost analysis”/cl, mt, ec, og, st, sn) and Europe
- cost* and costing and methodology and Europe and comparative not cost-effectiveness
- cost* and analysis and comparative and methodology not cost-effectiveness
- cost* and analysis and comparative and methodology and Europe not cost-effectiveness
- Costing model\$
- Cost-analyses
- Unit cost\$
- Process costing
- System\$ of costing
- Review
- Methodological review
- Systematic review
- Economic costs and comparison and review
- costs and pricing and costing and Europe and review
- methodology for national comparative costing
- DRG and costs and review
- International variation and Europe and review
- International variation and costs and Europe

- European Union and policy and costing
- European Union and policy and costs
- Resource use measurement and costing (18 studies)
- cost accounting (5498, 04/07/05)
- cost accounting and review (185)
- cost accounting and cost comparison
- cost accounting and review and Europe (17)
- cost accounting and Europe and costing (29)
- cost accounting and Europe and costing (3)
- product line costing (23)
- product costing (63)
- departmental costing (14, relevant 2)
- bottom-up approach and costing
- top-down costing
- micro-costing
- learning curve and cost (0)
- learning curve and costing (0)
- costs and tariffs and Europe

The aforementioned search strategies generated three major types of publications:

- Cost-of-illness studies (mainly focusing on a particular disease and using either purchaser or societal perspective) (e.g. cost-of-illness of stroke, epilepsy, rheumatoid arthritis, etc.);
- Costing/cost analysis studies (mainly focusing on a particular service using either purchaser or provider perspectives) (e.g. studies comparing reimbursement rate and actual costs, or comparing cost structure of different providers);
- Cost-effectiveness analysis and health technology assessment reports (using either provider, purchaser or societal perspectives);
- Comparative studies (making comparison between organisations, regions and/or countries, as well as health service models).

Presentation of the result

This is a narrative review of the selected English language literature.

Abbreviations

Abbreviation	Meaning
ABC	Activity based costing
ADE	Adverse drug event
BSC	Balanced score card
CCCR	Clinical care classification System
CCCM	Clinical care costing method
CCR	Cost-to-charge ratio
CMG	Case mix group
DRG	Diagnostic related groups
FC	Fixed cost
GAAP	Generally accepted accounting principles
ICD	International classification of diseases
ICU	Intensive care unit
LOS	Length of Stay
MC	Marginal costs
MCO	Managed care organisation
MDC	Major diagnostic category
RBRVS	Resource-based Relative Value Scale (RBRVS).
ROI	Return on investment
RVU	Relative value unit
TAM	Time and motion method
TC	Total costs
VC	Variable cost

Major findings

Theoretical foundation of costing

This short chapter will highlight some of the theoretical issues, although several technical terms will be discussed in the Appendix 1.

Accounting versus economic costs and cost assessment

The economic evaluation of health service costs is based on welfare economics, which is concerned with the impact of any changes on the total welfare of the society. Therefore, costing methodologies based on welfare economics try to assess the impact of any decisions (changes) from a societal perspective. According to economic theory, service cost measurement should be inclusive (all relevant cost item should be taken into account), and long-run marginal costs should be used, where variability in costs (e.g. geographical or inter-institutional variability) are also taken into account (Beecham 1995, Brouwer 2001, Byford 1998, Luce 1990).

On the other hand, accountants are usually assessing decisions from a particular organization's perspective. As a consequence, accountants define and measure costs more or less differently. As a result, mainly due to differences in perspectives, as well as the decision problems to be solved, economists and accountants could apply different costing methodologies, which show significant differences in all the major steps of costing (identification, measurement and valuation of resource use) (Brouwer 2001).

Definition of cost

Accountants and economists use different cost concept. Accountants are concerned with measuring costs for financial planning and reporting purposes. Therefore, accountants measure costs by the historical outlay of funds. Practically the cost of the product is equal to the acquisition price of the product, including

the costs of financing minus depreciation. The accounting cost of a health service is its costs estimated by a cost allocation report. It encompasses direct and indirect costs (McGuigan 1993, Smith 2003).

On the other hand, economists argue that the real costs to society of resources utilised by the patients are their opportunity costs (economic costs), and the benefits that could have been obtained from the next best use of resources. Therefore, in costing studies, the economic definition of costs should be used, not the accounting (or financial) definition (Luce 1990, McGuigan 1993, Smith 2003).

In other words, economists are concerned with measuring costs for decision making. Therefore, their objective is to determine the costs of different alternative options (solutions) in the near future. This approach requires a careful assessment of opportunity costs (sacrifices or benefit forgone), because, from a societal perspective, the full economic cost of a particular health service is its opportunity costs. The costs are equal to the value of resources in its best alternative use (McGuigan 1993, Smith 2003).

The distinction between economic and accounting costs can be important in economic evaluation, because some cost items may not have an accounting value (such as informal care (charity work) or buildings/equipment after their accounting lifetime). In other words, economists may include some additional costs in a cost calculation performed from a societal perspective that are not reflected in the cost accounting reports (e.g. time costs). Usually, there is less difference in the inclusion of explicit costs. On the other hand, a significant difference could exist in the inclusion of implicit costs (McGuigan 1993, Smith 2003).

Explicit and implicit costs

Typically, explicit costs are cash expenditures, and implicit costs are non-cash costs. Explicit costs such as labour, rent, raw materials, and interests are relatively easy to measure. On the other hand, implicit costs such as the opportunity costs of time and capital could be difficult to estimate (Hirshley 1995).

Cost measurement

Measuring accounting costs at hospital or departmental level can be relatively straightforward. Likewise, the measurement of opportunity costs (economic costs) for several costs items can also be uncomplicated (Smith 2003).

Measuring economic costs

In a “perfect market”, prices are good estimates of opportunity costs. However, the health care and health insurance market is heavily regulated in the EU member states. Furthermore, several market segments are oligopolistic, and most of the clinically effective and cost effective services are reimbursed in most of the EU member states (third party payment) and the utilisation of health care services can have positive and negative externalities. Therefore, market prices may or may not be a reasonably good estimate of opportunity costs. Consequently, market prices just after an

appropriate adjustment can be used as a reasonable proxy of opportunity costs (Garber 1996, Brouwer 2001, CCOHTA 1996, Luce 1990).

Opportunity costs can be substantially different from market prices in the following circumstances (Knapp 1993, Garber 1996, Brouwer 2001):

- where market price is significantly distorted by market failures
 - monopolistic / oligopolistic market
 - significant positive or negative externalities
 - in the case of public goods
- where market price is significantly distorted by third party payment system
 - for instance, acquisition price could be significantly different from market price (price discrimination)
- where market price is significantly distorted by government interventions
 - taxes, duties, or parallel import regulations
- where market price is unstable or unpredictable
- where market price is not in equilibrium or significantly changing by the stages of the product lifecycle.
 - Market price in the learning phase could be different from the price after widespread adaptation of the technology.
- where market price does not exist (for instance, in the case of informal care, charity work, including the measurement of opportunity costs of patient or caregiver time, especially for people out of the labour market, could be extremely difficult)
- where difficult to allocate/ apportion costs because inputs are shared.

Therefore, analysts should be careful in using market prices or tariffs in the evaluation or costing of health care services, because they may not reflect true opportunity costs without appropriate adjustment. In those circumstances, when market prices are likely to provide fundamentally flawed estimates of opportunity costs, an alternative solution is required, for instance official costs databases, such as the PSSRU's Unit Costs of Health and Social Care database in England (Brouwer 2001, Garber 1996, Knapp 1993).

Moreover, Finkler (1994) argues that "true cost" does not exist, partly because costs calculated by cost accounting methods can only be reasonably good estimate of economic costs. Furthermore, economic costs or opportunity costs reflect the value of the alternative use of resources. However, the calculation of the value of different alternative uses of resources may require knowledge of aggregate utility of all individuals in the society for each possible alternative. Unfortunately, economists have not yet developed a practical and economically feasible way to measure the social welfare function of different

alternatives. Moreover, the calculation of opportunity costs can be very costly and time consuming, because it may require individual special studies to identify all the relevant alternatives and estimate the costs and benefits of each alternatives, partly because opportunity cost is context specific. As a result, a new decision problem may require a new costing study (Byford 2003, Zimmerman 2003).

Therefore, the measurement of opportunity costs or true costs could be difficult and/or resource intensive. Accounting costs can provide reasonable accurate estimates of `opportunity costs relatively cheaply and quickly. However, accounting costs are not opportunity costs, partly because they are based on historical costs. Moreover, analysts could face significant challenges. For instance, most health care organizations have several joint costs, and so sharing out joint costs fairly could be difficult. As a result, in the real world, decision makers have to deal with reasonably good cost estimates (Bowling 2002, Finkler 1994, Luce 1990, Zimmerman 2003, see table 1).

Table 1 Examples of potential differences between accounting and economic approach in valuing resource use (Kesteloot 2000)

Resource use item	Accounting costs	Economic costs
Buildings	Historical acquisition (purchase) price	Replacement value
Equipments	Historical acquisition (purchase) price	Replacement value
Fixed assets	Opportunity cost is taken into account only if money is borrowed to purchase the asset	Opportunity cost of the capital is taken into account

The purpose of costing determines the choice from costing methodologies

There are several ways (appropriate methods) to estimate the unit costs of a particular service. Selecting the appropriate method depends on the type of service, the reason for costing and the economical feasibility of cost calculation. There is no universally accepted appropriate costing methodology. Different cost concepts and different costing methodology should be used depending upon the purpose for which cost data will be used (e.g. pricing, tax report, management control, internal cost containment decisions, supervisions, etc.) As a result, the cost of a particular service can vary substantially according to the purpose of cost data for which it was generated (Zimmerman 2003).

In general, two major types of costing methods have developed: (a) the economic evaluation method (based on marginal analysis) and (b) cost analysis based on cost accounting method (average unit cost assessment). Although, they are not mutually exclusive methods, one or the other method is more appropriate depending upon the decision problems faced (St-Hilaire 2000).

Relevant costs

In addition, the decision problem determines those costs that analysts should take into account. The type and accuracy of cost information required by decision makers may vary significantly, but those costs that should be taken into account in a given decision making problem are known as relevant costs. In other words, any costs, which will not affect the decision, are irrelevant to the decision. One of the examples is the so-called sunk cost, which does not vary across decision alternatives (Hirschey 1995). On the other hand, some type of costs analysis (e.g. cost of illness analysis) may consider all the costs, including those costs that could be sunk costs for other decision problems.

In addition, for tax purposes, actual historical costs are the relevant costs. However, for management decision making, the current costs are usually more appropriate. Current costs are often determined by replacement costs, which can be higher or lower than the actual acquisition costs were.

The decision problem influences the selection from cost techniques

Absorption costing

Absorption costing is the basis of all financial accounting systems. It means that all costs are absorbed (allocated or shared out) into production and operation statements do not distinguish between fixed and variable costs. In other words, both fixed and variable costs are included into the cost calculation. Conversely, fixed costs are not absorbed into production when marginal costing is used. Marginal and absorption costing could yield different profit (surplus) figures because they differ in stock valuation (Lucey 2002, Zimmerman 2003).

Because in absorption costing the cost objects are usually the final products (services or jobs), the absorption cost system is widely used to value the costs of products manufactured, or services and jobs delivered in manufacturing firms, as well as in service sectors, including health care. Although there is no substantial difference in the absorption costing used in service and non-service industry, defining a product (service or job) could be difficult in the service industry (Zimmerman 2003).

There are two major (basic) types of absorption costing: (a) job order costing and (b) process costing. Job order costing estimates the average unit costs for

each job delivered. Process costing assesses the average unit cost for each service provided in a given time period. It is important to keep in mind that absorption costing allocates historical costs, and therefore the unit costs estimated by this system may or may not be reasonably good estimates of opportunity costs (Zimmerman 2003).

Activity based costing (ABC) is a relatively new approach in full absorption costing. ABC is getting more widely used for costing public services, such as diagnostic imaging, laboratory services or intensive care. This latest approach allocates overhead costs more fairly. Using activity based costing could improve costing in health care, and shed light on services that were under-costed or over-costed in the past using traditional costing methodologies (Pyke 1998).

Marginal costing Marginal costing is a different approach compared to the aforementioned costing methodologies. Marginal costing methodology is used to calculate the cost of one additional unit of service. Economists argue that variable costs can be equal to marginal costs in the relevant range. In a given ranges of volume of services the fixed costs are constant, therefore the marginal costs are equal to the variable costs. Therefore, marginal costing requires the total costs to be split into fixed and variable components (definitions of fixed and variable costs can be found in the appendix) (Lucey 2002).

Marginal costing is useful for the short term (tactical decisions) such as accepting a special order (special order or marginal cost pricing), dropping a product or service, and/or making “make or buy” decisions, because the fixed costs remain unchanged. On the other hand, in the long term and/or when fixed costs are expected to change, the differential costing method should be used (Lucey 2002, Millchamp 1997).

Differential costing Differential costing has a broader focus compared to marginal costing. Differential costing assesses all the differences in revenues and costs between relevant alternatives and informs decision makers about the best possible option. Differential cost is calculated for make-or-buy decisions, keep-or-discontinue decisions, and special price decision making (Young 2003).

Average versus marginal costs Average costs include all the direct and indirect costs, while marginal costs only encompass variable costs. Using short run marginal costs in decision-making, however, has limitations, because only variable costs are considered. Therefore, depending on the decision problems and the assumptions applied, short run marginal costs may or may not be appropriate for costing. If the assumption of the costing exercise is that health care programmes can be expanded over the relevant range, costing should include both the variable and the fixed costs. In these cases, long run marginal costs should be used. However, our knowledge about the future is uncertain (Bowling 2002, Beecham 1995, Brouwer 2001).

Although, according to economic theory, decisions should be based on long run marginal costs, the practical convention is to use short run average costs as a proxy for long-run marginal costs, partly because our knowledge about the present is more accurate and certain than about the future (Beecham 1995, Brouwer 2001).

The selection between the two approaches (marginal and full absorption costing) depends on the decision problem and the context of the decision (Beecham 1995, Brouwer 2001). For instance, a survey showed in 1991 in the UK, that 69 % of the Health Authorities and 41 % of Trusts considered purchasing/providing services on a marginal-cost basis, and developed contract accordingly (Beddow 2001).

Time horizon - short run and long run

Economists distinguish between short run and long run over which costs may behave differently. From a cost behaviour point of view, short run is a time span over which most costs are fixed (constant). The time period depends on the nature of inputs and production. In other words, short run is the observation period until at least one input is fixed in availability, whereas in the long run all inputs are variable. However, the distinction between short run and long run can be rather obscured or arbitrary (Hirschly 1995).

On the other hand, in the long run all costs vary. However, the timeframe of the analysis could be determined by the decision problem, regardless of how costs may behave over the selected period.

Time horizon and product lifecycle

The time could have an impact on the cost of services in several different ways. For instance, during the learning curve phase costs could be significantly (10-30 %) higher than after it. Furthermore, some institutions could adopt a very efficient delivery process and the cost of service delivery could decrease substantially, but the inter-organisational or regional variation in costs could increase. In addition, further technological development could also reduce the costs. Therefore, the appropriate time horizon, and time of the costing exercise, as well as careful selection of the sites for costing, is very important (Brouwer 2001, Dranove 1996).

Perspective

In order to estimate the total costs of a particular health service, it is important to identify all the relevant costs, and those who bear these costs. The perspective of the cost analysis will determine whose costs should be taken into account (Drummond 2005, Elliott 2005, Green 1999, Luce 1996). Because costing as well as economic evaluation studies try to inform different decision problems, analysts apply different perspectives (Wimo 1997). (Figure 1)

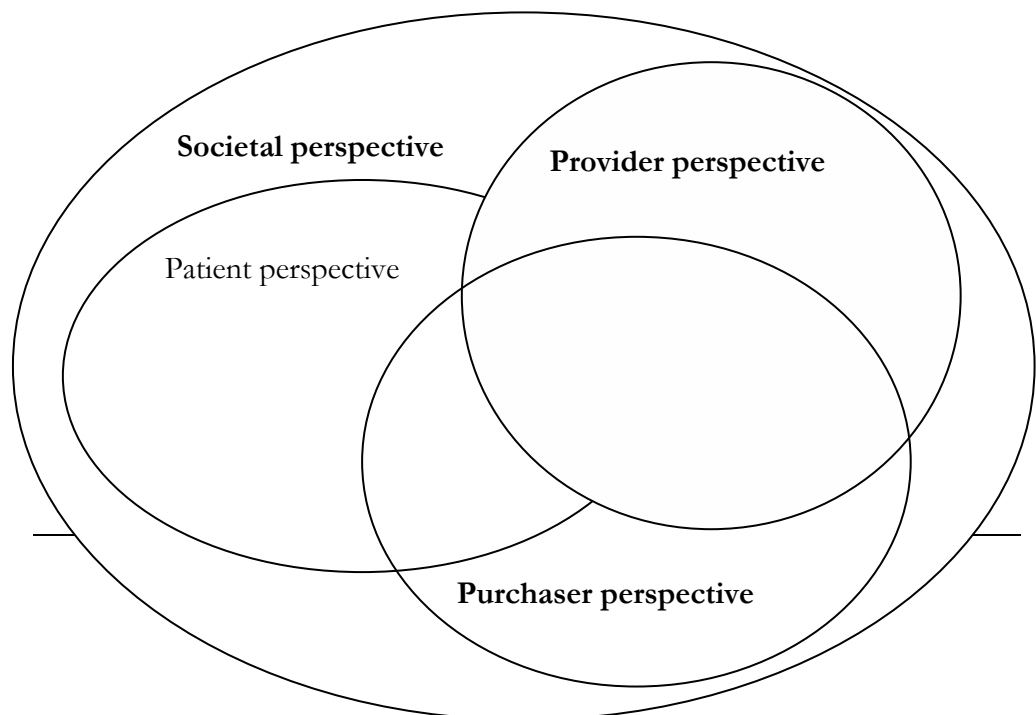
Public purchasers determining the best option for society may take all the costs into account regardless of who they fall upon (societal perspective), or take a narrower view and count all the costs which will be borne by the public purchaser (public purchaser or governmental perspective). On the other hand, (private) providers are only concerned with the costs fall on their institutions irrespective of any wider implication (knock-on effect or cost-shifting) for other institutions, purchasers or the patients and their carers (provider perspective) (Green 1999).

Because healthcare economic evaluation is based on welfare economics, it concerns with the welfare of the whole society. Consequently, welfare economists argue that economic evaluations should adopt societal perspective. Narrower perspectives, such as purchaser perspective could lead to maximising the benefits within the limited public budget, but not necessarily maximising the welfare of the whole society. Furthermore, broad societal perspective ensures that the analysts could consider those options, which allow the use of resources outside the healthcare sector yielding greater welfare to society (Byford 1998).

Moreover, using a narrow perspective (such as patient or provider perspective) could allow cost shifting, for instance, cost shifting between patients and the purchaser or cost shifting between different providers and the patients. A broad societal perspective could help to recognise cost-shifting (Byford 1998, Elliott 2005, Luce 1990, Johnston 2001). On the other hand, private providers might argue that government regulation could ensure that regardless they are adopting a narrow perspective, the optimal balance between private and public interest can be sustained (Byford 1998).

Beside the perspective of the study, other factors such as the form of economic evaluation (cost-minimisation, cost-effectiveness, cost-utility, and cost-benefit analysis) and/or cost analysis (cost of illness studies, unit cost estimation, and cost structure analysis) also determines whose cost and/or what type of costs included (Johnston 2001).

Figure 1 Differences in perspective



Economies of scale and diseconomies of scale

Economies of scope and scale could make a substantial impact on the unit costs of a particular service. In addition, researchers found that hospitals may not operate in their long run equilibrium, and could have significant excess capacities. There can be considerable economies of scale in hospitals, but these economies of scale could be relatively quickly exhausted as size increases. Therefore, comparative studies should compare providers with similar characteristics related to the economies of scale and scope (Butler 1995, Jacobs 2005, Luce 1990, Smet 2002)

Economies of scale

There are three different sources of economies of scale (Butler 1995, McGuigan 1993):

- product specific economies (output of one product)
- plant (institute) specific economies (output of one plant / institution)
- firm-specific economies (output of a firm's operation)

Greater specialisation in the use of labour and capital can enhance the economies of scale of one product. Furthermore, the learning curve effect can also contribute to the product-specific economies of scale. (Learning curve effect = amount of inputs / resources required to produce the same amount of output is decreasing with time. In other words, the long run average costs are declining with time due to improving technical efficiency). Although the learning curve phenomenon is important in the introduction of new health technologies, many health care providers do not fit into this pattern (Butler 1995, Hirschey 1995).

Institution or plant specific economies of scale can be explained partly by savings in capital costs and overhead costs such as maintenance and repair service costs. For instance, a unit cost of one hospital episode can be considerably lower in a hospital achieving 85 % bed occupancy rate compared to hospitals with 45 or 65 % bed occupancy rate due to the significantly lower fixed cost component. This is closely related to the so-called excess hospital capacity issues (Hankins 2004).

Firm specific economies are associated with the overall size of the firm. Firm specific economies can be the result of savings in marketing and sales, and/or

raising capital funds and/or the distribution of service delivery among different plants, as well as joint management. For instance, hospital chain or dialysis services with multiple satellite centres can capitalise on firm specific economies (McGuigan 1993).

Diseconomies of scale

Diseconomies of scale exist when (long-run) average costs are increasing at a higher level of output.

Economies of scope

Economies of scope occur when the full cost of joint production is less than the cost of producing the individual products. In other words, costs of a particular product or services can be affected by the production of other products or the delivery of other services. This is called economies of scope. Economies of scope are present whenever the costs of providing two or more services jointly by the same institution are less than the costs of providing them separately. This could be important for multi-product organisations such as hospitals or outpatient centres (Butler 1995, Clewer 1998, McGuigan 1993).

Variation in unit costs estimates can be caused by the differences in capacity utilisation; and therefore, capacity utilisation rate should be identified and reported. The importance of economies of scale and scope is widely acknowledged by methodological guidance, frequently without making any recommendations (Adam 2003, Jacobs 2005)

Summary

There are several scientifically sound and appropriate costing methodologies based on different cost concepts, because costs can (should) be measured in different ways, depending on the purpose of the measurement. For instance, costs obtained for financial reports are not always appropriate for economic analysis or decision making, because they may not reflect the opportunity costs of the various alternative options. However, the process of costing requires scientific rigour and individual discretion (judgement), as well as common sense, because costing is a methodology for practical purposes and the costing exercise should also be “cost-effective” or “good value for money” (Lucey 2002, Pyke 1998).

Marginal costing and full (absorption) costing, including activity based costing, are two different approaches frequently discussed in the literature. Full costing makes it possible to compare costs between internal and external providers, or to make cost comparison between regions, as well as countries. Full costing also enables the analysts to ascertain whether a particular provider is achieving value for money. Furthermore, full costing ensures that all the costs are recovered (Lucey 2002, Pyke 1998).

On the other hand, marginal costing is used for different management decisions, especially for short run decisions involving changes in volume and activities. Marginal costing can be very challenging because costs cannot be easily divided into fixed, stepped-fixed, variable and semi-variable costs. Furthermore, fixed costs can change slightly (Lucey 2002, Pyke 1998).

Costing methodology

Because the selection of appropriate costing methodology depends largely on the intended use of cost information, this chapter describes a five-step approach to costing. The decision problem and objectives of costing will determine the appropriate perspective and time horizon of costing, as well as partly influence the selection and definition of the particular services for costing. Finally, the total cost of a particular service is determined by the quantity of resources consumed and the unit cost of the resource items. Therefore, costing usually encompasses five major distinct steps (Brouwer 2001, Byford 2003, Finkler 2001b, Green 1999, Oostenbrink 2002, Sefton 2002):

- (a) Portray the decision problem and establish objectives of costing (Selection of study perspective, time horizon and explicit statement about the assumptions applied are also an essential part of this step.);
- (b) Detailed description of the service(s) for costing (final cost object);
- (c) Identification and classification of resource items and units of resources utilised to deliver a particular service or produce particular goods. The units of measurement (units of input) can be an activity or physical resources such as disposables or drugs;
- (d) Measuring resource consumption in natural units; and
- (e) Placing monetary value on these resource items (goods, activities, and/or services) and calculating the unit costs of a particular service.

The so-called “resource costing” follows the aforementioned steps, whereas the “price adjustment costing” approach may skip steps (c) and (d) (Seninger 2004).

Although some of the costing methodologies omit one or more steps, decision problem definition, service description, identification, measurement and valuation of resources are distinct steps in costing. Moreover, it should be noted that several costing guidelines focus only on the last three steps (Luce 1996, Alban 1997).

The following sections will describe these steps separately in more detail. Applying this didactic approach, however, may result in some repetition later.

Objectives of costing

The first step towards a decision is the appropriate identification of the decision problems and the decision makers' objectives. The way in which the decision problem is defined has an impact on the perspective of the cost evaluation, the way in which units of services are defined, the type of cost needs to be measured, and other methodological / practical issues such as the time horizon of the study and/or the level of details and precision of cost measurement (Jegers 2002, Seninger 2004, Shepard 2000, CCOHTA 1996). The following table shows examples of possible decision problems that comparative costing may inform (see table 2).

Table 2 Purpose of costing of services

1.	Pricing new services for an internal market
2.	Pricing new services for cross border care
3.	Pricing services for non-insured (private) patients
4.	Cost comparison between different providers
5.	Cost comparison between different providers in different regions
6.	Cost comparison between different countries
7.	Cost comparison with other mutually exclusive services
8.	Benchmarking for services / providers
9.	Identify areas of cost reduction / cost containment
10.	Assessing whether a particular service is good value for money
11.	Making formal coverage policy decision / reimbursement decision
12.	Fine-tuning (upgrading) incentives / payment policies
13.	Developing local cost conscious clinical guidelines / patient pathways
14.	Other decisions

The units of service may vary significantly depending on the reason for the cost calculation. For instance, if the purpose of the costing study is to compare prices / costs of different providers (e.g. in different countries), the selected unit of service should be commonly used by different providers in different countries and / or the calculation of the unit costs should be economically feasible. If the purpose of the costing study is to compare mutually exclusive services, the definition of the unit of service should be appropriate to the different type of services (Bean 1996).

In addition, different cost measurement methods may be needed for different questions or decision problems. Selection of the most appropriate costing

methods usually depends on the purpose of costing. For instance, the decision problem could influence the choice between full costing and marginal costing approaches. Moreover, the prerequisite for the development of a clear and scientifically sound costing guideline is a well defined objective of costing (for which purpose costing information will be used) (Magid 1991, Finkler 1994)

Accurate costing is important regardless of the actual purpose of costing, but it could be extremely difficult to select a reasonably accurate methodology without a clear description of the purpose of costing (Waters 2004).

Ambiguity at the beginning: no clear objectives

Description of study objectives which aim to inform health policy should be SMART (Hammond 1999):

- Specific (clear cost objects, well defined unit of service = population group, existing pathology, expected outcome, settings, health technology)
- Measurable (good quality data are available, and /or collection of data is feasible and economical)
- Achievable (costing methodology = trade-off between accuracy, reliability and timeliness)
- Relevant (to the original decision problem, e.g. whether the perspective of the study is appropriate or not = who will use the results and for what)
- Time-bound (deadline and year of measurement)

E.g.: Measuring and comparing costs of particular services (hospital, ambulatory, primary care, diagnostic, pharmaceutical, and home care) in the European Union member states at the year 2004.

Without a well-defined decision problem and clear objectives neither the alternatives methodologies nor the trade-offs can be assessed.

Perspective of costing

Because the study perspective could affect the question/decision problem addressed, the inclusion and exclusion of resource items (costs), methodology selected, and the statistical analysis completed, a decision or recommendation should be made about the perspective of the study (Drummond 2005, Seninger 2004). The analysts should be clear and explicit about whether the costing exercise is performed from a:

- (a) patient (first party)
- (b) provider (second party)
- (c) purchaser (payer) (third party),

- (d) employer or other sponsor (fourth party)
- (e) government, or
- (f) societal perspective.

The perspective determines the types of costs that should be taken into account. For instance, it can have an impact on whether direct non-medical costs (e.g. travel) should be taken into account whether or not they are reimbursed (Jegers 2002). Likewise, the perspective could determine whether social care (safe houses, nursing homes, home modification etc.) are included or not. Further challenges could be the partial inclusion or exclusion of multidisciplinary care costs (e.g. early intervention for schizophrenia). Furthermore, the perspective will determine whether productivity costs should or should not be taken into account, as well as whether (service providers') overheads should be added to direct medical costs or not (Luce 1996, Torrance 1996, Drummond 2005, Payne 2002).

Table 3 Inclusion and exclusion of costs by perspectives (Luce 1996)

Cost elements	Perspectives			
	Societal	Public purchaser	Private purchaser	Provider
Health service costs	All	Covered expenses	Covered expenses	Expenses of provided services
Productivity costs	Included	Excluded	Excluded	None
Informal carers	Included	Excluded	Excluded	Excluded
Transportation	All	If any paid	If any paid	Excluded
Other non health service costs	All	If any paid	If any paid	Excluded
Sick leave	Administration costs only	If any paid + administration costs	If any paid + administration costs	Excluded
Disability benefits / pensions	Administration costs only	If any paid + administration costs	If any paid + administration costs	Excluded

In general, identifying and valuing all the costs from a societal perspective could be challenging (e.g. not available and/or difficult to measure), but analysts should do their best to identify, measure and value resource use where it is possible in an economically feasible way (Green 1999, Seninger 2004).

In addition, Seninger and Smith (2004) argue that analysts should highlight all the possibilities of potential cost shifting to any other party, even if the actual value of cost shifting is not estimated, because it helps decision-makers to interpret the results of the cost analysis.

European guidelines recommendations

European guidelines for cost-effectiveness analysis in health care differ in their recommendation about analytical perspectives (source: ISPOR website):

- The **societal** perspective is recommended as the base case in Finland, Germany, Poland, Portugal, Sweden, and the Netherlands.
- The **purchaser / government** perspective is recommended in the Baltic States, Scotland, England and Wales.
- **Both**, the societal and purchaser perspectives are recommended in Belgium, Ireland, Italy, and Norway.
- Different perspectives are recommended **depending on the target audience** in France, Hungary, Spain and Switzerland.

Time horizon in costing

The decision problem addressed, as well as the selected perspective could influence the time-horizon of the study. The selected time horizon, however, could have an impact on the cost of services in several different ways. For instance, the time horizon of costing is an important issue because (a) the behaviour of costs change by time, and (b) the time horizon will determine which costs should be involved in the study. Likewise, the timing of the cost exercise is important, because comparability can be ensured if costs are measured in the same time period and expressed / converted in the same year. Therefore, studies should be explicit about the time horizon during which the study has taken place (Brouwer 2001, Drummond 2005, Jegers 2002, Oostenbrink 2002, Seninger 2004)

Time horizon and cost behaviour

Although the time horizon determines the nature (behaviour) of some costs (e.g. salaries or human resource costs), all types of costs can be variable costs in the long run. Uses of long run marginal costs are preferable (in economic evaluation), because short run marginal costs do not usually take into account the full cost of creating new services. There is a convention, however, in the literature to use short run average costs, which include both direct and indirect costs (running costs and capital costs), as an approximation for long run marginal costs (Allen and Beecham 1993, Slothuus 2000).

Time horizon and cost tracking

Although the appropriate time horizon of the study should ultimately be determined by the decision problem, analysts may have a choice about the definition of services for which costs will be measured and compared. The definition of services may influence the time period during which costs should be tracked. Inappropriate time horizons can bias the results and mislead decision-makers. For instance, the cost of a hip replacement could only

involve the costs of the operation or it could include the costs of the perioperative management and a reasonable follow up period. Analysts can face similar challenges in the case of day surgery or the treatment of chronic diseases. The difference could be significant and important from a purchaser point of view (Drummond 2005).

In addition, over a longer time period, practice variation could increase, technological changes can take place, and unit costs could also change significantly. Moreover, if the time span exceeds one year, costs should be discounted and expressed in present value, creating further methodological dilemmas, because methodological guidelines currently disagree on the most appropriate discount rate. As a result, most textbooks and guidelines agree that one year should be the time span for a costing study (Jegers 2002).

Time horizon and comparability

Cost comparison between EU member states is a cross sectional study, therefore the same (and as up-to-date as possible) calendar year should be used. This is crucial, because regulations, as well as practice patterns, can change significantly over years, including significant manpower substitutions. A substantial time-gap between the cost analysis and the decision or policy formation could make the information generated by any good quality cost analysis invalid or irrelevant (Beecham 1995). However, expressing the costs in the same year may make it necessary to use consumer or medical price indices. These indices could differ significantly, and some member states may not have official (medical) indices.

Time horizon and product lifecycle

In addition, during the learning curve phase costs could be significantly higher than after it. The learning curve effect is well documented in several surgical interventions, such as organ transplantations; for instance, 50 % cost reduction was observed in the case of heart transplantation over the first four years. Likewise, total treatment costs can be reduced by avoiding the potentially costly side-effects of an operation or drug protocols by fine tuning the local clinical practice guidelines / protocols. Furthermore, some institutions could adopt a technology very early on, while others adopt it several years later. As a result, by the time of the cost comparison, early “adaptors” could be implementing a very efficient delivery process and the costs of service delivery may have decrease substantially, but the inter-organisational or regional variation in costs could increase. Therefore, the appropriate time horizon, and time of costing exercise and/or the careful selection of the sites for costing are very important, because neglecting the learning curve effect could bias cost estimates (Dranove 1996, Brouwer 2001).

Comparability, time horizon and side effects

Moreover, in order to ensure comparability, it is important that studies have the same, as well as appropriate time horizon. A very short time horizon could cause bias in cost calculation. One of the

reasons for this is the difference in side effects and complications. For instance, keyhole surgery can be cheaper as an intervention, but taking all the treatment costs of the complications and side-effect into account, it could turn out that keyhole surgery is more expensive than traditional surgical interventions (Dranove 1996).

Defining health services for costing

In order to establish the unit costs of any type of inpatient or outpatient services, the particular services (cost object) should be defined clearly and in detail. Without a detailed description decision makers may not be sure that like is compared with like. Likewise, the accurate ascertainment of service cost relies on a clear description of the particular service. However, service description could be a very complex and challenging task in health care (Abedian 1998, Beecham 1995, Finkler 2001b, Lucey 2002).

Health services, however, can be defined differently; therefore, costing studies could focus on one of the following options:

- Comparing the (unit) **costs of particular services** (e.g. GP visits, cataract surgery, colonoscopy) or
- Comparing **costs of treatment episodes** (e.g. ambulatory DRG, inpatient DRG, costs of the treatment of common flu, costs of first psychotic episodes, etc.) or
- Comparing the **annual total costs of particular services** (e.g. the total costs of specialist pain clinic or costs of stroke unit per year)
- **Cost of illness** for a given time period (e.g. low back pain treatment in primary care in the first month or stroke treatment for the first year). This comparison may be more comprehensive and can avoid or uncover cost shifting (day hospital and informal care)

The selection and definition of health services (cost objects) will substantially determine the type of cost information is needed and the measurement and valuation method of resource use (Young 2003).

The current literature review focuses on the first two definitions, comparing the unit costs of particular in- and out-patient services as well as comparing the unit costs of treatment episodes.

To be sure that like is compared with like, the definition of services (or health technologies / treatments) should be sufficiently detailed, including all the essential or common elements of the service, because the common medical terms (e.g. rehabilitation, end-of-life care, etc.) could have an inconsistent meaning. In addition, the definition should describe the content, scope, settings, institutional arrangement, financial / payment systems, standards, quality and unique characteristics of the services. It may include a description of the following (Beecham 1995, Abedian 1998, Seningen 2004):

- Target population (age, gender, morbidity, co-morbidity, severity or stage of illness, and case mix);
- Type of facility (e.g. teaching hospital, special mental health hospital, independent or satellite dialysis unit, private for profit facilities, etc.);

- Location of the facilities (rural / urban, capital, large regional city centre, etc.) Local land and property prices, and sometimes wages vary significantly by regions or locations (e.g. “London multiplier” and “non-London multiplier”);
- Service intensity;
- Service mix (e.g. comparing DRGs, or hospital service costs);
- Average workload by the provider or department or service unit;
- Treatment of adverse events, complications and co-morbidities, readmissions, etc.;
- Type of hotel functions used;
- Quality and grade of health professional staff involved;
- Provision of non-medical elements of the service (e.g. patient transport, food, accommodation, etc.);
- Criteria of discharge or transfer (if the patients are hospitalised or treated as inpatient);
- Payment mechanism (e.g. capitation, fee-for-service, etc.);
- Source of payment (exclusively public purchaser, private purchaser, institution with multiple source of funding).

The detailed description helps to identify the relevant resource elements used to deliver a particular service (see later for more detail).

Example - defining a “day hospital”

”Treatment goal: to provide a therapeutic environment that stabilizes and improves the clinical condition of acutely psychotic adults diverted from inpatient admission. This option excludes those unable to maintain minimal standards of safety for themselves or others. On discharge, living skills will be such that, with supervision, clients can manage their own medication and have sufficient judgment to maintain a safe and healthy lifestyle in either a sheltered or supported living setting. The direct clinical staff to client ratio is 1:2. Staff are RNs with 1 MD:25 clients. The average length of stay is 26 days. No limits on the amount or duration of treatment. Coordination with other providers is essential: day hospital treatment is a step below inpatient treatment and a step above community support programs.” Source: Dickey 1999

Usually the descriptions of service content, scope, standards, quality and unique characteristics are inter-related and have an impact on the resource requirement of the service. Furthermore, the type of service, the reason for costing and the feasibility of measurement (as well as calculation) also

determine the definition and/or selection of service unit. For instance, resource use measurement may require an expensive and complex recording system, which is not in place. Therefore, costing studies may use an alternative (unit of) service definition, in which case the necessary information is more easily obtainable (Bean 1996).

Potential problems

Broad and/or vague definition of patient population

Often policy-makers, decision-makers or researchers do not give sufficiently detailed description of health services. As a result, the costing exercise may not be consistent enough to ensure comparability. For instance, several costing studies used very broad descriptions of the patient population, e.g. epilepsy, stroke, low back pain, dementia, etc. However, these broad terms could cover very different medical conditions with distinct health service needs. For instance, the costs of treating an uncomplicated fracture could be different from the treatment of complicated fractures in elderly diabetic patients or the cost of dialysis of patient without co-morbidities is considerably lower to the cost of dialysis with co-morbidities. Likewise, the cost of treating patients suffering from severe functional impairment (dependency) could be significantly different from treating patients with only mild functional impairment (e.g. sever versus mild Alzheimer's disease, or stroke patients with sever disability versus moderate disability) (Chuang 2003, Currie 2005, Dodel 2004, Ekman 2004, Grieve 2001, Grun 2003, Wimo 1997).

Moreover, the stratification by age and sex might not be enough, because resource consumption can be determined by other factors such as co-morbidity. Therefore, patient case mix should be taken into account, because earlier costing studies showed significant differences between subgroups patients (e.g. patients with diabetes having single or multiple vascular complications) (Dodel 2004, Currie 2005, Grieve 2001, Grun 2003, CCOHTA 1996, Luce 1990). For instance, Beck (1996) found significant differences in service costs between subgroups of AIDS patients. Likewise Dodel et al (2004) found significant cost difference by severity of disability. On the other hand, there is some disagreement in the literature about the most appropriate classification system used for grouping patients with co-morbidities and severity of illness (Melfi 2001).

Broad and/or vague definition of services and/or products

Catalogues or benefit packages as well as price lists (national tariffs) may not have sufficient details to allow sophisticated comparison. E.g. positive and negative drug lists usually describes the pharmaceutical products, and rarely the indications.

Practice variation

In addition, former studies showed that there is a significant variation in practice pattern between EU member states. However, significant variation

can make cost comparison practically impossible, because due to practice variation different products will be compared. This violate the basic principle that like should be compared with like. This is especially important in inpatient care, which tends to dominate service costs. Furthermore, studies showed that there are significant in-country, as well as inter-country variations (Knapp 2002, Leurquin 1995, Urdahl 2003). For instance, the cost of a psychiatric visit is 112 Euros in the UK, and 19 Euros in Germany, with 13 times the difference between the highest and the lowest (9 EU member state) (Urdahl 2003).

Identification and classification of resource items

Elements of service costs / resource items

Whichever method is used, one of the key factors for estimating accurate unit costs is the identification of all relevant costs (resource items) for the service delivery (Alban 1997, Beecham 1995, Byford 2003, Drummond 2005, Johnston 2001, Lee 2003, Luce 1990, 1996, Seninger 2004).

Depending on the essential infrastructural requirements, services can be divided into two major subcategories: (a) facility-based services and (b) peripatetic services (health services that can be delivered in a variety of different places) (Beecham 1995). The delivery of these two types of services may require a variety of different inputs such as (Bean 1996):

- Human resources
- Other goods and services
 - Medical equipment
 - Disposables
 - Pharmaceuticals
 - Diagnostics
- Fittings, fixtures and equipment
 - Office furniture
 - Computer hardware and software
- Building, land (capital costs)
- Accommodation
- Administration / management
 - Printing, posting,
 - Rents
 - Security
 - Cleaning
 - Utilities
 - IT/IS services
 - Repairs and renewals.

This report focuses only on health service costing methodologies from provider or purchaser perspectives, and therefore, non-healthcare resources, as well as non-resource costs use will not be taken into account.

Identification tools

In practice, identifying most of the resource items is usually straightforward and easy, although some of them can be a little bit problematic, and a few of them very difficult. For instance, some of the overhead costs, such as training costs, supervision costs, and administrative overheads are frequently omitted from the cost calculation. Likewise, the identification of joint costs is crucial, but challenging (Yazbeck 2001).

Developing a detailed description of a clinical management pathway (process) or flowchart could help identify resource items. Local or national clinical care pathways and/or protocols (guidelines) could help to develop a detailed flowchart. Likewise, (legally bound) accreditation norms, TQM/QA process and task descriptions could also be helpful in practice. Moreover, literature reviews, focus group discussions, interviews and individual consultation with experts / health professionals may also be helpful. The aforementioned methods can be used alone or in combination. It is important, however, to keep in mind, that without a valid and detailed description of the health service process, it is unlikely that all the resource items, which will be used, regardless of the feasibility of measurement, will be identified (Byford 2003, Griffiths 2005, Kesteloot 2000, Lee 2003, Luce 1990, Oostenbrink 2002).

How comprehensively is resource utilisation measured?

Comprehensiveness is partly determined by (a) the decision problem, (b) the perspective of the study, (c) the requirement of representativeness and generalisability, as well as (d) the availability / feasibility of data measurement. Although there will be good reason not to measure a particular resource item, it is important to list all relevant resource items, and justify their omission from the cost calculation. Furthermore, measurability or ease of observation should not be criteria for resource identification (Brouwer 2001, Luce 1996). In practice, over-inclusion (including non-relevant resource items) and over-exclusion (excluding relevant resource items) can be a problem (Byford 2003).

Patient and non patient related costs

In the real world, identification of non-patient related resource items (overheads) can be challenging. Therefore, it is worth to highlight some of the non-patient related costs (overhead costs), such as (Edbrooke 1997, Wilson 1997):

- Hotel costs (e.g. building maintenance)
- Capital equipment maintenance
- Capital equipment depreciation
- Some management costs (e.g. general management costs)
- Some contracts (cleaning)
- Non patient related consumables (cleaning fluids)
- Consumable wastage costs
- Drug wastage costs
- Others

Edbrooke (1997) found that non-patient related costs are less than 15 %. However, Wilson (1997) found non-patient related costs are significantly larger, at up to 55 % of the total cost.

“Unrelated” services

In addition, there may be several direct medical and non-medical costs which can be categorised (defined) as “unrelated”, such as compulsory opportunistic screening or costs associated with co-morbid conditions. Likewise, the treatment costs of other co-existing conditions during the same disease

episodes (e.g. in hospitals DRG classifications and case mix problems) can be seen as unrelated costs. However, it may be difficult to separate the costs of a disease from the costs of co-existing conditions.

Classification and coding

Before measuring resource utilisation, it is important that all resource items are accurately classified and their relation to the cost object (cost unit) is established, e.g. direct or indirect to the final cost centre. Classification is the process of arranging resource items into groups according to their degree of similarity, such as disposables, drugs, etc. Classification usually mirrors the objectives of the costing system. The classification system is based on coding systems to identify resource items without uncertainty. Coding can reduce errors by uniformly applying unique, distinctive and exhaustive codes. A coding system, however, should be simple, flexible, and expandable (Lucey 2002).

The concept of capturing costs means that all the relevant resources used are taken into account during the cost calculation. This is essential for accurate cost calculation, although, in practice, it could be very challenging. For instance a doctor treat several patients in the intensive care unit, therefore it is necessary to apportion a doctor's salary between patients to estimate the real / correct costs of the treatment of a patient in the intensive care unit (Bean 1996).

Due to the practical difficulties and the potentially high costs of data collection and analysis, Drummond et al (1997) suggest that it may not be worth collecting detailed information about small cost items (resource utilisation), especially if they have no impact on the decision problem.

Furthermore, costs (resources used) should be unambiguously classified as fixed, step-fixed, variable and semi-variable, joint and non-joint, recurrent or capital costs (resources). Incorrect classification could lead to bias (Yazbeck 2001).

Selecting the appropriate unit of resource measurement

The type and characteristics of the resources used and the feasibility of the measurement determine the definition and/or selection of unit of resource measurement. For instance, a detailed resource use measurement (e.g. minutes spent on a particular subgroup of patients' care) may require an expensive and complex recording system, which is not already in place. Therefore, the definition and/or selection of physical units for resource use measurement have to take into account the availability and quality of data, and analysts may use alternative units of measurement if the necessary information is more

easily obtainable. However, the units should also be relevant to the particular service in question as well as to the objectives of costing (Bean 1996, Beecham 1995). The following table shows frequently used units of health services:

Figure 2: Different units of health services

Type of service	Commonly used units	Other appropriate units		
Psychotherapy	Per hour	Per occasion / visit	Treatment periods	Per type (e.g. short long, etc.)
GP visit	Number of visits			
Catering service	Per item	Per head	Per meal	
Diagnostic services	Per intervention			
Hospital. services	Per admission	Per day	Per case	Per DRG
Outpatient medical service	Per visit	Per hour	Per patient	Per episode
Nursing care	Per hour	Per patient	Per bed	Per activity
Home care	Per hour			

Resource use measurement

General principles

Ideally, resource utilisation measurement should be comprehensive, reliable, valid and representative. All the identified resource elements (resource items) should be measured. However, this may require access to several databases (statistics) such as provider records, patients' records, insurance claims, and household surveys. In addition, the opinion of experts, health professionals and the patients as well as the carers could also be very useful (Lee 2003, Yazbeck 2001)

Approaches to resource consumption measurement vary widely and may be determined by the aim of the cost analysis and by the availability of data. At one end of the spectrum, there is the direct measurement of patient-specific resource utilisation, frequently called micro-costing, activity based costing or the bottom-up approach. At the other end of the spectrum is the estimation of resource utilisation and costs by assigning a (national) average figure on non-patient specific bases such as using Diagnostic Related Groups (DRGs), or Healthcare Resource Groups (HRGs) based on national (or regional) administrative databases. The latter is often referred to as the gross-costing or top-down method. The choice between micro-costing and gross-costing approaches has consequences for the identification of resource items and the measurement of resource utilisation (Luce 1996, Brouwer 2001, Smith 2003).

In gross costing, health services or health care interventions are broken down into large components (intermediate products) and these large cost items have to be identified (Brouwer 2001). As a result, gross-costing can be simple and transparent. The result may be externally valid, and may be able to tackle regional or institutional variability. In addition, cross costing is usually faster and cheaper than micro-costing, but may be less accurate, because relatively large resource units are measured (for instance one hospital episode, or one day in intensive care unit is the unit of measurement rather than a single procedure or activity performed during the hospital stay). Less precise costing, however, could adversely affect decisions related to patient care as well as health policy (Luce 1996).

On the other hand, in micro-costing, a very detailed service delivery process (inventory) is established (identified) and all the relevant resource items identified and measured separately. Micro-costing frequently use measurement techniques developed by other industries, such as time and motion studies in which the production function is broken down into discrete activities (steps) which are analysed separately (more details later). Therefore, micro-costing could be more reliable and precise, but it could be expensive and may not always be practical (e.g. estimating future costs of a vaccination programme). However, it may be the preferred method when gross costing is a poor estimate of resource utilisation, or in cases where relatively small, but significant differences in cost could have a considerable impact on the decision (Luce 1996).

The choice between micro-costing and gross-costing must balance competing objectives. Usually there is a trade-off between (a) reliability and accuracy of cost information and (b) feasibility and costs of data collection (measurement). In principle, an approach more close to the micro-costing end of the spectrum is preferred, but analysts should take feasibility, costs and comparability into account, especially in comparative international studies. In practice, economic evaluations often use both approaches within a single analysis, partly due to lack of patient specific resource data for some resource items. As a result, resource utilisation of different cost items could be measured with different accuracy in the same project (Luce 1996). A decision on the precision of resource utilisation measurement can be influenced by the possible impact of uncertainty the particular resource utilisation could have on the decision (Drummond 2005).

In order to calculate the cost of each element required to deliver the service, there is a need to measure the resource utilisation of each cost element (unit of measurement). The selection of appropriate resource utilisation measurement tool could be influenced by (a) the type of services / health technologies, (b) the context in which the services are delivered, and (c) the existing information / activity recording system, as well as (d) the cost accounting system. Medical records, clinical trial case reports, surveys or the cost accounting system can be used depending on the decision problem (Drummond 2005).

The costing methodology selected partly determines the level of detail required. For instance, micro-costing requires very detailed resource utilisation measurement compared to gross costing (Brouwer, 2001).

Measurement techniques / methods

There is a widely hold consensus that resource use should be measured in physical or natural units (Elliott 2005, CCOHTA 1996, Slothuus 2000).

Selection of measurement method

Selection of the appropriate measurement method is partly determined by the (a) decision problem, (b) the perspective of the study, (c) the estimated impact of the resource item on the total cost (precision requirement), and (d) the requirement of representativeness (internal validity) and generalisability (external validity), as well as (e) the availability / feasibility of data measurement. There could be a trade-off between external and internal validity (Beecham 1995, Brouwer 2001, Oostenbrink 2002, CCOHTA 1996).

For instance, a cost assessment from a provider perspective can use a cost accounting database, because it may contain all the relevant resource utilisation. On the other hand, a costing study applying a societal perspective should generate resource use data by using several different resource measurement methods. A requirement for generalisability and representativeness can influence site selection and sample size, as well as the data source. For instance, an international comparative study may require a large, representative sample of tertiary hospitals. Consequently, the results may not be generalisable to small district hospitals. On the other hand, for local

(district) hospital level decision, a relatively small sample size and local utilisation data may be sufficient (Beecham 1995, Brouwer 2001, Oostenbrink 2002).

Based on the aforementioned criteria, analysts should decide whether primary or secondary data will be used during the costing exercise. Secondary data, such as national statistics, are frequently aggregated, and may not allow detailed analysis. Moreover, it may have high external validity, but may not be representative locally. On the other hand, primary data will be locally representative, but could be time consuming and expensive (resource intensive) to generate (Oostenbrink 2002).

Retrospective versus prospective design

In general, resource utilisation can be measured prospectively and retrospectively, as well as modelling can be used to estimate resource utilisation. Because the top-down method frequently relies on financial accounts and other databases, the top-down approach is retrospective in practice. On the other hand, bottom-up method can be either prospective or retrospective (Gyldmark 1995, Slothuus 2000).

Table 4 Measurement methods (modified from Gyldmark 1995)

		Relationship to time	
		Retrospective	Prospective
Data registration method	Top-down	Using hospital information system (including accounting, statistics, etc)	Not possible
	Bottom up	Using (electronic) medical records, cost accounting, billing and other information systems and/or surveys/ interviews	Using (electronic) medical records, cost accounting, billing and other information systems and/or surveys/ interviews

In general, Smith (2003) argues that the aggregation level of cost analysis (data collection) and the feasibility of data collection guide the choice of collection methods. Feasibility is determined by the “ability to observe” factors and the cost of collecting the data. For instance, existing databases / electronic patient information systems may offer an opportunity for more detailed data collection. On the other hand, the aggregation level is partly determined by the definition of service being studied. In general, prospective studies offer more detailed measurement and/or more flexibility than retrospective studies (Brouwer, 2001). The quality and reliability of retrospective studies depend on the accuracy and availability of the original data recording system (e.g. medical records, cost accounting or billing system) (Gyldmark 1995).

In general, whatever method is used, careful consideration should be given to very accurately measure those resource items that are likely to form the largest components of the total cost. These items are usually called cost drivers, and they frequently involve only a few resource items (Patel 2005).

MICRO-COSTING / BOTTOM-UP APPROACHES

In general, micro-costing approaches take representative samples of a particular service (and/or patient) and measure most of the resource use at the service (patient or cost object) level (Evers 2004, Gyldmark 1995).

Zimmerman (2003) mentions two different methods which can be used for resource use measurement: (a) time and motion studies and (b) account classification. In addition, Smith (2003) refers to (c) activity logs and (d) manager surveys as commonly used direct measurement methods. In addition, (e) postal surveys, (f) patients diaries, (g) participant recorded activity logs and (h) the review of medical case records are also used for resource measurement (Patel 2005). One might argue that (i) economic assessment alongside clinical trials and (j) naturalistic studies are special forms of micro-costing in health care. The abovementioned methods can be used independently or in combination with one other. Whatever method is used, however, analysts should have a clear and detailed view about the process of care. Flowcharts can be a useful visual aid to assist researcher in this stage (Lee 2003).

Observer-based methods

The aforementioned methods can be divided into two main subgroups: (1) observer-based reports and (2) participant based reports (Lee 2003). Observer based measurement methods include time and motion studies, managers' surveys, clinical trials/studies, and other observer-based work samples as well as account classification.

Time and motion studies

In time and motion studies, assessors directly measure the time required to deliver a service or produce a particular product. This method uses variety of techniques including random sampling. Researchers using this method usually prepare a detailed process flowchart that includes all the relevant (necessary) steps in the delivery of a particular service. The flowchart may be developed by using existing clinical care pathways and protocols (Dranove 1996, Kobeissi 1998, Luce 1996, Lee 2003, Smith 2003, Yates 1996, Zimmerman 2003).

Special attention should be paid to joint production, because time spent in joint production should be allocated / divided between the two (or more) tasks. For instance, sometimes it is difficult to differentiate between time spent on research, teaching and clinical responsibilities. Large variations in time could be an indicator of joint production. Failure to recognize joint production and non-relevant tasks may lead to overestimation of labour intensive services (Dranove 1996, Smith 2003, Zimmerman 2003, Kobeissi 1998).

Advantages and weaknesses

Time and motion studies can be important, because health professionals and patients may over or underestimate the time they spend on specific activities such as time spent on administering drugs in wards or non-direct clinical work (Kobeissi 1998, van den Brink 2004, van

Zanten 2003). Bratt et al (1999) found that TAM studies are significantly more accurate than other methods such as interviews with health professionals, self-administered timesheet or patient based method. Disagreement between these methods was especially large in non-productive time estimates.

On the other hand, TAM studies can measure how much time health professionals spend on delivering a particular service instead of how much time is necessary to deliver the service in the most efficient way. Furthermore, TAM studies can be very costly, because observers have to be trained and paid to do the job. Moreover, measuring activities, which are performed infrequently, could increase costs even further. One possible compromise used in practice is the self-reporting questionnaire or self-reporting activity log, but this option has its own limitations (Dranove 1996, Griffith 2005, Kobeissi 1998, Lee 2003, Smith 2003, Zimmerman 2003)

Site selection and sample size can also be crucial for external and internal validity. However, there is a trade-off between the costs of measurement and the accuracy and validity of the findings (Griffith 2005).

Use in practice

Time and motion studies were used alone in costing studies, but have recently been more frequently used with activity based costing to calculate the costs of different laboratory services, diagnostic imaging

services in Finland and the USA, non-drug costs in the Netherlands, service costs in the UK (Kobeissi 1998, Laurila 2000, Nisenbaum 2000, Trisolini 1987, van Zanten 2003).

Manager survey

Manager surveys gather information about human resource utilisation by type of personnel involved in service delivery. This is a relatively cheap and quick method, but it can be inaccurate especially when several managers are surveyed (Smith 2003).

Service use questionnaires and interviews

Especially complex and detailed questionnaires are frequently filled out by the observer during an interview. Where interviews will be carried out for any other reasons, it can be coupled with a (structured) service use questionnaire. Questionnaires and interviews are also used to collect information from providers. Interviews can be done either face to face or via phone. These methods are particularly useful in cases where patients use a broad range of services over a particular period. An observer-based questionnaire and/or interview can be more accurate and containing fewer missing data compared to self-reported questionnaires, but it can be time consuming and costly. (Amin 2004, Byford 2003, Johnston 2001, Lee 2003, Patel 2005, van den Brink 2004).

Medical case record review

Researchers, for resource measurement, also frequently use health service records including medical case records/case notes and patient notes. Medical records can be more accurate and detailed compared to self-reported questionnaires, which are subject to recall bias. On the other hand, there seems to be a relatively good agreement between patient interviews and providers'

report in reporting hospital days, or medical visits, but providers reported medication and medical products/device use more accurately compared to patients (van den Brink 2004, Byford 2003).

Medical case record reviews, however, require informed consent of the patients, and it could take a relatively long time to get access to the necessary number of records. Moreover, medical records may not be accurate (e.g. selectively recording the medically important events and neglecting the economically important events) and can be incomplete or missing, as well as it can contain illegible entries (Byford 2003, Johnston 2001, Kennedy 2002, Patel 2005).

Account classification

One of the simplest methods for estimating fixed and variable costs is account classification, because each account in the cost accounting system is labelled as variable, semi-variable, step-fixed or fixed. Dividing the total relevant variable costs of a particular service by the volume of services provided yields the variable costs per unit. Likewise, the total relevant fixed cost divided by the volume yields the fixed costs per unit. Although this method can be quick and simple, it may not be very accurate (Zimmerman 2003).

This method has been used, for instance, in the Netherlands to calculate the unit costs of an inpatient hospital day (Oostenbrink 2003).

Participant-based measurement methods

The participant based measurement methods include surveys, diaries, activity logs, participant recorded work sampling. These methods tend to be cheaper than observer-based studies, but the reliability could be poorer (Lee 2003).

Self reported activity logs

In this case, employees record their activities over a particular time, and categorize them according to whether or not the activities are necessary to deliver the service being studied. Usually measurement is based on a random sample. Accuracy can be comparable with time and motion studies. As well as time and motion studies, activity log method requires training and monitoring/quality assurance. Furthermore, analysts should ensure that the random sample is representative (Smith 2003).

Economic assessment alongside clinical trials

Resource use measurement can be organised alongside clinical trials, where actual resource utilisation is measured by collecting data from actual patients enrolled in the clinical trial. This approach could result in high quality and reliable data (good internal validity), but external validity may suffer, partly due to the protocol driven resource utilisation, and partly to the selection of patients (stringent inclusion and exclusion criteria). Furthermore, clinical trials usually organised in large teaching hospitals or specialists clinics, which can further reduce the generalisability of the results in part because differences in resource use among

centres (heterogeneity in resource use), and large teaching hospitals are usually situated in urban areas where the input prices could be significantly different compare to rural areas (heterogeneity in unit costs) (Heaney 2002, Johnston 2001).

Naturalistic studies

Naturalistic studies can be retrospective and prospective. This approach may have good external validity (generalisability (settings and case-mix) is good), but internal validity may suffer (data collection may not be complete, identification of resource items may not be comprehensive or may be biased if based on insurance claims and/or administrative databases, etc.). Furthermore, clinical trials and naturalistic studies can be time consuming and expensive (Heaney 2002).

Postal surveys and self-reported questionnaires

Data on health service utilisation (resource consumption) are frequently collected retrospectively by researchers using structured questionnaires. Postal surveys (questionnaires) are usually cheaper than interviews but can result in a low response rate. In a prospective study, patient's diary method can also be used as a source of resource utilisation. Self-reported questionnaires are also used to collect information from providers (Amin 2004, Johnston 2001, Lee 2003, Patel 2005, van den Brink 2004).

Advantages of patient based surveys and interviews

One of the advantages of this method is that it can be particularly useful in cases where patients use a broad range of services over a particular period. Furthermore, it can be easier, quicker and cheaper than data collection from several different providers, partly because providers need a patient's informed consent. It can be the preferred method when interviews can not be arranged. In addition, one study found that self-reported resource use was as reliable as time and motion studies for broad categories, but less reliable for specific activities (Amin 2004, Lee 2003, Patel 2005, van den Brink 2004). Moreover, Mirandola et al (1999) compared two different ways to collect patient level resource utilisation data, and found that the customized interview schedule (ICAP) and the psychiatric case register (PCR) have comparable accuracy. Furthermore, one study found good agreement between postal surveys and medical case record reviews, but other studies found relatively poor agreement between the two methods (Kennedy 2002, Patel 2005).

Disadvantages of patient-based surveys and interviews

Poor agreement between patient based and observer based resource use measurement can be explained partly by recall and selective non-responder bias. Especially retrospective surveys (questionnaires) and interviews can be subject to recall bias and selective non-responder bias. The recall bias can be considerable when the recall period is relatively long (e.g longer than 3 months), the patients is frequently use several different healthcare services, and/or patients suffer from cognitive disturbances (Byford 2003, Mauskopf 1996).

Moreover, patients (responders) can struggle to answer long and complex questionnaires, and they could misinterpret the questions. Furthermore, patients may fail to fill in the diary cards. Patients may also systematically over or underreport some resource utilisation (e.g. how much time they spend with the doctors). In addition, surveys, diary cards and interviews may not be suitable for special patient groups (e.g., children, the elderly suffering from dementia, and/or patients with learning disabilities or severe mental disorders). In addition, the response rate may be low. Furthermore, currently there is not any generic, validated resource use questionnaire. The costs of data collection can go up sharply if analysts have to either monitor or motivate patients to fill in diary cards or questionnaires (Amin 2004, Byford 2003, Goossens 2000, Johnston 2001, Mauskopf 1996, Patel 2005, van den Brink 2004).

Beside the aforementioned weaknesses, validity and reliability can be a problem in part because wide variety of questionnaires are used in practice but these instruments are rarely tested for reliability and validity (Adam 2000, Johnston 2001).

Cost Diary

Service-use diaries are also used to collect resource consumption data, including recording time spent on different activities. Because it is used prospectively, the accuracy can be better compared to self-reported retrospective questionnaires. The diaries can be designed to be user-friendly (easy-to-fill) to enhance accurate, standardised data collection. On the other hand, cost diaries are also subject to incomplete response, misinterpretation of the questions, and/or not clear answers. Inaccuracies and incomplete responses, however, can be minimised if the cost diary is designed carefully in order to avoid misunderstanding and incomplete recording and the method is coupled with interviews and reminder telephone calls at regular intervals (Byford 2003, Goossens 2000, Mauskopf 1996).

Practical application

Micro-costing was introduced in some American hospitals in the 1970s. The original design used master flowcharts, and identified elements (the main activities) of service delivery. These activities were combined into procedures. Time and motion studies were used to estimate resource consumptions. A direct labour time was used to allocate overhead resources. Micro-costing was used to estimate the costs of bacteriology, radiology services and several surgical procedures (operating room costs), as well as the cost of renal dialysis (Shuman 1992).

Relative value scale approach

The development of relative values scales was based on the micro-costing method. However, this initiative were partly based on costing studies and partly based on expert opinion. For instance the resource-based relative value scale (RBRVS) developed by Hsiao (1988) was based on (a) time consumed by the provision of the service or procedure, (b) overhead costs of practice including liability insurance premiums, (c) training opportunity costs and (d) the intensity and complexity of work (knowledge and skills required, as well as emotional workload (stress).

Limitations of RVS

However, the procedural time was based partly on subjective estimates, and later one study found that these estimates did not match actual resource consumption (Henderson 1999, Shuman 1992).

Moreover, RBRVS exercise was limited to 14 specialities, excluding anaesthesiology, paediatrics and rheumatology as well as oral/maxillofacial medicine (Henderson 1999).

One might argue that German point system for ambulatory services (adopted recently in many formerly socialist countries in Central and Eastern Europe, for instance in Hungary, is based on the same principles, and works as a relative value scale. However, the adaptation of these scales might have been based on an expert opinion rather than micro-costing studies.

Diagnostic related groups

Another special application of micro-costing principles is the development of diagnostic related groups. The DRG payment method was implemented in several EU member states such as Belgium, Finland, France, Germany, Hungary, and Sweden. However, the development of DRG payment was not always based entirely on micro-costing studies, for instance in Hungary (Waters 2004).

The implementation of a prospective payment system forced the providers (hospitals) to upgrade their accounting systems and implement a more sophisticated cost accounting system, which enables the management to measure, analyse and forecast costs more accurately (Shuman 1992).

Special practical problems

Analysts should be aware of the so-called “Hawthorne effect”. The measurement itself can cause bias in cost measurement, and joint production could cause further measurement problems.

Direct measurement can be costly and time-consuming to implement, especially when applied to complex hospital based services. In addition, micro-costing could miss important cost / resource items, in part because it is necessary to determine fixed costs and overheads separately (Muennig 2002 Shepard 2000, Slothuss 2000).

Moreover, registering overheads and capital costs at the cost object level can be very difficult or impossible. Therefore, most of the costing studies apply a mixed approach (see later) (Gyldmark 1995).

Lack of external validity

Furthermore, the generalisability (external validity) of the results of a micro-costing exercise could be limited, in part because the results will reflect the characteristics of the local institutional arrangements as well as the socio-economic and demographic composition of the local population. Likewise, the result of comparative analysis could be biased if there is a significant difference in health service needs between the measured sample and the targeted patient population (Luce 1996, Muennig 2002).

Adjustment to routine care

Health economic evaluation guidelines agree that resources used should be separately identified, physical units of resource use should be clearly defined, and resource utilisation should be recorded and reported separately. Furthermore, guidelines suggest that resource utilisation should be measured under routine circumstances and clinical trial protocol driven resource utilisation should be excluded. However, guidelines are not consistent about any adjustment of utilisation date to routine care (Jacobs 2005).

One way to overcome the weaknesses of the aforementioned measurement method could be to use modelling and data from different sources including clinical trials, other clinical and economic studies, expert opinion, and databases as well as insurance claims (Heaney 2002).

Sample size

In addition, sample size could also be a crucial factor in resource consumption measurement. The sample size calculation should take into account the anticipated cost differences, the distribution of costs in the study population and the drop-out rate (number of lost patients) (Seninger 2004).

Legal and/or administrative requirements

Data collection, including anonym patient records data, can be strictly regulated and may require clearance from the local, regional or national ethical committees or other supervisory authorities. For instance, to obtain anonym medical bills in the USA requires clearance from the Institutional Review Board. In addition, informed consent of the patients can also be compulsory. In some cases, additional administrative hurdle could slow down the data collection (Mauskopf 1996).

GROSS-COSTING / TOP-DOWN MEASUREMENT APPROACHES

While resource measurement techniques and their steps are relatively sharply separated and straightforward in micro-costing methods, gross-costing may or may not have very distinct steps for measurement and valuation. As a result, resource measurement and assigning monetary value to resource utilization may not be separate steps, but an integrated process (Luce 1996).

The aim of gross-costing is to generate good-enough resource usage estimates for the different resource items necessary to deliver a particular service. However, the physical units of measurements are relatively large, such as (a) acute hospital care episode, (b) non-acute hospital care episodes, (c) nursing home care, (d) outpatient specialist care, (e) primary care, (f) counselling / psychotherapy, (g) pharmaceuticals and medical devices, and (h) physiotherapy

and psycho-education, as well as (i) alternative / traditional medicine. For instance, studies using a gross costing approach measured resource utilization by hospital episodes (defined in the DRG system), or number of days (Luce 1996).

Gross-costing approaches usually rely on large, aggregated (national) databanks (called secondary data) such as national statistics, national insurance fund utilisation databases, etc. As a result, gross costing is inevitably based on the assumption that there is only a small variation between patients and/or providers (Elliott 2005).

Advantages and disadvantages

A top-down approach can be cheaper and faster than micro-costing. In several cases, especially when complex hospital services are included into the costing exercise, a top-down approach could be the only feasible option. This approach was also used by several cost of illness studies partly because detailed input data (resource utilisation data) were not available (Ekman 2004, Elliott 2005, Evers 2004, Forsgren 2005, Heaney 2005, Muennig 2002, Street 2002).

On the other hand, this method may rely on several assumptions, which could have considerable impact on the accuracy of the unit cost estimate (e.g. practice variation is negligible). Likewise, the accuracy and reliability of the gross costing method depends on the quality of secondary data (Luce 1996, Drummond 2005, Muennig 2002).

Furthermore, macro-costing cannot be used in some cases, such as when no cost data is available in hospital or national databases or in the literature. This is frequently the case before the implementation of new technologies. Likewise, macro-costing cannot be used to measure small changes in resource consumption, for instance inside hospitals, because macro-costing cannot differentiate between patients (e.g. the impact of a new drug on the unit costs of a particular inpatient service) (Muennig 2002, Elliott 2005).

MIXED APPROACH

Cost of illness, cost analysis and cost effectiveness studies sometimes use a mixed approach to cope with missing data and/or collecting data that is routinely not collected (Porsdal 1999). Furthermore, some of the guidelines, for instance, the NHS Costing Manual guideline as well as the VA (USA) consensus guideline, recommend this approach (Department of Health 2005, Swindle 1999).

Advantages of mixed approach

A mixed method can be cheaper than using only bottom-up approach and it can be more accurate than using only top-down approach. The mixed model allow analysts to tailor the cost measurement towards the study objectives and decide where they will rely on micro-costing,

and where they use macro-costing. Macro-costing can be used where variation in resource use is reasonably small, and/or when the level of aggregation is relatively high as well as where micro-costing would be very expensive. On the other hand, micro-costing can be used where the accuracy of resource measurement is important, and data collection is feasible in an economically sensible way. This approach could be suitable for institutions without very sophisticated cost accounting system (Swindle 1999, Luce 1996).

Disadvantages of mixed approach

Study using mixed approach could suffer from low external validity. For instance, local data may not be externally valid, whereas national data may not be locally representative and could over or underestimate real resource utilisation (Swindle 1999). One study compared the result of cost estimates based on national average and local data and found that using different methods (micro or macro-costing) could influence the unit cost estimates and the result of comparative studies. However, the inclusion or exclusion of cost items could have larger impact on the results than the selection between different resource measurement methods. Using the mixed approach may reduce the variance caused by the differences between national average and local utilisation pattern, but may not be able to eradicate the “resource item inclusion/exclusion bias” (Chapko 1999).

Source of information for resource measurement

Current cost analysis and economic evaluation studies use primary and/or secondary sources to estimate resource use. Both sources have its advantages and disadvantages. In ideal case, the source of resource measurement should have the following characteristics (Melfi 2001):

- Database includes essential demographic information such as age, sex, race, marital status,
- Database contains adequate information about the type of disease (e.g. diagnosis), stage and/or severity of the disease, as well as co-morbidities
- Database allows longitudinal follow-up (e.g. for measuring resource use per patient episode)
- The database clearly identifies when a treatment episode begins and ends
- Database comprehensively collect detailed information about resource use
- Quality assurance system is applied to ensure reliability and minimise the frequency of missing data.

In general, the selection of databases as well as sources of resource use data should depend on (a) the primary objective of the study, (b) the perspective of the study, (c) the precision required, (d) the details necessary, and (e) the resources available for resource measurement. In the case of a costing study conducted from a provider perspective, the provider's database (information system, cost accounting system) can be the most appropriate source of information (Melfi 2001).

Primary data is generated by (free standing) costing studies and clinical trials (with concurrent economic evaluation). One of the advantages of primary data collection is high internal validity, but local resource utilisation may not be typical. For instance, costing studies as well as clinical trials are frequently conducted in large teaching hospitals and/or specialised institutions, but their resource utilisation and/or practice pattern can be significantly different from those of district hospitals. Consequently, the external validity could suffer (Brouwer 2001, Oostenbrink 2005).

Primary data collection can be prospective or retrospective, and could offer more flexibility. Furthermore, more detailed patient level data can be collected which may ensure subgroup analysis. It could be relatively easy and quick when the provider is equipped with a sophisticated medical information and/or cost accounting system, but additional data collection using surveys, interviews may be necessary.

On the other hand, primary data collection can be time- and resource consuming (Menke 1999) For instance, interviewers/data collectors should be trained to improve agreement between interviewers and avoid misinterpretation of resource use, because only well trained data-collectors/interviewer can guarantee accurate and reliable data collection (Mirandola 1999). Moreover, cost data are usually skewed. Therefore, small samples may not be enough to draw statistically significant conclusion. On the other hand, using large representative sample could be expensive and/or difficult (Melfi 2001, Zhou 1997). Analysts should balance out the accuracy gain of micro-costing and the extra costs of micro-costing (Menke 1999).

Resource utilisation can be estimated using secondary data extracted from national registers or statistical databases as well as using published (research) literature (Byford 2003).

*Advantages of secondary databases
/ administrative databases*

The advantages of secondary data are that they can have reasonably good external validity, and they may already be in the public domain (freely available, and quickly attainable). In addition, most of the databases contain huge number of observations (sometimes hundreds of thousands) of observations. Moreover, cost data are collected in a same way, and data quality assurance system may be applied (Melfi 2001). Furthermore, it is relatively inexpensive to use compare to primary data collection (Johnston 2001)

Large (national) databases can also be used for inter-institutional (inter-regional) comparison, because data collection is standardised. Furthermore, the unit cost of different treatment options (services or care episodes) can be compared either nationally (regionally) or between regions (Melfi 2001).

Another advantage of large databases is that they can be comprehensive. As a result, all the resource use data can be extracted from one database. It is easier and could be more accurate compare to cost analysis relying on several databases using different resource measurement methodology, because in this later case, all the databases should have the common patient identifier to link databases and compute resource consumption at the individual patient level. The likelihood of underreporting resource use and other biases could be greater when the analysis is relying on several databases (Melfi 2001). For instance, the French hospital admission database is reasonable comprehensive and available on-line (www.le-pmsi.fr) which was used for micro-costing studies (Montagne 2000)

*Disadvantages of secondary
databases / administrative
databases*

Missing data, artefacts and incomplete records can be a problem, because databases may not have data quality insurance system and it may not be designed for the particular costing exercise. Furthermore, data extraction may need training. Large databases can also be out-of-date and special databases may be

non-representative due to selection bias (Johnston 2001). Furthermore, a recent technology assessment report assesses the available databases in the UK, and finds 60 databases, including several clinical registers such as Hospital Episode Statistics (HES), which can directly be used for resource use measurement. Although the databases have internal consistency check, the external quality audit may be exceptional. Accessibility and comprehensiveness can also be a problem in practice. On the other hand, the report highlights that studies very rarely use these databases to estimate the resource use (Raftery 2005).

In addition, potential problem with insurance database could be that it may not contain detailed information about the patient eligibility for different kind of services, as well as when the insurance coverage was cancelled. Therefore, cost analysis using insurance database may underreport resource utilisation (Melfi 2001).

Moreover, most of the available provider, insurance and/or national (regional) databases do not contain data about productivity costs or patient as well as carers time used. Furthermore, joint costs could cause further challenges (Melfi 2001).

National registers
versus accounting
databases

In several countries, there are national registers for resource use of particular services, such as resource measurement for inpatient or outpatient DRG calculation, or for renal replacement services (RRT), or organ transplantation services. These registers may be useful for top-down cost calculations and/or

international comparative studies when national representativeness is important. On the other hand, local accounting database can be used for local level decisions such as adopting a particular technology or extending the local hospital formulary or contracting out services. Decision makers, however, have to bear in mind that accounting information systems are usually designed for supporting management and financial decisions, not costing for economic evaluations or international cost comparison (Brouwer 2001). Therefore, resource use or cost data is recorded according to accounting principles and may or may not be able to provide all the data required for the resource use measurement. Building in redundancy into the data collection could help to crosscheck data from different cost accounting systems especially by the help of an accountant (Menke 1999).

Costing services alongside clinical trials

When a costing exercise is taking place alongside clinical trials, case report forms can be used for data collection purposes (resource measurement). However, the case report form may need slight amendments (Brouwer 2001).

Special challenges / practical problems

Data collection method -

A top-down approach is always retrospective, while a bottom-up approach can be either retrospective or prospective. Prospective data collection can be more flexible and tailored towards the objectives of the study, but time consuming and expensive (Dickey 1999, Merx 2003).

In comparative studies, using a standard questionnaire has its limitations in part because the data may not be available, and/or not in the same structure (especially if a questionnaire is used retrospectively), as well as because the sample may not be representative (response rate is too low). For instance, Merx (2003) found that half of the Swiss and German hospitals did not report any information about hip replacement. In addition, a further barrier could be if data are not available for the same financial year, and/or the institutions charge for the data.

Currently there is no agreement about the gold standard of data collection methods. Furthermore, several methods are used without appropriate validation (Johnston 2001).

Statistical consideration

The most appropriate statistical method for cost analysis is debated in the literature. Resource use data frequently follow skewed distribution (not-normal distribution). Sometimes it is highly skewed due to a small percentage of patients with very high resource consumption. Therefore, Melfi (2001) and Zhou (1997) argue that the median could be more representative than the mean as a measure of central tendency. Moreover, the log-normal distribution

of resource use can follow normal distribution. On the other hand, Thompson and Barber (2000) argue that the arithmetic mean should be compared, because this is more useful for decision makers. However, current studies varied significantly in the applied statistical method.

Usually four statistical tests are commonly used to compare the means between two different resource use samples: (a) student t test, (b) parametric student t test, (c) non-parametric Wilcoxon (signed rank) test, and the (d) Mann-Whitney U test (equivalent of Wilcoxon rank sum test). Alternative solution could be the (e) Z-score method and (f) the non-parametric bootstrap method. Each method has its limitation. For instance, the student t test assumes that resource use data are normally distributed, Z-score test developed to compare log-normally distributed resource use data. In addition, each results of these method needs different interpretation because they compare different things (e.g. arithmetic means versus geometric means). Therefore, it is important to use these statistical methods appropriately and interpret the results correctly to avoid biased results as well as misplaced conclusions (Applegate 2003, Hart, 2001, Thompson 2000, Zhou 1997).

Statistical analysis can be misleading if the sample size is too small, and/or the case-mix or service mix is significantly different from the routine practice and from each other, and/or the samples are collected at non-representative sites (site selection bias), and/or there is considerable practice pattern variability (usually not normal distribution). Moreover, the results could be biased in comparative studies if data for the two or more samples are collected from different databases (e.g. provider database versus insurance database) (Melfi 2001).

Statistically significant differences are necessary but not sufficient to act upon the results. Decision-makers should look beyond and assess whether the difference are meaningful (clinically, financially and politically significant) (Melfi 2001)

Other source of biases	Accurate measurement of joint costs and fair apportionment of overhead resources could be challenging in costing studies. In addition, special attention should be drawn to assess the appropriate lifetime of different medical equipments, buildings and other fixed assets (capital cots) (Lucey 2001, Young 2003).
Obstacles of data collection	The country legal regulation could create obstacles of detailed, especially patient level data collection. For instance, the French law does not allow linking individual patient hospitalisation records (Montagne 2000)

Attaching monetary value to each unit of health care resource

Basic principles

The final step in determining costs is to place a monetary value on each of the resources that were utilised. The general principle is that values for assigning monetary value to health services should be extracted from a database that reflects the perspective of the study. As a result, there are several equally appropriate sources for the monetary value of resource use depending upon the study perspectives (Seninger 2004).

Although economic guidelines and textbooks emphasise the importance of opportunity costs, and this is the most widely recommended valuation base, in practice, costing studies, as well as economic evaluation, use five general ways to value resources (calculate the unit cost) (Getzen 2004, Jacobs 2005, Drummond 2005, Oostenbrik 2002, Slathuus 2000).

1. **Direct measurement** of costs (top down, bottom up)
2. Using **cost accounting** methods
3. **Using standard unit costs** (there may be significant overlap between the above three methods)
4. **Use of fees, charges** (cost-to-charge ratios) or market prices
5. **Estimates / extrapolation** based on information from the literature and previous (published) studies.

Selection of valuation method

Selection between the aforementioned methods is partly determined by (a) the decision problem, (b) the perspective of the study, (c) the estimated impact of the unit costs (uncertainty about the unit costs) on the total cost (precision requirement), (d) the requirement for representativeness (internal validity) and generalisability (external validity), as well as (e) the availability of data. In addition, the choice between valuation methods could be closely linked to the selection of a resource measurement method. For instance, a cost accounting system could be used to measure resource use and calculate unit costs (Beecham 1995, Brouwer 2001, Oostenbrink 2002).

Although the opportunity cost concept is the theoretically preferred way to estimate costs for decision-making, it can be very costly and time consuming, because special studies may be required to identify all the relevant alternatives of possible use of resources and estimate the costs and benefits of each alternative. Furthermore, some of the alternatives could involve non-marketable goods and/or services, which could make it necessary to use debatable costing techniques such as human capital approach or willingness-to-pay methods. Frequently accounting costs can provide reasonably accurate estimates of `opportunity costs relatively cheaply and quickly. However,

accounting costs are not opportunity costs, partly because they are based on historical costs (Zimmerman 2003, Bowling 2002).

One argument is that using charges in comparative economic evaluations may be more relevant than costs from the purchaser perspective. On the other hand, the choice between charges and costs depends on the decision problems. For instance, third party payers may reimburse less than 100 % of the charges, or charges could be different for insured and uninsured patients partly due to discounts for large purchaser (Drummond 2005, Suttles 2003).

European
guidelines
recommendations

Currently, methodological guidelines disagree about the best way of attaching monetary value to resources. (For instance, whether the most reasonable way is to use prices (tariffs, charges) with or without adjustment and/or administrative databases and/or third party payer rates and/or surveys and/or health system accounting databases and/or insurance claims and/or scientific literature (e.g. published cost studies) and/or a combination of these methods.)

Table 5: recommendation from European guidelines is varied

Type of recommendation		Country
No clear recommendation		Finland, France, Germany, Ireland
Specific recommendation		
	Using standard costs	Belgium, Portugal, Poland, Hungary (insurance funds fees and costs calculations if purchasing perspective was adopted), Sweden (partly for pharmaceuticals), The Netherlands, England and Wales, Switzerland (insurance tariffs)
	Local country specific methods (unspecified):	Baltic states (local costs), Norway (country specific method), Scotland,
	Micro-costing:	Italy

Common cost measurement approaches

Direct measurement approaches

Direct measurement is used when existing cost databases, tariff books, market prices and/or published studies are insufficient to estimate the monetary value of a particular service. It can be used alone or in combination with other costing

methods. It is frequently used to measure the costs of new health technologies (Smith 2003a, 2003b).

There are three major direct measurement approaches: the bottom-up, the top-down and the mixed approach. Selecting from the three approaches is mainly determined by the level of precision required for the decision problem. For instance, if comparing nursing home costs, where very similar patients are looked after, gross costing (or departmental costing) could be sufficient. However, if calculating the costs of nursing home care for a particular patient group, which may require more intensive care and supervision, treated in the same nursing home, than a micro-costing approach is more appropriate. Likewise, calculating the cost of a unique service for which data or unit cost estimates are not available may require a detailed direct costs measurement. Although in practice gross-costing (or a top-down approach) is used most often, these techniques are frequently used simultaneously or jointly. However, all of the methods follow the full absorption cost principles known from cost accounting (Brouwer 2001, Petitti 2000).

TOP-DOWN APPROACH

Top down costing first calculates the total costs of the service at the organisational, provider or departmental level, then disaggregates the total costs to the department or the units of services (or products) depending on the richness of available data and the homogeneity of services provided. It can be done through multiple steps, e.g. allocate costs to cost centres (e.g. intensive care units, or postoperative care), then divide the total costs of the cost centre by the number of units (e.g. patients treated or number of hospital days, etc.) (Beecham 1995, Muennig 2002, Waters 2004). This method is also called gross-costing or average costing approach, as well as departmental costing (Orlewska 2003, Finkler 1994, Phibbs 2003).

A top-down approach is suitable for homogenous services (e.g. nursery, long-term care), but it may be unsuitable for certain type of services because top-down approach assumes an equal distribution of resources between patients (Negrini 2004).

Advantages of top down approach

Due to the lack of detailed (patient level) data, the top-down approach is sometimes the only feasible option. Furthermore, the top-down approach is cheaper and faster than a bottom up approach. In addition, it can be more comprehensive (including all the relevant costs) than micro-costing (Beecham 1995, Muennig 2002, Street 2002, Waters 2004).

Disadvantages of top-down approach

However, a top-down approach is less detailed and so accuracy can suffer. It does not allow detailed analysis of cost structure or patient level analysis. Furthermore, allocation of resources can be more or less arbitrary. In addition, accurate estimates require correct information about the number of services delivered over the observed period, the service mix and the relative resource consumption of each "typical" product, but this information may or may not be available in a sufficient and reliable manner. As a result, top-down cost estimates could overestimate unit costs if more services are provided than

expected or reported (assuming that semi-fixed costs remain constant). Conversely, it could underestimate the unit costs, if fewer services are provided than expected or reported. Moreover, it is retrospective cost estimation, and standard cost cannot be calculated this way (Edbrooke 1999, Bailey 1997, Gyldmark 1995, Lievens 2003).

Use in practice

Accountants and managers of health care institutions frequently use the top-down approach to calculate hospital treatment costs in several countries, including Australia, Belgium, Sweden, the UK, and the USA (Change Foundation 2004, Jegers 2002, Street 2002). A special version of the top-down costing method, the so-called Cost Block Method, has been used to compare intensive care unit costs between hospitals and between countries (Edbrooke 1999, Jegers 2002, Csomos 2005). Moreover, another form of top-down approach is used to cost pathology services in the UK and Australia (Bailey 1997).

BOTTOM UP APPROACH

The bottom-up approach records resource utilisation at the patient or individual service level, and aggregates patient/service level utilisation data to identify the type of resources used and to measure resource utilisation in order to calculate the costs of specific services. This method can be deployed retrospectively and prospectively using medical records, surveys, questionnaires or other reliable databases. It is particularly useful when cost data are not available from other reliable sources (Gyldmark 1995, Jegers 2002, Muennig 2002). Researchers frequently use this approach, and it may be associated with primary data collection within clinical trials or observational studies. It is also called micro-costing or activity based costing. It can also be used to calculate standard costs per service. A bottom-up approach is used, for instance, in Canada to calculate hospital costs (Bailey 1997, Negrini 2004, Orlewska 2003, Phibbs 2003).

Currently, activity based costing is one of the most widely used forms of bottom-up costing. It breaks down the patient's care process into discrete activities, which is necessary to deliver a particular service. An activity is a collection of resource utilisation combined to deliver a particular activity. Resource utilisation measurement is performed separately for each activity (Negrini 2004).

Advantages and disadvantages

The advantages of the bottom-up approach are as follows (Beck 1999, Change Foundation 2004, Edbrooke 1999, Gyldmark 1995, Waters 2004):

- More detailed (comprehensive) and can be more accurate than top down approach
- Billing system can be used as source of data,
- More easy to use where fee-for-service system exists

- Bottom-up approach could be more suitable for non-homogenous services, e.g. intensive care.

The disadvantages of this approach could be (Bailey 1997, Beck 1999, Edbrook 1999, Gyldmark 1995, Muennig 2002):

- It can be very time consuming and costly, especially when applied to complex services
 - It can be especially time consuming and costly if the actual service is delivered by several units and sub-units (auxiliary services)
- It can be biased or inaccurate if the existing administrative databases (billing system, accounting system or FFS database), on which the calculation is based, are distorted, and/or the unit costs/ prices are not available, or may not be reliable (do not reflect actual resource use). Therefore, analysts have to be sure that the billing and/or accounting system is valid and reliable (to avoid imperfect registration bias).
- External validity / transferability / generalisability can be limited.
- Comparative studies need similar hospital billing and/or cost accounting systems.
- Medical records and/or resource use registration could also be inaccurate.
- Unit cost of resources consumed may not be available.
- Unit costs of resource elements might have been calculated as an average cost per unit of output (which could over or underestimate the real costs of resource consumption).
- Problem with allocation of joint activities or joint costs items (e.g. overheads and capital costs)
 - Fixed costs, including overheads cannot be registered at the cost-object level; and therefore they should be treated separately.

Major steps

Major steps in the bottom up approach may include the following (Gyldmark 1995, Luce 1996):

1. Identification of activities which have a cause-and-effect relationship with the service for which the study would like to calculate costs,
2. Detailed description / identification of elements of the particular activity (resources used to deliver a service or part of the service),
3. Estimation / measurement of quantities of each element needed to undertake the activity.
 - Data can be obtained from central financing departments or databases, using cost accounting information, (electronic) medical records, etc.
4. Identification of unit costs of the elements,

5. Allocating fixed costs / overheads.
6. Calculation of the unit cost of the service in question by aggregating the costs of all the elements (activities).

Special forms of micro-costing in health care

The relative value unit system (RVU) can be seen as a special application of micro-costing. RVU is based on (a) the complexity of procedures, (b) the amount of resources consumed and (c) the time spent delivering the service (treatment). One of the advantages of the RVU system is that it uses clinical activities (treatments, interventions) rather than reimbursement categories as bases for determining service level costs. On the other hand, the RVU approach assumes that each RVU consumes the same amount and the same mix of resources (West 1996).

MIXED APPROACH

Several published studies have applied a mixed approach, which is based partly on bottom up and partly on top-down approaches. For instance, the NHS Costing Manual guideline, as well as the VA (USA) consensus guideline, reconciles bottom up and the top-down approach (Department of Health 2005, Swindle 1999).

One of the special forms of mixed approach is the step-down costing method, which is based on the provider's cost accounting system. Using this method, the accuracy of cost estimates depends on the order in which different costs are allocated, the selection of allocation base, and the number of cost centres (Zelman 2003). Furthermore, ABC can be combined with top-down approaches to allocate some of the costs (Lievens 2003).

Advantages of mixed approach

The mixed approach could avoid some of the disadvantages of both methods. A mixed method could be cheaper than using only bottom-up approach and it could be more accurate than using only top-down approach because it can reflect variation in resource consumptions many costing study require. The mixed model allow analysts to tailor (prioritise) the cost measurement towards the study objectives and decide where they will rely on direct cost measurement (micro-costing), and where they use computer based databases (macro-costing). Macro-costing can be used where resource variation is reasonably small, and/or when the level of aggregation is relatively high, as well as where micro-costing would be very expensive and/or would not be worthwhile. On the other hand, micro-costing can be used where the precision / accuracy of resource measurement is important, and data collection is feasible in an economically sensible way. This approach could be suitable for institutions without very sophisticated cost accounting system (Byford 2003, Luce 1996, Swindle 1999).

Disadvantages of mixed approach

Study using mixed approach could suffer from the weaknesses of both methods. Local data may not be externally valid, whereas national data may not be locally representative and could over or underestimate real resource utilisation (Swindle 1999). One study compared the result of cost estimates based on national average and local data and found that the selection of data source could influence the unit cost estimates and the result of comparative studies. However, the inclusion or exclusion of cost items could have larger impact on the results compare to impact of data from different sources. Using the mixed approach may reduce the variance caused by the differences between national average and local utilisation pattern, but may not be able to eradicate the “resource item inclusion/exclusion bias” (Chapko 1999).

Accounting costing methods

Costing methods are designed to suit the way that services are provided or health care products are produced. Therefore, complex health care organisation, such as large teaching hospitals could use different costing methods at the same time. Nevertheless, health care providers providing the same or very similar health services could have very similar costing methods, while health care providers offering significantly different services or producing different health technologies could employ very different costing methodologies. However, whatever methods are used, the basic costing principles relating to analysis, absorption, classification, coding, allocation and apportionment are applied. Furthermore, whatever method is used, it can be combined with one or more appropriate cost techniques such as total absorption costing, actual cost ascertainment, standard marginal costing, marginal costing, and /or standard costing. (Lucey 2002)

On the other hand, not all health care institutions may have adequate cost accounting systems, which are suitable for a wide variety of unit cost calculations. Furthermore, in practice, little may be known about the reliability of the accounting systems implemented according to unit cost calculation in the EU member states (Schulman 1998)

Table 6: Overview of costing principles, methods and techniques (Lucey 2002).

Costing principles	Costing techniques	Costing methods
Analysis,	Total absorption costing,	Job costing
Absorption,	Actual cost ascertainment	Contract costing
Classification and coding	Standard marginal costing,	Batch costing

Allocation	Marginal costing	Process costing
Apportionment	Standard costing	Service / function costing

Specific order costing and process costing

Cost accountants argue that there are two basic categories for costing health technologies, namely specific order costing and process costing. Specific order costing can be subdivided into job costing, contract costing and batch costing. Operation/process costing or unit costing can be subdivided into service costing and process costing. Specific order costing is used to cost very different jobs or contracts. The cost unit here is the job or the contract. Conversely, process or unit costing is used to establish the average (unit) cost of services, which are very similar or identical (Lucey 2002).

Table 7: Costing methods (Lucey 2002)

Main categories	Subcategories	
Specific order costing	Job costing	Product costing
	Contract costing	
	Batch costing	
Operation / process or unit costing	Batch costing (?)	Service costing
	Process costing	
	Service / function costing	

Selecting the appropriate costing methodology

The prerequisite for unit costs calculation is a well defined output (unit of service). Unit costs calculation is retrospective. There are several ways to calculate unit costs; most of them follow full absorption cost principles. This means that all costs (direct and indirect) relating to the provision of a particular service are included in the cost calculation. These costing methods can be used separately, or sometimes they can be combined. The choice between the following methods depends on (a) the availability of good quality data about resource utilisation (e.g. timesheets), (b) the complexity of the service, (c) the type of service users, (d) the purpose of costing (e.g. calculating fair transfer costs or calculating the fee for cross border care), (e) the cost-accounting method used by the institution, and (f) resources (time, money and personnel) available for costing, as well as (g) the number and range of different service activities delivered (Bean 1996).

SPECIFIC ORDER COSTING

Specific order costing encompasses three different costing methodologies: job costing, contract costing, and batch costing.

Job costing

In job costing, costs are attributed to individual jobs. This method is suitable for outsourced services such as diagnostic services, cleaning, security, or a health service, which is provided to customer's requirement, etc. The particular job is specified in detail, and costs calculated accordingly. Job costing requires the detailed measurement of resource utilisation (comprehensive work documentation, material, labour and time booking system), a sophisticated and appropriate overhead allocation method (fair absorption rates) and in-house expertise. The main objective of the job costing exercise is to charge all costs incurred to the particular job. Usually a job card technique is used. Although any cost technique can be used for job costing, the most frequently used cost technique is the total absorption technique. On the other hand, a costing exercise should be transparent and cost-effective; therefore, decision makers may not favour a very sophisticated, but complex system. (Bean 1996, Lucey 2002)

Practically, batch costing is very similar to job costing; therefore it will not be discussed in detail here (Lucey 2002).

Contract costing

Contract costing shows many similarities to job costing, and it is usually applied to relatively long term jobs which are frequently site based. Since most costs can be directly traced to the contract, this type of costing is characterised by a relatively high proportion of direct costs, and low proportion of overhead costs (Lucey 2002).

CONTINUOUS OPERATION AND SERVICE COSTING

Operation or unit costing is an umbrella term covering several different costing methods such as output costing, service costing and process costing. Process costing encompasses joint product and by-product costing. This type of costing can be used by organisations delivering virtually identical outputs, or being characterised by repetitive operations or processes. In order to calculate the unit costs of services the total costs of service delivery should be divided by the number of services provided (Lucey 2002).

Output costing

This costing method is suitable for providers offering one service or product, for instance, nursing home, respite care, or a safe housing service could use

this method. The unit cost is calculated by dividing the total costs of service delivery by the number of services (products) provided (Lucey 2002).

Process costing

Process costing is a form of operation costing method. This method is frequently used in cases where the unit of service is the result of a process or encompasses input from different departments and follows a series of sequential processes (such as drug manufacturing). The services or productions are broken down into a number of consecutive stages (phases). The cost of each stage is calculated separately. The unit cost of a service is the total sum of the costs of all stages (Bean 1996). It requires clearly defined process cost centres accumulating all relevant costs, and detailed, as well as accurate records of activities. The output of one phase will form the input of the next phase or stage of production or service delivery (Lucey 2002).

Joint product costing and by-product costing

Process costing methodology encompasses two subcategories: joint product costing and by-product costing. Joint product is the term used when two or more products are produced at the same time in one particular phase of the production or service delivery and each product has a significant (sales) value, for example, different ingredients in a drug industry or different meals using the same raw materials. By-product costing is a costing method to deal with relatively small sales value products or goods, which were produced at the same time as a high value product. If the (sales) value of by-products is relatively large, it may be reasonable to treat them as joint products (Lucey 2002).

Accountants differentiate two phases of production, which are separated by the so-called “split-off” point. Up to the split-off point, all costs are joint costs, and after it, costs are called additional processing costs. From costing point of view, the challenge is the fair apportionment of joint costs. The two most common bases of apportionment are the number of outputs (products or services) and the (notional) sales values of the products /services. However, most of the case apportioning methods are selected arbitrarily (reflecting conventions), because it is difficult to assess their comparative accuracy (Lucey 2002).

Joint products (or services) are the result of a particular production process where none of the products (or services) can be produced separately. For instance in the case of automated chemical laboratory tests, several tests are delivered at the same time.

Joint product or joint service costing is a challenge for the service industry too. For instance, during a medical visit, several different services can be delivered, including medical and risk assessment, counselling, and patient education as well as treatment formation.

Service / function costing

This subtype of unit costing can be used for costing different health care services including inpatient and outpatient services. One of the difficulties is to define a realistic / feasible cost unit. A composite cost unit is usually used for costing purposes, such as meals served, one hospital day, patient served, and/or number of operations. The calculation of unit costs is similar to output costing (the total costs per period are divided by the number of service units delivered) (Lucey 2002).

In practice, similar providers could use different service unit definitions, which make comparisons difficult. Furthermore, comparison is only possible if the providers treat the same type of patients, with the same severity of illness, and with the same co-morbidity, as well as having very similar equipment (technologies) in place. Cost comparison is only valid if like is compared with like, but unit costs may or may not reflect the quality or the outcome of services (e.g. health improvement), as well as built-in regional differences (Lucey 2002).

Furthermore, despite the straightforward calculation of unit costs, health care providers can face significant difficulties in collecting the data necessary for costing purposes, as well as analysing it. Moreover, a suitable and well-functioning information system can be very costly to run (Lucey 2002).

From an international, inter-regional or inter-institutional cost comparison point of view, if a near identical service unit cannot be defined or used, then a job costing approach can be used as a second best alternative (Lucey 2002).

Process-based costing

Process-based costing has been used in health care to cost particular services. It is important to differentiate process-based costing from process costing, which is a cost-accounting term (see above).

Process based costing has five steps: identifying a particular service, developing a flowchart (identify the common steps / process of service delivery), estimating resource use for each step, valuing resources utilised, and calculating the total costs. This technique has been used for costing a variety of services, including long term care. Process-based costing can be implemented in hospital settings as well as in nursing homes; and it can be used to calculate the unit costs of new or modified nursing processes (Lee 2003).

OTHER COSTING METHODS APPLIED IN THE PUBLIC SECTOR

Flat rate costing

This is a relatively simple method; usually the total costs are divided by the total number of units of service provided. This method can easily be used for homogenous services (e.g. nursing home service), a whole service or a single activity. On the other hand, flat rate costing may be a rough, non-specific

estimate of service costs, which can be misleading because poor value for money activities may not be discovered (Bean 1996).

Hourly rate costing This is an umbrella term, because an hourly rate can be calculated in different ways. This method is frequently used in those circumstances where a tangible or well-defined output is not easily identifiable.

Flat rate per hour Flat rate per hour is calculated by taking the total cost of service and dividing it by the total hours used to deliver the particular service. The disadvantage of this costing method is that it also takes the unproductive hours (holidays, sick leaves, administration, and training) into account. Therefore, depending on the aim of the costing exercise, it may be more appropriate to use only the direct productive hours (time) of staff for the calculation of a flat hourly rate (Bean 1996).

Differential rate per hour The accuracy of cost per hour rate calculation could be important, because these unit costs may be used for other service cost calculation. Therefore the flat rate per hour may not be the most suitable method for calculating unit costs. For instance, medical doctors, technicians and nurses contribute differently to the delivery of a variety of services, and their salaries can be significantly different. Furthermore, nurses' salaries can vary by grades and specialty. In these cases, the differential rates per hour may be a more accurate estimate of costs.

There are several equally valid methods to calculate the differential rate per hour; they can produce significantly different results. Methods may differ in their data requirement, assumptions and complexity as well as the costs of the costing exercise. Choice of approach should depend on the reason for calculation, ease of calculation and the type of services (unique features of services) (Bean 1996).

REFINING ACCOUNTING COST SYSTEMS

Traditional costing techniques could over- or undercost services and products in the past, partly because they use a relatively gross cause-and-effect allocation basis. Increasing globalisation and competition, including the free movement of goods and services inside the EU, has forced providers and producers to improve their costing/pricing methodologies. At the same time, modern information technology and significant advancement in existing internal information systems made it possible to refine costing methods / costing systems (Horngren 2003, Zelman 2003).

One of the advantages of a more sophisticated cost system could be more accurate cost estimates, which help to re-engineer service provision, readjust prices, and improve technical efficiency (Vance 2003).

The “fine-tuning” of costing systems focused on three major areas:

- Increasing the proportion of direct cost tracing
- Creating more homogenous indirect cost pools, which have a clear cause-and-effect relationship with their respective cost allocation base.
- Using cause-and-effect criteria more widely to define (select) a cost allocation base.

Activity based costing

One of the refined costing systems is called the activity based costing system. ABC is based on the paradigm that activities consume resources, and services or products are the result of activities. Therefore, if the resource consumption of any activities can be measured more accurately, a more accurate cost estimate can be calculated (Zelman 2003).

An activity-based costing system tries to use individual activities with a specified purpose as cost objects, such as dispensing a drug, administering a transfusion, or putting on a bandage. The next step of ABC is the calculation of the costs of each activity, and assigning costs to cost objects such as services on the bases of the activities needed to deliver each service (Horngren 2003). In this way, ABC follows the principles of bottom-up costing methodologies. Conversely, traditional costing methodologies apply a top-down or mixed approach (Zelman 2003).

Due to the fact that most direct costs can relatively easily be traced to services or products, the real difference between traditional costing systems and ABC is that ABC tries to reclassify substantial parts of the indirect costs and directly allocate them to the cost object by (a) identifying specific activities which are necessary to deliver a particular service (asking again and again whether or not a particular activity is necessary to deliver the job), and (b) sub-dividing existing cost pools and creating more homogenous “small” cost pools, because some of the costs in these new cost pools could be reclassified as direct costs. Finally, the ABC system systematically seeks a cost-allocation base that has a cause-and-effect relationship with costs in the cost pool (Vance 2003, Horngren 2003).

Selection between the traditional system and the ABC system

The ABC system could be useful to estimate service costs for rare diseases or infrequent services. Furthermore, ABC could differentiate between services for patient subgroups belonging to the same medical diagnosis or DRG groups. In other words, ABC compared to DRG, CCR or traditional accounting costing methods could more accurately estimate the costs of several different services or sub-types of services (Larsen 2004).

In practice, there is usually a trade-off between the benefits of ABC (more accurate cost information, improved profitability, improved delivery processes, better product/service mix, and strengthened cost control) and the relatively high costs of the ABC system (implementation, training and running costs). The traditional costing system is relatively inexpensive, easy to implement and could provide reasonably good estimates especially in organisations with few

types of services. Decision makers should carefully weight the benefits and costs before opting for a more sophisticated system (Vance 2003, Horngren 2003, Ridderstolpe 2002, Zelman 2003).

Current application

Although ABC is a relatively new system and expensive to implement, there is a growing number of publication about the usefulness of this method in hospital settings. It has been used to cost laboratory services, radiology services, inpatient services such as heart centres, different surgical procedures, and renal dialysis services. However, the ABC system may suffer from similar problems (difficulties) to the traditional accounting systems, such as difficulties to collect data, missing data, incorrect classification of data, vague definition or classification of costs and resource intensive maintenance and upgrade (Ridderstolpe 2002).

PROBLEMS / CHALLENGES OF USING ACCOUNTING COSTS

Non-comprehensive measurement

The total costs of a completed patient episode may require treatments from different providers and/or personnel in different settings. As a result, existing accounting systems may not identify all the relevant costs (resource consumption) of a particular service. Even if the service is provided within a single institution, the existing accounting system may or may not be able to identify and collect all the relevant resources (e.g. physicians are paid separately by a third party payer or depreciation is covered separately by the local municipalities, or the outsourced laboratory services are covered separately by the insurance fund) (Seninger 2004, Shepard 2000).

Systemic distortions

Moreover, a cost accounting system should be carefully used to attach monetary value to resource use, especially in hospital-based care, because it could also be distorted by differences in accounting practices, and internal, as well as external financial and non-financial incentives.

Differences in accounting practices

For instance, if a building or equipment is fully depreciated, the financial (accounting) costs could be zero, but the opportunity costs could be substantial (Brouwer 2001). In addition, cost allocations / cost accounting system could behave as an internal tax system creating several intended and unintended incentives, which could ultimately influence the total costs of services (unit costs) (Zimmerman 2003).

Cost accounting practice and third party payer

Furthermore, there is evidence that cost accounting systems especially in the 1980s and 1990s were tailored towards reimbursement and billing rather than management purposes (e.g. costing and pricing)

(Shuman 1992). For instance, in the USA, reimbursement of hospitals was tied to reported cost especially until the early 1980s. It created an incentive to allocate more overheads to cost objects, which will be reimbursed on a reported cost basis. It was frequently reached by changing the allocation bases of overheads. Currently some nursing home reimbursement is still tied to reported costs (Zimmerman 2003). Consequently, most American hospitals found the Medicare cost reports practically useless for estimating real resource consumption in the 1980s (Young 2003).

Moreover, third party payers may insist on using a “standard” cost accounting system for reimbursement purposes. This external requirement may have an influence on the selection of cost centres, cost objects, and allocation of overhead costs, including allocation base. However, these external standards may or may not fit well into the existing cost/management/ financial accounting system of the particular provider. Because the cost accounting system could be tailored towards the requirements of the third party payer, as well as to maximise revenue for the provider, the unit costs of the same service could be significantly different between organisations. These differences, however, cannot be explained by the differences in actual resource consumption, but the differences in cost accounting practices (Young 2003). At the same time, lack of standardisation of cost accounting practises in a multi-purchaser environment made inter-hospital and inter-country comparison practically impossible or invalid (Shuman 1992).

Therefore, analysts should carefully assess the potential impact of incentives created by reimbursement systems on the cost accounting practices of the providers, because they could bias cost comparison especially between regions and countries (Zimmerman 2003).

Lack of suitable accounting system

Lack of a credible cost accounting system, which is suitable for unit cost calculation, is frequently mentioned as a barrier in the literature (Ellwood 1992, Goeree 1999). For instance, in 1985, a large survey recruiting 3000 hospitals in the USA found that only 50 % of the hospitals had some type of computerised accounting system. Another survey in 1991 found that only 30 % of the hospitals had computerised accounting systems, and only 20 % of the hospitals used them regularly. One of the most important barriers to using a computerised accounting system was the huge investment costs of the system (Ellwood 1992).

High cost of implementation

In addition, the refined costing method, the ABC system, can be even more costly and difficult to implement (e.g. appropriate cost drivers cannot be found). Health care providers may not have the necessary resources and human resources to switch smoothly to ABC (King 1994, Hankins 2004). When the costs involved are low, it may be worth considering other cost allocation system, such as relative value units (RVU). Although RVU may be based on experts’ subjective judgements, using RVU to allocate relatively low cost overheads may not significantly affect the cost estimates (Hankins 2004). In addition, ABC does not eliminate all the difficulties of cost allocation. As a

result, ABC may not be worth implementing in those clinical areas where an existing system is able to trace most of the costs directly to cost objects (King 1994).

Observation
period

Some resource consumption may only be available annually, or there could be a significant seasonal fluctuation of resource use. In this case, a short observation period (e.g. 1-3 month) may not be sufficient, and could lead to poor estimates. In addition, longer observation periods could improve the reliability of comparative studies by eliminating seasonal effects since providers (e.g. hospitals) may be affected differently by these factors. On the other hand, long observation period could substantially increase the costs of the analysis (Shepard 2000).

Using prices, fees, tariffs, and charges

Attaching values to market items

USING MARKET PRICES

Economists argue that in costing studies, the economic definition of costs, not the accounting (or financial) definition, should be used. Furthermore, economists claim that the real cost to society of resources utilised by the patients are their opportunity costs, the benefits that could have been obtained from the next best use of resources. In a “perfect market”, prices are good estimates of opportunity costs partly because the perfect market is in equilibrium and the firms are price takers. Therefore, market prices can be used as reasonably good estimates of opportunity costs unless there is a particular reason to divert from this approach. However, in real healthcare market, prices for the relevant services may not exist, and /or may not reflect the societal value of resources (opportunity costs) (Brent 2003, Drummond 2005, Raftery 2000).

In reality, health care and the health insurance market are heavily regulated and may be non-competitive in the EU member states. In addition, health care market and insurance market failure could further distort prices. Several sub-market can be oligopolistic or monopolistic, where firms (providers) are not price takers, making market price an inaccurate estimate of opportunity cost. Furthermore, prices may be subsidised and third party payment may be the dominant form of payment for services. Moreover, insurance coverage could be partial and the reimbursement rate could vary considerably from service to service causing further distortion of prices. As a result, market prices may or may not be a good proxy of opportunity costs. Using unadjusted market prices may substantially alter the results. Avoiding this type of bias, market prices just after an appropriate adjustment should be used as a reasonable proxy of opportunity costs (Brent 2003, Drummond 2005).

Reimbursement fees for public providers can reflect or depend on several factors, such as provider payment mechanisms, market characteristics, accounting practices, etc. Therefore, fees may not be a good proxy for opportunity costs. Furthermore, fees set by private providers may not be relevant for public providers, because of the differences in pricing (e.g. including profits, higher management salaries, etc) (Brouwer 2001).

Adjusting market prices	Prices usually involve a fair return on investment and risk compensation, but sometimes the profit margin is excessive. In the latter case, prices are not reasonable estimates of opportunity costs for society. In the USA, the common method for adjusting prices is the cost to charge ratio. These ratios indicate how the opportunity costs can be estimated by using prices (Young 2003).
Public sector versus private sector prices	There are several cases where the provider offers services for both the public and the private sector. However, providers can exercise price discrimination, which means that the price of the same service in the public sector may be significantly different from the prices in the private sector. In this case, the lower price (usually the public sector price) corresponds to actual costs, assuming that there is no cross-subsidisation and no predator pricing practice (Dranove 1996).
Recommended price	Another price adjusting method is the recommended price, which is used in Canada, Australia and the Netherlands in the economic evaluation of health technologies (Drummond 2005).
When to use shadow price?	<p>Shadow price method can be used in those cases where market prices need to be adjusted whatever reason (e.g. market prices do not reflect marginal social values of the goods or services in the competitive market, for instance in a monopoly situation or positive externalities), and/or no market price exists (Slathuus 2000).</p> <p>Since healthcare is relatively human resource intensive, a substantial part of cost differences can be related to differences in salaries / wages. However, human resource costs (salaries and fringe benefits) can be the result of political bargaining and the decommodification of human resources. Consequently, salaries may not reflect opportunity costs (Whitehouse 1997). In addition, in several formerly socialist countries (relatively) very low salaries in the public health care system are accompanied by widespread practice of informal payment, which may not be taken into account in a costing study (Gaal 2005). Without using “shadow prices” to correct market distortions, cost estimates could be significantly biased.</p> <p>The decision as to whether or not shadow prices are used in the valuation depends on the purpose of the costing exercise. Unfortunately, current health economic guidelines provide little details on how shadow price method should be used in practice. Consequently, only a few studies applied this method so far (Adam 2003). For instance, Medline search can find only a few studies using shadow price methodology in costing, e.g. Busschbach (1998).</p> <p>It is important to keep in mind, however, that shadow prices are only used for economic analysis (evaluation), and the actual budget should be prepared using market prices (Green 1999).</p>

Source of prices Acquisition prices can be found in recent contracts, and donor supply records. In other cases, local dealers' estimates can also be a useful source of information (Creese 1994).

USING FEES / TARIFFS AND CHARGES

Costing studies as well as economic evaluations frequently used charges to attach monetary value to resources. Charges could be reasonably good proxy for costs because most of the healthcare organisations are not-for-profit or public organisation, and, in principles, purchasers' payment (reimbursement) was directly linked to actual costs in several countries including the USA (Brent 2003). In other words, if the fee schedule development is based on detailed costing studies such as the RBRVS in the USA or the AN-DRG in Australia, fees (charges/tariffs) could be a relatively good estimate of actual costs. (Brouwer 2001, Seninger 2004, Waters 2004)

Possible advantages of using fees / charges Cost estimates could be reasonably accurate especially for non-complex organisation only providing a few types of services, such as GP services or nursing homes. In addition, a tariff system can be very sophisticated (complex/differentiated), giving accurate estimates for subgroups of patients or patients with particular needs. Furthermore, costing studies applying a purchaser perspective should use charges (tariffs) in the analysis, because charges (fees/tariffs) are the true costs for the purchaser (Brouwer 2001, Drummond 2005, Petitti 2000, Seninger 2004, Waters 2004).

Tariffs may exist in institutions funded by capitation or global budget if they providing services for other institutions or accepting private patients. For instance, in the UK, most hospitals have extra contractual referrals tariffs (Johnston 2001). Likewise, providers in several formerly socialist countries should have a pricelist for private patients. Local researchers may have access to these tariff books (lists).

Potential disadvantages of using fees / charges Not only could prices be distorted and a poor proxy of opportunity costs, charges (tariffs and fees) could reflect the historical bargaining power either of the provider or the insurance fund, and mirror the different incentive systems embodied in the payment system, and may not represent market clearing prices (or costs). Furthermore, charges and tariffs may be developed historically, reflecting differences as well as changes in cost accounting practices. As a result, charges (fees/tariffs) may or may not be reasonably good estimates of economic costs. They could either overestimate or underestimate real (or "true") costs. For instance, in Germany the relative value scale used for establishing the ambulatory fee schedule is mainly driven by political negotiation. Likewise, the physicians' fee in Denmark is negotiated between the association of local councils and the association of general practitioners (Brent 2003, Brouwer 2001, Clewer 1998, Seninger 2004, Waters 2004).

Moreover, huge variation in charges can exist due to differences in accounting practices, and charges could include several non-service elements that make

charges a poor proxy of opportunity costs. In addition, cross-subsidisation generated by financial incentives could further distort charges as a proxy of opportunity costs (Brouwer 2001, Clewer 1998, Seninger 2004). Likewise, cross-country differences in financing and payment systems as well as accounting practices may result in considerable differences in tariffs and charges independent of the true costs of health care services (Schulman 1998).

In addition, charges (fees/tariffs) may cover the running costs, but may not cover full costs. In publicly financed systems, providers' revenue could be generated from several different sources (dual or triple financing arrangement), where capital costs are financed separately. Moreover, hospitals and large outpatient centres are complex, multi-product/multi-department organisations, where cross-subsidisation could be substantial. Therefore, charges/tariffs/fees should be used cautiously, especially if there is an indication that they may not be reasonable estimates of actual costs. In these cases, appropriate adjustment or direct costs measurement is warranted (Brouwer 2001, Schulman 1998, Seninger 2004).

Cost-to-charge ratio

One of the most common techniques used to calculate the costs of hospital services by using charges is the cost-to-charge ratio (CCR). The ratio between what a particular service costs and what the hospital actually charges for the service is called the cost-to-charge ratio. The ratio is usually determined by special costing studies (Zelman 2003).

The departmental or lower level cost-to-charge ratios (e.g. service specific ratios) may offer more precise estimates of actual costs than the hospital level cost-to-charge ratios especially in complex, multi-product organisations, because the overall ratio could over- or underestimate the actual costs of a particular procedure. Therefore, the detailed or service/procedure specific cost-to-charge ratio is the preferred method to use (Hayman 2000, Luce 1996, Suttles 2003, Trisolini 1987, Zelman 2003). However, Taira (2003) argues that departmental level CCR could be a reasonable compromise between accuracy and feasibility.

Advantages and disadvantages

The advantages of cost-to-charge ratios are that they are easy to use and publicly available for Medicare services in the USA (Drummond 2005, Zelman 2003). In addition, Young (2003) argues that CCR could be a reasonably good estimate of average total costs of a large group of services, but could be misleading for any single service or procedure. One study showed that using CCR only half of the estimated unit costs were within 10 % of their detailed accounting cost estimate counterpart. Compare to DRG based cost estimates, approximately 70 % of CCR estimates were within the 10 % range. The actual difference could be more than 1000 USD (Brent 2003). Departmental or lower level CCR cost estimate could be 95 % accurate and about 85 % accurate for a DRG. More accurate cost estimates can be achieved by using advanced cost accounting techniques (Brent 2003, Young 2003).

Charges and third party purchaser

Even though hospital charges and outpatient service fees may or may not exceed actual costs, they may be appropriate in an analysis from an insurer's perspective. Likewise, in the case of laboratory tests or diagnostic imaging, charges or tariffs may be the most appropriate valuation base (Luce 1990, Drummond 2005).

Internal and external validity

However, cost to charge ratio has its limitations. Although CCR could yield a reasonably good estimate of actual resource consumption, in practice, it could be distorted by socio-political factors, government and/or third party regulation and cost containment measures. Moreover, if the ratio were determined by using the provider cost accountant system, the accuracy of cost-to-charge ratio depends on the reliability of the cost accounting and billing system of the provider, as well as the methodology used to calculate the ratio. The current Medicare (USA) regulation, which does not require a uniform accounting and reporting system, may allow considerable variation in the calculation of CCR (Drummond 2005, Leivenes 2003, Luce 1996, Suttles 2003, Zelman 2003).

Likewise, if the ratio was determined by an individual study, the accuracy of the CCR depends on the quality (reliability and accuracy) of this study. In addition, hospital level CCRs could particularly underestimate the costs of services with high service intensity and overestimate the costs of services with low service intensity. Furthermore, the accuracy of CCR within the same institution depends on the relative stability of volume and case mix as well as usage of the same medical technology. Similarly, considerable changes in the proportion of fixed and variable costs could result in inaccurate CCR (Zelman 2003, Larsen 2002).

Moreover, costs calculated by using the CCR are regarded as average costs rather than marginal costs (Luce 1996, Drummond 2005, Suttles 2003).

In addition, these charges may not reflect the actual unit costs. For instance, in the Netherlands and Belgium, outpatient charges are lower than the actual costs, whereas inpatient charges are higher than the actual costs (Brouwer 2001).

Charges and health systems

Patients bills, on which most of the charges are based, are not prepared by Veteran Administration (VA) hospitals in the USA, and several other countries where hospitals are funded through global budgets, or DRG payment system. As a result, the CCR system cannot be used in these countries. VA developed several methods to estimate the unit costs of services provided by VA organisations such as pseudo-bills, average costs database, and cost functions based on regression analysis (Barett 2003).

CCR in practice

More than 30 costing studies, which used the cost-to-charge ratio in the USA for calculating hospital costs, were found by simple Medline search. However, none of them used it for cost comparison between hospitals, states or regions.

Furthermore, published cost-to-charge ratio may not be available in any of the EU member states, partly because it is based on routinely generated patient bills. As a result, cost-to-charge ratios are rarely used outside the US hospital sector (Luce 1996, Trisolini 1987, Suttles 2003). An advanced Google search did not find any English language studies or published cost-to-charge ratios in any EU member state.

In addition, an institution-specific and/or departmental-specific cost-to-charge ratio has frequently been used inconsistently, which may reduce the comparability / generalisability of the results. Furthermore, hospitals may calculate their own CCR using more or less different methodologies as well as different accounting systems, which limits the use of the CCR method in comparative costing studies. Moreover, providers could use different rates for different departments without being explicit about it. The cost-to-charge ratio also varies from state to state for instance, it is 0.328 in California, and 0.769 in Maryland (Suttles 2003). Comparability can be improved by using standard methodology and/or cost databases developed by standard methodologies. (Radensky 2001).

Diagnostic related groups

Diagnostic related groups (DRGs) are a special form of hospital charges set in advance (prospective payment system). DRG has redefined the unit of cost measurement. Instead of using one hospital day or item, one hospital treatment episode became the new cost object. Actual resource utilisation is measured by relative weights, and minimum and maximum length of stay, attached to each DRG category. The actual charges are established by multiplying the base payment by the relative weight of each DRG. However, DRGs may not include capital costs; for instance, Medicare established a separate operating and capital payment rate. Therefore, some adjustment is necessary to estimate the total average cost (Henderson 1999, Larsen 2004, Santerre 2004). In addition, the payment rate or charges are adjusted to geographical variation in input prices and specific hospital characteristics in the USA (Santerre 2004).

Advantages and disadvantages

The advantages of DRG charges are that they are publicly available and usually upgraded annually, as well as the costing methodology, including the upgrading, can also be publicly available.

On the other hand, DRG calculation may assume constant returns to scale and preclude economies and diseconomies of scope, but hospitals may benefit from simultaneous production of several different services (economies of scope) (Butler 1995). Furthermore, in the presence of joint productions, the accuracy of the DRG charges can depend on the fairness of the apportionment of joint costs. For instance, using ABC method to estimate the unit cost of one patient episode may have better internal validity and could yield significantly different unit cost estimates compared to DRG, but it can have less external validity, because DRG charges are national or regional averages while ABC unit costs are organisational specific averages (Butler 1995, Larsen 2004).

Some experts argue that DRG charges are a set of prices instead of charges reflecting actual resource use or costs. In this case, hospitals are price takers and tailor their behaviour (production) accordingly to avoid losses on the treatment of particular type of patients. Moreover, this theoretical approach assumes that hospitals can select from patients and only treat the “profitable” type of patients. In other words, the case mix may be an endogenous factor for the hospitals. Consequently, the DRG charges may not reflect actual resource use and may not be a good estimate for actual costs. This practice, however, may not be accepted on ethical and legal ground in several countries using DRG financing system (Butler 1995).

DRG in practice

The DRG system was originally developed and implemented in the USA in 1982-1983, and used as a prospective payment for inpatient care by Medicare, and adopted and implemented in several EU member states, including Belgium, Denmark, Germany, and Hungary. Countries may differ in the total number of DRG groups and subgroups. In the USA there are 495 DRG categories (Henderson 1999). In Germany, more than 824 different DRG categories exist, while the UK used 48 HRG categories in 2004 (Lungen 2004).

Fees based on relative value scale

Resource based relative value scale (RBRVS) was developed in 1988, and introduced in 1992 in the USA as a physician payment system. RBRVS is an index of relative level of resource use for physician services or procedures. To calculate the actual fee for each physician service, the RBRVS is multiplied by the value of one unit. The conversion factor is upgraded annually to account for inflation and other changes (Henderson 1999, Santerre 2004). Similar relative value scale is used in Germany and Hungary for ambulatory (specialist outpatient) services (Waters 2004).

Advantages and disadvantages of RBRVS

RBRVS is transparent, already in the public domain and it could be based on actual resource consumption. Three type of resources were taken into account in the development of the RBRVS in the USA: (a) health professionals workload (time), skills and risk, (b) practice expenses including costs of support staff, equipment and supplies, and (c) professional liability insurance. Several other countries currently use similar value scales to develop and upgrade their outpatient and/or physicians fee schedule including Japan, Germany, and Hungary (Henderson 1999, Waters 2004).

On the other hand, even in the USA some of the indices are based on expert opinion, therefore some RVUs could under- or overestimate actual costs such as non-physician human resource costs and practice expenses (American Academy of Pediatrics Committee on Coding and Nomenclature 2004, Melzer 2004). In addition, in order to ensure budget neutrality (of Medicare), the specific conversion factor was selected. Furthermore, the RBRVS does not take economies and diseconomies of scale and scope into account, because the development was based on the assumption that long run MC equal AC implying constant return to scale (Brent 2003).

Moreover, the German fee schedule is based on negotiations and reflecting the bargaining power of different parties (Waters 2004). Furthermore, Santerre (2004) argue that this valuation method fails to consider input prices.

Payments

There are studies using payments (e.g. third party payments, public purchaser payments) rather than charges for attaching monetary value to resource consumption. Payments may or may not be based on detailed costing studies, and the methodology used for costing could vary country by country. For instance, Beck and his colleagues (1999) compared the trust prices in England with the costs estimates based micro-costing approach, and recognised that trust fees/prices were significantly lower compare to micro-cost estimates. Moreover, payments are limited to covered (reimbursed) services and could be highly regulated and tailored towards policy objectives such as cost containment. On the other hand, analysis adopting purchaser perspective should use payments to attach monetary value to resource use (Luce 1990, Drummond 2005, Waters 2004).

OFFICIAL UNIT COST DATABASES

In other circumstances, when market prices are likely to provide fundamentally flawed estimates of opportunity costs, or do not exist, an alternative solution is required. For instance, official costs databases, such as the Ontario Case Costing Initiative in Canada, NHS reference costs, tariffs and the PSSRU's Unit Costs of Health and Social Care database in England, EBM in Germany, NTR in Italy, MoH database in Portugal, and the Decision Support System in VA (USA). Unit cost databases also exist in Australia, France, the Netherlands, Spain and Sweden. They have higher external validity than an individual costing study performed in one hospital, and they may already be in the public domain (Blackhouse 2003, Brouwer, 2001, Guerrini 2001, Knapp 2002, Oostenbrink 2003, Schulman 1998).

These databases or sources are frequently called secondary data as compared to cost data derived from direct measurement (such as an individual costing study).

Advantages and disadvantages

Although the official unit cost database may or may not be comprehensive in all the aforementioned countries, and suffers from methodological limitations, these databases could be the most accurate and reliable cost estimates available publicly. Using standard cost reduces the impact of cost differences due to differences in accounting practices, measurement methods and practice variation. Consequently, using standard costs could enhance comparability of service costs between countries (Oostenbrink 2003).

Unit costs database may not be comprehensive

On the other hand, there are countries where official unit cost estimates may not be available for most of the interventions, and researchers should rely on insurance reimbursement fees, tariffs, or other available price data (e.g. Netherlands, France).

Moreover, neither unit costs nor fees/charges are available for several medical services in some EU member states (Blackhouse 2003, Knapp 2002, Schulman 1998).

External validity

Furthermore, standard costs reflect national average costs; therefore, unit costs may be a poor proxy of actual resource utilisation in a particular organisation. Moreover, unit costs cannot be used in

studies requiring more detailed costs / resource use information. For instance, if the study would like to assess the cost differences within one unit cost object (Oostenbrink 2003). Likewise, unit costs reflects average rather than marginal costs, therefore, it may not be useful for decision-problems requiring marginal analysis.

Moreover, the unit costs estimates should be detailed to avoid case-mix and site-selection bias. For instance, studies using the Canadian unit cost database could suffer from the case-mix bias (Jacobs 1996).

Methodological biases

In addition, unit cost estimates can be computed using different costing methodologies (top-down, bottom-up or mixed costing approaches). As a result, depending on the method used, unit costs

estimates could suffer from methodological biases, consequently could have similar disadvantages as either the bottom-up or the top-down approach. (These issues were discussed earlier) (Jacobs 1996).

Attaching monetary value for non-marketed items

Attaching monetary value to a non-marketed item is usually based on official unit prices or shadow prices. Schulman et al (1998) suggested two additional methods to calculate the unit costs of “non-marketed” items: (a) the market-basket based imputation method and (b) the relative value unit method.

Moreover, the Veteran Administration has developed several methods, such as pseudo-bills, average costs database, and cost functions based on regression analysis, to estimate the unit costs of services provided by VA health care organisations, which do not develop patient bills. Although VA costing methodologies could be implemented in Canadian settings, little is known about the adaptability of the VA methods in European countries (Barett 2003, Blackhouse 2003).

Using official unit cost databases

In the case where market prices do not exist, unit cost databases could help analysts to attach a monetary value to health services. However, official unit cost databases may not be comprehensive. For instance, they may not cover several medical services and informal care in different countries. In these cases, (a) a market-basket based imputation method and (b) a relative value unit method could be used to calculate the unit costs (Schulman 1998).

Examples of non-market item are blood products (e.g. RBC transfusion) or donor organs in several European countries. From a societal perspective, charity work, volunteers and carers' time also non-marketable resource items. Several different approaches, such as the human capital approach, implicit valuation, willingness-to-pay, and the overtime rate, have been used to value these resources. All have advantages and disadvantages.

Furthermore, a recent technology assessment report assesses the available databases in the UK, and finds only two databases, the NHS Reference Cost Database and the database of the Prescription Pricing Authority (PPA), which can directly be used to estimate the unit cost of health technologies. The PPA includes prices of pharmaceutical products dispensed by GPs in the UK. Although the databases have internal consistency check, the external quality audit may be exceptional (Raftery 2005).

When should shadow price be used?

Informal care can be a substantial part of the total cost of the health and social care of several patient groups (Whitehouse 1997).

Attaching monetary value to informal care

There are two alternative methods to cost informal care: (a) the shadow price method and (b) the opportunity cost method. The shadow price method simply estimates the costs using the prices of comparable activities. For instance, in the case of informal home care, the costs that would be incurred by the family or the third party payer if health professionals treated the patient at home instead of an institution will be used as the shadow price of informal homecare. However, time spent by an informal caregiver could be much more than time spent by health professionals to deliver the same type of service partly due to the differences in experience and training (Busschbach 1998, Brouwer 2001, Gold 1996, Kavanagh 1993, Smith 1994, Wijk 2005).

Patient and carer time and productivity costs

Due to the perspective chosen for this review (public purchaser and/or provider) patient and carer time, as well as productivity cost measurement and valuation methodology is not included in this review. Moreover, European economic evaluation guidelines differ in their recommendation regardless of the recommended perspective. For instance, (source: ISPOR website): **separate reporting** of productivity costs are recommended in the base case in the Baltic states, Finland, France, Norway, Poland, Portugal (human capital method), and in the

Netherlands (friction costs method). On the other hand, some guidelines recommend that productivity costs should **be included in the base case** in Germany, Italy (human capital method), and Sweden (human capital approach). While **individual discretion** is allowed by the national guidelines in Portugal, Spain and Switzerland.

There are, however, several good reviews highlighting methodological and practical issues (debates) regarding productivity costs including McDaid (2001), Knapp (1999), Sculpher (2001), Tranmer (2005) and van den Berg (2004).

Estimates / extrapolation based on (published) studies

In some cases, when similar services or activities have already been valued and the unit costs calculated, information can be extracted from published studies, reports or analysis (e.g. economic evaluations and/or costing studies). It may be helpful to contact the authors directly to discover more details about the costing exercise in order to assess the quality and reliability of these estimates (Muennig 2002).

Practical challenges
– biases

However, published studies may suffer from similar weaknesses as direct costs measurement, e.g. good internal validity and poor external validity, which may hinder their usefulness. Furthermore, the prerequisite of using published studies for assigning monetary value to resource items are the detailed reporting of unit costs and their sources. However, several cost studies do not report unit costs separately and/or their sources (Ekman 2004, Stone 2000). (table 8)

Table 8: Source of unit cost estimates used in cost utility analysis (%) (Stone 2000)

	Publication (including government catalogues, tariff books)	Charges including CCR)	Cost accounting system	Expert opinion	Not specified or could not be determined	Number of studies
Health care services	73 %	29 %	25 %	25 %	43 %	226
Non-health care services	45 %	3 %	0	26 %	36 %	38

Please note that one study may have used more than one source.

Furthermore, information about costs of services especially from Central and Eastern European countries is very limited in the English language literature (Treulsen 2005). Likewise, the unit cost data may only be available for a few diseases, (and predominantly about medical costs. This latter can be a problem for studies adopting societal perspective).

Moreover, the result of costing studies can be biased. The most common biases in costing are the followings (Jacobs 1996):

- 1) Costing method bias
 - a) Inclusion non-relevant and exclusion of relevant costs item (e.g. exclusion relevant overhead costs, or some other important relevant direct costs items).
 - b) Misclassification bias (misleadingly classify fixed costs as variable or vice versa)
 - c) Scale bias (inappropriately assuming that marginal costs equals short run average costs)
- 2) Study design bias
 - a) Small sample size in direct measurement of costs
 - b) Case-mix or service mix bias (severity, co-morbidity)
 - c) Site selection bias (e.g. using a single unrepresentative hospital)

It is difficult to predict the magnitude and direction of these biases. Furthermore, they could have synergetic effect (exacerbating each other's impact) causing significant diversion from true differences (Jacobs 1996).

Estimates / extrapolation based on expert opinion

Although expert opinion is generally seen as the least reliable source of information about effectiveness and costs, several studies had to rely on multiple sources when assigning monetary value to resources, including expert opinion in international comparative studies (e.g. Carabin 2002, 2003).

Practical problems of costing

Allocation of overhead costs

One common problem in costing a particular service is the allocation of overheads (indirect costs). Estimating the prime cost of a particular service is relatively straightforward, at least in principle. On the other hand, apportioning overheads, especially in multi-product institutions, can be problematic (Millichamp 1997, Young 2003). Moreover, health economic methodological guidelines frequently do not provide sufficient details about the recommended cost allocation methods (Adam 2003).

By definition, overhead, or indirect, costs cannot be (“directly”) traced to services / products (costs objects) in an economically feasible way. Therefore, overheads should be allocated fairly to cost objects (services or products). The real question is what proportion of the overheads should be allocated to a particular service and what is the most appropriate method to do it. Different, but entirely reasonable, methods can lead to significantly different results. Although the most common allocation bases are direct labour hours, direct wages, direct materials, machine hours, or direct labour costs, choosing between allocation methods usually depends on which allocation method more closely approximates the factors that generate overhead costs in the long run (Clewer 1998, Lucey 2002, Zimmerman 2003).

The Federal Accounting Standard Advisory Board (USA) recommends that “cost assignment should be performed by (a) directly tracing costs whenever feasible and economically practicable, (b) assigning costs on a cause-and-effect basis, (c) allocating costs on a reasonable and consistent basis.” For instance, ABC costing uses cause-and-effect criterion to allocate overheads. However, other cost allocation criteria, such as benefit received, fairness and equity, or ability to bear, may be used in practice (Horngren 2003).

Cost allocation using a direct allocation method or carefully selected cost drivers may be costly and require complex information / accounting systems. Further problems could be created by incentive systems based on internal accounting, because information is collected and analysed by people who may be affected by the allocation. For instance, support services, or interdependent services or departments, may attempt to maximize their revenues and set charges above their true costs. As a result, other departments may not be able

to recover all their costs, which could jeopardize the mission of the institution (Bean 1996, Brouwer 2001, St-Hilaire 2000).

Table 9 Overhead cost allocation method (Bean and Hussey 1996)

Allocation base	Allocation method	Advantages	Disadvantages
Flat rate	Shared equally between service areas	Simple and transparent	May be unfair because allocation is not based on actual utilisation of overheads. Cross-subsidisation could distort costs/prices and undermine competitiveness. No financial incentive to reduce overhead costs
Square footage	Proportion to the amount of floor occupied for service delivery.	Simple and transparent, may be appropriate for accommodation costs	May not be suitable for all kind of overhead costs. May be unfair because allocation is not based on actual utilisation of overheads. Cross-subsidisation could distort costs/prices and undermine competitiveness.
Employee numbers	Proportion to the direct number of staff engaged in service delivery.	Simple and transparent, and could also be fair for human resource intensive services	Human resource costs may not be a good proxy for actual use of overheads; Service delivery may require significantly different human resources (human resource mix) which could cause cross-subsidisation
Employment costs	Proportion to the direct human resource costs of service delivery	Simple and transparent, and could also be fair for human resource intensive services	Human resource costs may not be a good proxy for actual use of overheads;
Budget size	Proportion to the direct expenditure budget of each service area	Simple and transparent, and could also be seen as equitable	Budget may not be a good proxy for actual use of overheads; as a result services could be cross-subsidised.
Capital asset value	Proportion to the assets used in the service delivery	Suitable for overheads relating to medical equipment and premises	Difficulties in the case of old equipment and assets. May not be suitable for non-equipment related overheads
Output	Proportion to the units of service outputs	Strong link between overheads and productivity Reducing price/cost distortion	Transaction costs could be relatively high If output is low, mid-term adjustment may be required to absorb all the overheads
Number of patient days	Shared equally between patients	Simple and transparent	May be unfair because allocation is not based on actual utilisation of overheads. Cross-subsidisation could distort costs/prices and undermine competitiveness. Little financial incentive to reduce overhead costs.
Actual utilisation	Proportion to actual utilisation of overhead costs	Fair, Creates a financial incentive to reduce overhead costs	Transaction costs could be relatively high, may require a sophisticated internal accounting system and a mix of different allocation (apportionment) methods.

Choosing the appropriate absorption base

The accuracy (fairness) of overhead allocation depends on both the allocation method and the allocation base. In principle, the selection of overhead allocation bases should be guided by the existence of a strong cause-and-effect relationship (Young 2003). Although there are several factors to be considered

in the selection of the appropriate allocation base, the final choice is usually a matter of judgement and common-sense (Lucey 2002). The following table summarises the most frequently used apportionment methods and their advantages and disadvantages (Bean 1996).

Bean (1996) argues that the best (fairest) allocation base to allocate overhead costs to cost objects is the “actual utilization method”, but this may not be feasible in practice.

Selecting the appropriate allocation method

After the selection of the appropriate allocation base, analysts should choose a suitable allocation method to allocate all support centres cost to mission centres. Four allocation methods are mentioned in the literature: (a) direct method, (b) step-down method, (c) multiple allocation method, and (d) simultaneous equation method (Ellwood 1996, Drummond, 1997, Finkler 2001, St-Hilaire 2000, Young 2003).

- **The direct allocation method** (or single stage method) is simple to apply but it ignores interaction between cost centres and the allocation of reciprocal services. Consequently, unit costs could be much distorted. Therefore, it may not be permitted to use, for instance, HCFA in the USA does not permit its use. In the NHS (UK), however, it was allowed to use for contract pricing (Ellwood 1996).
- **The step down** (or two-stage) **allocation method** allocates costs in two stages. As a first step, all costs are allocated to either mission or support centres. Afterwards all the costs of the largest or most important support centre are allocated to other cost centres, and this process continues until all the costs are allocated to mission centres, but no costs can be allocated to those support centres, which have already allocated their costs. Support centres are ranked according to their relative importance and costs are assigned to centres lower down in the scale in a step-wise fashion. It is more precise than direct allocation, partly because partial adjustment is made for interaction of overhead departments. The ranking of cost centres, however, could be arbitrary, which may considerably affect unit cost estimates. Moreover, this method can be more time-consuming and resource intensive compared to direct allocation methods (Finkler 2001, St-Hilaire 2000, Young 2003).

The Medicare guideline standardised to order of cost allocation as well as the allocation base in order to reduce unnecessary variation of unit cost estimated (Elwood 1996).

- **Reciprocal method** uses mathematical methods (usually computer based) to model the interaction between cost centres and allocate costs. The results are more accurate than those obtained using direct allocation or simple step down allocation (Elwood 1996).
 - **The step down with iteration**, or multiple allocation, **method** allows full adjustment for interaction of overhead departments. Repetition is used to reduce bias resulting from arbitrary ranking of cost centres (Finkler 2001, Young 2003).

- **The simultaneous equation allocation method** makes full adjustment for interaction of overhead departments. Theoretically, it could be the most accurate method, and it can be computerised, but it is the more complex method, and can be difficult to implement (Finkler 2001, Young 2003).

No consensus on the recommended method

There is no consensus in the literature on the best process to use in practice. One group of experts including the Cost Accounting Standard Board (USA) concluded that the reciprocal method (simultaneous equation method) is the most useful and theoretically sound (Young 2003, St-Hilaire 2000). On the other hand, others argue that the step-down approach offers an optimal balance between accuracy and costs of use (Finkler 2001b). Likewise, St-Hilaire and Crepeau (2000) found no significant difference in the outcome when using different allocation methods. Moreover, they argue that the results can be influenced not just by the allocation method selected, but also by the allocation base used. However, utilisation of the theoretically most appropriate allocation base could be difficult or impossible in practice. Conversely, other comparative studies have found significant difference in the unit cost estimates (e.g. 30 %) between the step-down method and the reciprocal method (Elwood 1996).

In economic evaluation, if marginal analysis is used, the important question could be which overhead cost would change the result of the analysis. One might argue that, from the study point of view, those overhead costs, which bear no impact on the results, could be omitted from the calculation (Luce 1996, Drummond 2005).

Predetermined overhead rates

Instead of using the actual overhead rates to attach overhead costs to cost objects (e.g. services), several organisations, use predetermined overhead rates to allocate overheads to cost objects. The main advantages of a predetermined overhead rate are the following: (a) it is simple and easy to use, (b) it ensures comparability over time and between services, and (c) it is less time and resource consuming. Health care organisations frequently use this approach in costing a variety of different (research) projects and contracts. On the other hand, using a predetermined overhead rate could be less accurate, and the costs figures could be very misleading, especially in cases where the overheads are a large proportion of the total costs (Young 2003).

Under and over-absorption

Accountants usually use a predetermined absorption rate, which can lead to over or under-absorption. Over-absorption occurs when a cost object absorbs more overheads than the actual overhead utilisation. Under-absorption occurs when fewer overheads are absorbed than the actual overheads. In general, complex / diverse / small quantity services (goods) will tend to be more

costly, using actual utilisation methods or activity based costing (ABC) compare to traditional absorption methods. Conversely, when overheads are only a small proportion of the total costs, the absorption methods used may not make too much difference (Lucey 2002).

Activity based costing and overheads

Activity based costing (ABC) was developed to refine overheads allocation and reduce the probability of both under-absorption and over-absorption. The method of overhead absorption is crucial in those cases where overheads are relatively high proportion of the total costs. Traditional overhead allocation methods assume that overhead consumptions change proportionally with the allocation base used (e.g. volume or budget size, etc). Overheads, however, frequently vary with product / service complexity and diversity, rather than volume of services provided (Lucey 2002, Frinkler 2001).

To partly address this problem, ABC applies cost drivers and cost pools to improve overhead allocation. Unlike traditional overhead allocation methods, which only use a few allocation bases, the ABC system uses several cost drivers (multiple allocation bases). Ideally, there are cause-and-effect relationships between the cost drivers and the costs of a product or service. This is why ABC is able to directly trace more overheads to a particular service or product and at the same time to rely less on arbitrary allocation bases. However, selecting realistic cost drivers can be difficult in practice, in part due to lack of a universally applicable methodology/rules (Lucey 2002).

Selecting cost drivers

Ideally, there is a cause-and-effect relationship between the consumption of cost overheads and the cost driver, and usage of the cost driver correlates well to the amount of overheads in the cost pool. The number of cost drivers used by an organisation could vary from a dozen to hundreds. There is a trade-off between accuracy of overheads allocation and the transaction costs of ABC. The number of cost drivers usually depends on (a) the level of accuracy required, (b) the extent to which the cost driver captures the actual consumption of overheads, and (c) the number of homogenous activities (one cost driver per one cost pool) (Lucey 2002).

The advantages and disadvantages of ABC

The advantages and disadvantages are summarised in the following table. In general, treating more costs as direct costs can lead to more accurate unit cost estimates, but it may require more detailed and complex cost accounting system, which can be very costly and may not necessarily lead to better decisions. For instance, ABC system could reduce cross-subsidisation due to misallocation of costs, but research evidence shows that cross-subsidisation is mainly driven by market forces (e.g. reimbursement/payment policies), and therefore, a more precise unit cost estimate may not influence decisions (Ellwood 1996).

Table 10: Advantages and disadvantages of ABC (Lucey 2002, Lievens 2003, Finkler 2001)

Advantages	Disadvantages
More accurate costing, partly due to more overheads, is “directly” traced to products.	Cost drivers can be a poor proxy for overhead costs (they may not capture most of the overhead costs)
ABC focuses on cost generating activities, and provides information about the cost structure that is more detailed. Therefore it can help to improve technical efficiency.	The relationship between the usage of the cost driver and the overhead costs may or may not be linear.
ABC is well suited to a complex and diverse delivery process (environment)	Apportionment of common costs and/or joint costs could still be challenging
ABC is able to inform decision makers about the long-run variable costs.	It can be very complex and expensive to run.
ABC is flexible enough to support different costing purposes or decision problems.	It may need substantial investment and training (installation / implementation cost)

One of the crucial factors of the implementation and use of the ABC system could be the degree of complexity, which is partly determined by the level / degree of details of the cost measurement. Optimal balance is important. Less detailed cost systems can be cheaper and less time consuming to run, but may provide less accurate unit cost estimates. On the other hand, a very detailed cost system can provide accurate cost estimates, but could be expensive and time-consuming to run (Lievens 2003).

Capital costs and costs of investment

Starting any kind of health services needs investment (capital). Capital assets have an economically useful life, which, by definition, is longer than one year. However, except fields (land), fixed assets are being worn down, and therefore depreciation should be included in the average unit costs calculation.

To allocate a fair share of a fixed asset to a particular service, analysts should know the value of the fixed asset, the working life of each particular asset, and either the acquisition costs or the replacement costs of the assets (Shepard 2000). Fixed assets can be defined as assets of reasonably high value offering economic benefit for the healthcare provider for more than one financial year (Lucey 2002, Millichamp 1997).

ATTACHING MONETARY VALUE TO FIXED ASSETS

Valuing assets fixed There are different methods of measurement of capital costs: (a) the replacement value of facilities, and (b) the rental value of facilities. One study found no difference in the results when comparing the aforementioned measurement methods. However, the capital costs were only a small part of the total costs in that study (Rosenheck 1994). Another method used in valuing capital assets is the original purchasing price. However, in countries with relatively high inflation, this could significantly underestimate the value of the capital asset (Shepard 2000).

Another way to attach monetary value to fixed assets such as buildings is based on conventions. The opportunity costs of buildings or other investments can be calculated by using the interest rate (of the national bank) (money could have been earned by an alternative use of money) (Bowling 2002, Drummond 2005). This approach has been criticised because public organisations may not have the opportunity or right to choose between these options (Shepard 2000). However, analysts should be aware that initial investment and/or depreciation may not be listed in the cost account system, if, for instance, the equipment or building was a generous gift.

Estimating asset's working life the total The working life of equipment can vary significantly. Frequently, it is possible to obtain information from the local accounting system / policy about the average working life of each fixed asset. In other cases, expert opinion or a consensus statement may be helpful for estimating the working life of a particular piece of equipment / building / land, etc. (Creese 1994).

DEPRECIATION

Most cost items, including overhead costs, have their values determined by external factors (e.g. rent, interest rates, electricity or drug prices, etc.). In several EU member states the salaries of health professionals are also mainly externally determined by salary scales, etc. However, the values of several resources (tangible fixed assets) are mainly determined internally. Fixed assets can be defined as assets of reasonably high value offering economic benefit to the healthcare provider for more than one financial year (Lucey 2002, Millichamp 1997).

Accountants spread the cost of a fixed asset over its lifetime. The process of allocating the appropriate share of total costs of a particular fixed asset over its life span is called the depreciation process. Sometimes depreciation is overlooked because no cash-flow takes place. It is important, however, that the

costs of expensive tangible assets (e.g. buildings, land, and equipment) are included in the total costs of services. Depreciation is one of the practical ways to do this (Lucey 1990, Lucey 2002, Millichamp 1997). However, land is not depreciable item, because it can maintain its value, but it still has opportunity costs (Millichamp 1997).

Time based and output based depreciation methods

There are several ways to calculate the costs of depreciation, but they can be grouped into two major categories: (a) time based methods and (b) output (volume or level of activity) based methods. Whatever method is used, the total costs of the tangible asset have to be calculated. The total cost, usually called net asset cost, is calculated as follows (Lucey 2002):

Net asset cost = (purchase price + installation + delivery cost) – net scrap value.

The net scarp value (or net salvage value) is equal to the amount realised on disposal less disposal costs. It is important to keep in mind that registered organisation should deduct VAT from the invoice price, while unregistered organisation should use the gross invoice value (Lucey 2002, Millichamp 1997).

The most common methods used to calculate depreciation are: (a) straight line depreciation, (b) the reducing balance method, and (c) the production unit method. However, there are organisations using other methods, such as the revaluation method, the repair service method and the sinking fund method. All methods have advantages and disadvantages. For instance, the straight-line method assumes that assets give up their value evenly over their lifespan, but, in reality, the value of medical equipment could fall much more quickly in the early years than later on. Details can be found in cost accounting textbooks (Lucey 2002, Millichamp 1997).

Usage of fully depreciated assets

It could happen that a fixed asset is still in use after it is fully depreciated. This may happen if the lifetime of the asset is underestimated or it is not replaced. Accountants usually recommend charging depreciation until the asset is replaced. The advantage of this method is that the costs of delivering a particular service will reflect the costs of using the asset. Sometimes the depreciation costs are recalculated using new useful life estimates (Lucey 2002).

Replacement value and historical costs of a tangible asset

Accounting practice may differ regarding the best choice for a depreciation base. There are arguments for using the current replacement value as a depreciation base, because it is a better proxy for the

real economic value of the asset. However, this may contradict with basic accounting principles (Lucey 2002). Furthermore, the replacement value of an equipment could be much lower than the acquisition price (e.g. computers, ultrasound machines, or CT/MRI, etc.) (Yates 1996).

Obsolescence

The rapid, unforeseen loss of value of a tangible asset (known as obsolescence) is usually not included in depreciation. Common practice is that loss of value of a fixed asset due to obsolescence is directly charged to the general profit (Lucey 2002).

Practical approach

Estimating net asset costs and useful life span (depreciation period=period over which the fixed asset loses its value) can be difficult in the real world. In practice, estimates are required for the useful lifespan and salvage value (net scrap value) of a fixed asset. However, these estimates may vary significantly between institutions (Ellwood 1992, Yates 1996)..

According to accounting practice, land will not be depreciated, because land does not usually have limited life-span in normal circumstances. Buildings have a limited useful life (e.g. 40-50 years), and the straight line method is used to depreciate their value. On the other hand, vehicles usually have a 5 (max 10) years life-span, and different methods are used for depreciation (Millichamp 1997).

Although institutions may vary significantly in their depreciation policies, health care providers should consistently apply whichever depreciation policy is selected, over the years. For instance, many institutions use a policy where the salvage value of medical equipment is regarded as nil. However, differences in depreciation policies may create an obstacle with inter-institution and especially inter-national cost comparisons (Millichamp 1997).

Expressing the result in the same financial year

Because discounted cash flow (net present value) is the theoretically correct way to assess decision problems, economic evaluation guidelines recommend that results should be converted and expressed as if they all occur at the same time. Cost data are usually converted to the present value, using either the beginning of the year or end-of-year present value (Zimmerman 2003).

In addition, cost data should be adjusted for inflation. The nominal interest rate comprises real interest rate and inflation. If the discount rate is stated as a nominal interest rate, then costs should be stated in nominal terms (adjusted to inflation). It is important to avoid inconsistency in handling cost data. However, some future costs may be fixed (e.g. due to long-term contracts), and therefore, they should not be increased by inflation (Zimmerman 2003).

One of the methodological questions is whether adjusting for inflation should be done using a consumer price index or a medical price index. Kernick (2000) argues that a service specific inflator should be used, but this may not be available. Parviainen et al (2004) used the Finnish Local and Regional Authorities Guideline to adjust their result for inflation. However, American studies frequently use the medical price index to adjust for inflation (Auerbach 2000).

Fringe benefits / informal payments / in-kind help

Fringe benefits can be seen as part of the human resource costs, and therefore it should be included in the costing study. A special form of fringe benefit could be the so-called informal payment or gratitude money. Shepard (2000) argues that these benefits should also be included in the study. Likewise, in-kind work (help), unpaid charity workers time or donated items (e.g. free drugs) could be substantial, and excluding in-kind (unpaid) work may lead to incorrect conclusions (Shepard 2000).

Taxes

Taxation and interest are not included into the routine cost calculation, because they are deducted from profits. Furthermore, taxes and other social transfers can be seen as not being real economic costs; and therefore, they should be omitted from the economic analysis (Brouwer 2001, Lucey 2002).

On the other hand, taxes, social insurance contributions, VAT and interest could be important information in special decision problems. In some countries, VAT may not be refundable, and prices paid by the organisations include social transfers. Moreover, decision-makers frequently have to consider the full human resource costs. In these cases, they should be included, but listed separately in a well-tabulated form (Brouwer 2001, Lucey 2002).

Value added tax

Value added tax (VAT) can be claimed back by registered organisation; and therefore, for these organisations VAT does not represent a true cost. Consequently, it should be omitted from routine cost calculation (Lucey 2002). On the other hand, VAT may not be refundable for not-for-profit and/or public organisations, and it can be considered as operating costs. For instance, hospitals in Belgium cannot claim back VAT (Kesteloot 2000).

Variability of unit cost estimates

The unit costs of health services vary considerably partly because of (a) differences in costing methodologies including differences in resource use measurement and valuation, (b) differences in cost accounting systems and practices, (c) differences in inclusion and exclusion of particular costs (e.g. incidental costs), (d) differences in controlling regional and seasonal variations during costing, (e) structural/organisational differences between providers, (f) differences in patient case-mix and socio-demographic characteristics, and (g) differences in financial and non-financial incentive systems, as well as (i) geographical differences in input prices. Comparative studies should address these issues (Adam 2003, Luce 1990, 1996, Oostenbrink 2003, Shulman 1998, Wernermar 2004).

Biases in costing

Scientific literature about unit cost estimates has to be critically appraised before it use, because the result of cost studies could be biased causing unexplainable variation in unit cost estimates. Common biases in costing are the followings (Jacobs 1996):

- 1) Costing method bias
 - a) Inclusion non-relevant and exclusion of relevant costs item (e.g. exclusion relevant overhead costs, or some other important relevant direct costs items).
 - b) Misclassification bias (misleadingly classify fixed costs as variable or vice versa)
 - c) Scale bias (inappropriately assuming that marginal costs equals short run average costs)
- 2) Study design bias
 - a) Small sample size in direct measurement of costs
 - b) Case-mix or service mix bias (severity, co-morbidity)
 - c) Site selection bias (e.g. using a single unrepresentative hospital)

It is difficult to predict the magnitude and direction of these biases. Furthermore, they could have synergetic effect (exacerbating each other's impact) causing significant diversion from true differences (Jacobs 1996).

Disagreement between guideline, non-compliance with guidelines

Health economic methodological guidelines disagree in some of the fundamental methodological issues and their recommendation is not sufficiently detailed which may also contribute to the observed variation in unit cost estimates. For instance, unclear guidance in resource use measurement, cost allocation, and/or using shadow prices could be partly responsible for the variation in unit costs. In addition, analysts not always comply fully with existing methodological guidelines especially in the inclusion and exclusion of resource items (Adam 2003).

<p>Variability of costs estimates between countries</p>	<p>Schulman (1998) argues that overheads and capital costs are responsible for a large proportion of cross-country variability of unit cost estimates, whereas country-specific factors explain only 11 % of the variability. Differences in accounting practices (e.g. differences in overheads allocation rules) and personal time spent on delivering a particular activity could account for the remaining variability.</p>
<p>Variability caused by differences in the incentive systems</p>	<p>There is evidence in the literature, that differences in payment systems and non-financial incentive systems could cause significant differences in medical practice pattern, such as selection between treatment modalities, strategies or following different clinical guidelines, reference patterns. These differences are observable inside one country and between countries. For instance, the same public purchaser could apply different payment systems for private for profit and public providers as in France or Hungary. Consequently, it could cause considerable differences in the unit cost estimates (Lievens, 2000a,b, De Vecchi 1999, Horl 1999, Montagne 2000)</p>
<p>Variability caused by regional variation in costs</p>	<p>The calculation of unit costs of services should take variation in (input) costs into account. For instance, rent could be significantly different in rural areas compared to urban areas. Furthermore, salaries may be different especially in the presence of incentive systems to encourage provision of work in special areas (Beecham 1995).</p>
<p>The importance of economies of scale in cost comparison</p>	<p>Comparing the costs of institutions with low and high utilisation rate could be very misleading. The following techniques may ensure or improve comparability (Jacobs 2005):</p> <ul style="list-style-type: none"> • Use a benchmark, such as comparing the costs of institutions with 80 or 85 % bed occupancy rate (according to international standards in hospitals). Using benchmarks may also be possible for the comparison of outpatient departments, day clinics, and laboratories. • Another alternative could be to use some adjustment of costs for the actual utilisation. However, this option may be less transparent than the former suggestions.
<p>Variability in cost accounting systems and accounting practices</p>	<p>Due in part to the differences in cost accounting systems, providers may classify the same costs differently (e.g. treating drug costs as direct costs or indirect costs). Furthermore, a sophisticated accounting system could create the need for a detailed data collection. Consequently, these providers could have richer statistics and apply more accurate costing methodologies including selecting a suitable allocation base for overheads. Moreover, a more sophisticated accounting system enhances more detailed cost analysis even at departmental or lower level. These differences, however, could cause</p>

significant variation in unit costs and at the same time hinder comparative analysis between regions or countries (Oostenbrink 2003, Wernerman 2003).

Managing uncertainties

There are two main methods for analysing uncertainties: (a) statistical analysis and (b) sensitivity analysis. These two methods have complementary roles in dealing with uncertainties (Johnston 2001).

Sensitivity analysis

Sensitivity analysis can be defined as a systematic assessment of how changes in selected resource use, input price or assumption affects the unit price estimates. Analyst should justify the selected range across which parameters will be varied. Ranges of resource utilisation should be clinically meaningful, whereas ranges of input prices should be economically plausible (Johnston 2001).

Ideally, all relevant health care costs should be included in the costing exercise, but in the real world, this is not always possible. In some cases, accurate measurement is not feasible. In these cases, researchers may use a “quick and dirty” approach and pay attention to the “big tickets”. Furthermore, costing exercises may apply several assumptions. Therefore, a sensitivity analysis should be performed to check the robustness of the results (Kernick 2000).

Chapko and Hedrick (1999) found that acute inpatient care, outpatient medical care, and the combination of nursing home and day hospital care account for 98% of the variation in total cost per patient in the USA. Furthermore, they demonstrated that the results of costing exercise based on local data and national average costs could differ significantly. Therefore, sensitivity analysis is warranted whichever method is used to estimate the costs (Kernick 2000).

Statistical analysis

Uncertainty in resource use and input prices can be assessed by statistical analysis. Because the distribution of cost data can be highly skewed, non-parametric test, log-norm parametric test and bootstrapping can be used to test the difference (Johnston 2001).

Health service specific issues

Primary care

The detailed WHO guideline of cost analysis in primary care was published in 1994. The original target audience was health service managers in low and middle-income countries, but it could be a useful reading for analysts in EU member states (Creese 1994).

Consultation fees

Graham and McGregor (1997) reviewed GP consultation fees in the UK, and found relatively large variation between consultation fees (3-4 times). The variation can be explained partly by (a) the lack of transparency of the costing methodology used, partly by (b) the lack of compliance with methodological principles/guidelines, and partly by (c) the differences in costing methodologies applied.

However, national unit cost estimates and detailed methodological guidance for costing GP consultation is currently available in the UK (PSSRU Unit Cost of Health and Community Care). This guidance makes it possible to calculate the local unit costs data using individual practice information. One advantage of local unit costs data is that it could be more relevant for the study compared to national unit cost estimates. However, more standardisation is needed to cost out-of-hour consultancy in primary care (Kernick 2000, 2002).

Also, Hankins and Baker (2004) give a detailed description of primary care visit cost estimation in a US environment, including the usage of activity flow charts.

Nursing care

Traditionally, the cost of nursing care in a primary care setting was estimated by using the number of visits (encounters) for a given time period (e.g. one patient episode). However, a new costing method has recently been developed in the USA using Clinical Care Classification System (CCCS). It uses a three dimensional classification system to differentiate between different types of activities provided by nurses, and allocates time to each activity. The cost of

one nurse visit can be calculated by adding together the time spent on different activities and multiplying it by the costs of human resources. This costing method offers more accurate estimates than the traditional visit number method (Saba 2004).

Dental care

Using Medline search strategies, I could not find any comparative costing studies in dental care in Europe. Furthermore, except for water-fluoridation and regular screening (prophylaxis) there are very few published costing or cost-effectiveness studies in this field.

Outpatient care

Renal Replacement Treatment

Peeters and his colleagues (2000) critically reviewed the cost analysis of renal dialysis in Western Europe. The cost of dialysis varied according to the objectives of the study and the perspective applied. They found that one-third of the studies did not give enough details about the methodology and most of them did not explicitly state the perspectives of the study. In addition, the number and type of resource items included in the cost calculations varied significantly. Frequently costs of transportation, adverse events/side-effects, hospitalisation, and home treatments were not taken into account. The differences in costing methodologies (resources measurement and valuation) reduced the comparability of the results. The authors concluded that more detailed reporting of resource use and unit costs may be necessary to ensure comparability between studies, as well as between countries. There may be a need for either a new costing (reporting) guideline or better compliance with the existing guidelines (Peeters 2000).

In addition, Wordsworth et al (2005) compared the bottom-up and the top-down approach in Estonia, France, Greece, Hungary, and Scotland and found that the estimated cost, as well as the relative cost difference, between haemodialysis and peritoneal dialysis depends considerable on the method used, but centre specific and technology specific factors were also responsible for some of the differences. The study concluded that only the bottom-up method was able to shed light on the real causes of differences in costs. (Table 11)

Table 11: Main methodological / practical differences using the top-down and the bottom-up method in costing dialysis services in European countries (Wordsworth 2005)

	Top-down approach using cost accounting system and special questionnaire	Bottom-up approach
Availability and reliability of data	Could be difficult to obtain detailed and well structured information and /or interpret data (except sites with sophisticated cost accounting system)	Relatively easy to obtain detailed dataset in standard format from each centres (but may need dedicated research staff to do it)
Comprehensiveness of data	Could vary by areas	Could be evenly detailed
Cost allocation	Apportionment of joint costs as well as allocation of overhead costs mainly depends on the existing cost accounting system, and it could be unclear (not transparent) and vary by centres	Cost allocation and joint cost apportionment could be more standardised (greater consistency between sites)
Separation between resource use and unit prices	Not always possible	Allow separate recoding and reporting (greater transparency)
Identification of differences in treatment policies / practice patterns / resource use	Could be difficult to identify	It is possible to identify

Community mental health care

Although the quality of economic evaluation of mental health care varies significantly, some lessons can be drawn from the current literature (Evers 1997).

Defining health services

Although the ICD 10 and the DSM IV classification system are widely used, a unique problem in mental health care is the uncertainty about the diagnosis. Therefore, the resource consumption could vary significantly, due to lack of homogeneity of the patient group (Evers 1997).

Measuring resource utilization

Studies used either micro-costing or gross-costing method to measure resource use of different mental health services (Evers, 1997).

Assigning monetary value to resource items

Evers et al (1997) found that most of the studies used charges or CCR to attach monetary value to resource consumption, and only a few valuation were based on direct measurement (micro-costing). However, this can be explained partly by the dominance of American studies.

Informal care

Informal care in some countries could be a substantial part of total costs, especially for special patient groups such as mentally ill (schizophrenia, dementia), and/or patients with severe disability/dependency (several neurological diseases e.g. multiple sclerosis). The same type of care may be fully or partly reimbursed in other countries. Therefore, especially in international comparative studies, it can be very important to calculate the costs of informal care. Due to the lack of consensus about the gold standard in resource use measurement and valuation of informal care, several different methods has been used to measure and value informal care such as the market price method or the reservation wage method (Adam 2003, Brouwer 2001).

The scope of this review, however, is costing methodologies from a purchaser or provider perspective, and informal care is usually taken into account when a cost assessment is performed from societal perspective. Therefore, costing informal care falls outside the scope of this review. For that reason, this review only highlights some of the practical and theoretical dilemmas.

Measuring resource use

Usually data about informal care are not collected. Furthermore, cost studies rarely focus on informal care. Therefore, analysts and researchers have to rely on surveys, interviews and occasional publications (Luce 1996). In practice, however, it can be difficult to measure the time, type and quality of informal care, partly due to “joint-cost problems”. For instance, it might be difficult to estimate (share out) the time of a relative spent on supervising a relative with demented and time spent on other household activities. Furthermore, the existence of co-morbidities could cause further challenges (Wimo 1997).

Valuation of informal care, charity work and donation

Although it is important to value appropriately both charity work (informal care) and donations, economic and costing guidelines vary considerably in their recommendation (Adam 2003). One approach to valuing informal care is to use national wage statistics, for instance the average wage of in-home caregivers (replacement cost approach). However, if such costs are only a small fraction of total costs, a sensitivity analysis can be used to deal with it. However, this method could be debatable (Smith 2003, Wimo 1997)

From a methodological point of view, the valuation of time could depend on what kind of time is being sacrificed (e.g. paid work or leisure time) (Brouwer 1999, 2000).

Hospital specific costing issues

Hospital costs may be one of the main cost drivers of health service costs (Porsdal 1999). Therefore, it is important to estimate hospital costs accurately.

According to Llewellyn and Northcott (2005), the three most important factors responsible for the variability of hospital costs are (a) differences in cost allocation practices, (b) differences in fixed running costs and (c) clinical practice variation. In addition, Oostenbrink et al (2003) found that (1) the type of hospital, (2) the type of ward, (3) the case-mix, (4) the sophistication of hospital cost accounting systems, and (5) the inclusion of “incidental costs” may also contribute to the variation of hospital unit costs. Therefore, comparative studies should control these factors to enhance comparability.

Furthermore, the cost structure of hospital services shows that overheads could be more than 40 % of the total costs, and the largest cost drivers are ward costs and expensive medical interventions (e.g. surgery). Consequently, analysts should pay attention to measuring ward costs and the costs of expensive medical technologies accurately, and apply a reasonably fair overhead allocation method (Llewellyn 2005).

MEASURING RESOURCE USE

Current reviews highlight that economic evaluations have employed either top-down or bottom up approaches (including activity based costing) or a mixed approach to estimate the costs of hospital care. However, the lack of harmonisation of costing methodologies substantially limits the comparability and generalisability of the results of the published literature (Negrini 2004, Pines 2002).

In addition, using existing accounting systems could lead to inaccurate estimates, due in part to accounting systems having gaps (some costs are excluded and data may be missing) (Shepard 2000). For instance, physicians could be self-employed or paid directly by third party, and as a result, resource use data may not be able to be obtained from the hospital accounting systems (Oostenbrink 2003).

Time and motion studies

In an ideal situation, TAM studies would be the most accurate means for measuring several aspects of hospital care. However, this is one of the most expensive methods for measuring resource utilisation. As a result, only a few published studies have used this method over the last two decades (Annemans 2005, Baldwin 1997, Dranove 1996, Dexter 1995, Grossman 1999, Turner 1996, Tierney 1993).

Relative resource scale

Traditionally the nurse-to-patient ratio was used to allocate nurse time (workload) to different ward based nursing care services. The recently developed CCCS system offers a more accurate alternative measurement method, based on a three-dimensional classification system. One might argue that the CCCS system is similar to the RVU system, comparing different activities and allocating the necessary nursing time accordingly (more details in the primary care section) (Saba 2004).

ABC system

The ABC system can use a bottom-up approach or a mixed approach to measure resource utilisation as well as costs. A growing number of articles demonstrate that it is a feasible and realistic alternative to other measurement techniques (Lievens 2003).

Large (national) databases

Large statistical databases also can be used to measure resource consumption. For instance, Montagne et al (2000) used the French hospital database to measure inpatient resource use for MI.

Hospital information system

Resource use measurement can be based partly or fully on hospital information system. Depending on the comprehensiveness and level of details of the medical information system, other additional data collection methods have to be used to collect all the resource consumption information (Oostenbrink 2005).

ATTACHING MONETARY VALUE TO RESOURCES

Hospitals, as well as costing studies of hospital services, use different methods to value hospital resource use, including traditional charges, DRG-based costs, activity-based costing, micro-costing, pseudo-billing, average cost based on cost distribution reports, etc. (Barnet 1999). These valuation methods could yield significantly different results partly due to the fact that (a) they could include or exclude different cost categories, (b) they can apply different assumptions, (c) they can use different overhead allocation methods, and (d) they may or may not include research and teaching related costs (Larsen 2004, Taira 2003). These methods have their own advantages and disadvantages. For instance, the DRG may only reflect the operational costs of the hospitals (e.g. capital costs may not be included.) The ABC system may be useful for calculating the costs of unusual or rare diagnosis, but may not be useful to measure important changes in resource consumption within one DRG group (Tiara 2003).

Using charges / fees One of the most common methods used in studies adopting the purchaser perspective is using charges, fees and official tariffs for attaching monetary value to resource use.

Cost-to-charge ratios In the United States, hospital specific or department specific cost-to-charge ratios are frequently used to estimate hospital costs (Arnow 1993, Chalom 1999, Cher 1997, Doering 2000, Elting 2004, Haley 1991, Hall 2004, Krahn 1999, Lawrence 2001, Macario 1995, MaWhinney 2000, Nigrovic 2000, Olshansky 2001, Paramore 2004, Phillips 1996, Radensky 2001, Rizzo 2001, Schneider 1995, Smith 1994, Soprano 2000, Velasco 1996, Woods 1996, Zenati 1997). Countries such as Germany, where hospitals send detailed bills to third party payers, may be able to adapt this method to attach monetary value to resource use.

Advantages and disadvantages

In the United States, cost-to-charge ratios are in the public domain for most of the hospitals. Hospitals usually use traditional cost accounting methods to calculate the cost-to-charge ratio (CCR). Analysts can use the charges and CCR to calculate the actual costs. However, economics of scale and case-mix can influence the results; therefore, the target capacity level (e.g. 80%), as well as the case mix should be reported with the CCR. Furthermore, hospitals could use different cost accounting methods to calculate the CCR, and the method used may or may not be in the public domain. Moreover, published studies do not always contain details about the calculation of costs using CCRs, leading to uncertainties regarding the final figures, and some studies use a hospital level CCR while others use a departmental level CCR. In addition, hospital charges are as accurate as the hospital cost accounting system, especially their overhead allocation system. Furthermore, charges may or may not include all direct medical costs, because physicians and diagnostic laboratories may submit their bill directly to third party payers in the USA (Dranove 1996, Gyldmark 1995, Jacobs 2005, Taira 2003).

Profit maximising hospitals may use market centred pricing principles to charge for their services. As a result, charges could vary significantly inside one country. On the other hand, in countries with a regulated price / fee / tariff system, charges may only reflect the outcome of a complex political bargaining process. In either case, charges will not reflect actual costs born by the provider. This is one of the reasons why large insurance companies such as Medicaid and Medicare are able to negotiate substantial discounts, sometimes up to 50 %. As a result, analyst should use an appropriate adjustment technique to estimate the actual costs of hospital services (Gyldmark 1995, Dranove 1996, Jacobs 2005, Oostenbrink 2003, Beddow 2001)

Per diem payment Using average price per day could also be problematic, because constant costs per day may not represent well the actual resource use. For instance, it usually

does not reflect patient specific resource use and it assumes that resource use is constant during the hospital stay, and this assumption may be inappropriate in most cases.

Diagnosis Related Group fees

Diagnosis Related Groups (DRG) is a hospital costing and payment method, which classifies in-hospital patient cases into categories with relatively similar resource use. The grouping is based on clinical diagnoses and/or procedures performed, and age, sex and health status at discharge. Several European countries (Belgium Germany, France, Hungary, and Sweden) have implemented the DRG method, which was originally developed in the USA. The International Classification of Diseases (WHO) is used for clinical diagnosis and grouping services into larger groups (The Change Foundation 2004, Lungen 2004).

One of the potential problems in using DRG values in comparative studies could be that analysts may not be able to determine whether the DRG values are based on charges or costs. For instance, the Belgian DRG was based on charges in the early 1990s, which would be relevant to studies from a third party payer's point of view, but may not be suitable to an analysis adopting societal perspective (Drummond 1994).

Another problem could be that DRG fees can be a reasonable good estimate of average (uncomplicated) cases, but DRG fees may underestimate the costs of complicated cases. For instance, Montagne (2000) found that DRG fee was not a good estimate of costs of complicated AMI in France, which can be partly explained by the way how DRG fees are calculated.

In addition, DRG fees as other fee schedules need timely upgrading partly due to the technological change. However, the adaptation of new technologies can be significantly different between providers and/or specialities. Therefore, while an upgrade in every 3-5 years might be sufficient for some specialities, annual upgrade (benchmarking) is necessary for others (Montagne 2000).

Using cost accounting systems to allocate costs

WHO recently published guidance to help hospital managers more accurately calculate the unit costs of particular hospital services (Shepard 2000, downloadable from: <http://sihp.brandeis.edu/Shepard/w-manual.pdf>).

The WHO guideline suggests a 7-step cost accounting method (approach) to calculate the unit costs of hospital services (Shepard 2000):

1. definition of the final product (service) (cost object)
2. determining the cost centres
3. identifying full costs for each input (identifying resource items, and classifying them as direct or indirect)
4. assigning inputs (resources) to cost centres (resource allocation)
5. allocation of all costs (resources) to final cost centres (cost objects) (resource allocation)

6. computing the unit costs for each final cost centre (mission centre or cost objects)
7. reporting the results

These steps follow the traditional cost accounting method to calculate the unit costs of any cost object (service) (Young 2003).

*Prerequisite of cost measurement
using cost accounting system*

Ellwood (1996) argues that the following infrastructural elements are the prerequisite of cost measurement using cost accounting system: (a) separate and reasonably detailed information about clinical services (departments) and support services (departments), (b) reliable and valid information system according financial and cost data, as well as basic statistical data about clinical specialties and support services, and (c) appropriate cost allocation methods.

Activity based
costing

Overheads could account more than 40 % of the total unit costs of hospital services. Therefore, a more accurate overhead cost allocation could lead to more accurate unit cost estimates. Likewise, accurate cost estimates of large cost items, such as ward costs and expensive medical procedures, are essential to unit cost measurement. Furthermore, the arbitrary allocation of overheads could undermine comparability and generalisability (Llewellyn 2005, table 12).

Because the ABC method can more accurately allocate overhead costs, it has gradually gained ground in hospital costing in the last decade. However, it does not eliminate all the difficulties and uncertainties of cost allocation. As a result, the ABC may not be worth implementing in those clinical areas where an existing system is able to trace (directly) most of the costs to cost objects (King 1994).

Table 12: Cost structure of one patient episode (Llewellyn 2005, % calculation was made using the authors' data)

Cost items	Cost per patient episode	% of total costs
Ward costs	1211.51	49.0
Theatre costs	716.76	29.0
pathology	101.02	4.1
Radiology	32.32	1.3
Physiotherapy	73.46	3.0
Occupational therapy	39.99	1.6
Cardiomeasure	1.51	0.1
Other	295.35	11.9
Total	2471.92	100 %

Several studies used an activity based costing method to estimate the cost of particular services, such as coronary artery bypass surgery or radiotherapy at hospital level in Europe (Belgium) and North America. Implementation of the ABC system can be difficult, time-consuming and resource intensive, however, it could open avenues for more accurate cost estimates, detailed information about cost structures, and, consequently, better cost control, and better management decision making, as well as improved strategic planning. For instance, the ABC could improve the allocation of overhead costs between departments and/or service units compared to traditional cost accounting systems, which could allocate more overheads to high volume products regardless their actual overheads utilisation rate. Therefore, activity based costing could improve the accuracy of health services' cost estimates (Laurila 2000, Lievens 2003, Ridderstolpe 2002, Poon 2004).

Cost allocation and
(third party)
reimbursement

Cost accounting systems should be carefully used to attach monetary value to resource use in hospital-based care. For instance, in the USA, the reimbursement of hospitals was tied to reported cost, especially until the early 1980s. It created an incentive to allocate more overheads to cost objects (services), which will be reimbursed on a reported cost basis. It was frequently reached by changing the allocation bases of overheads. However, some nursing homes' reimbursement is still currently tied to reported costs (Zimmerman 2003).

In addition, cost allocations / cost accounting systems may behave as an internal tax system creating several intended and unintended incentives, which could have considerable impact on resource utilisation, including medical practice patterns, and ultimately influence the total costs of services. For instance, the insulating and non-insulating allocation system could foster or inhibit cooperation between hospital departments, or the full cost transfer price could cause a death spiral. Both could have a significant impact on resource utilisation (Zimmerman 2003).

Therefore, analysts should carefully assess the potential impact of incentives created by reimbursement systems on the providers' cost accounting practices, because this could bias cost comparison, especially between regions and countries (Zimmerman 2003).

National unit costs
databases

Several countries (Australia, Canada, Italy, the Netherlands, UK) have already developed a national unit cost register (database) which can be used for cost analysis. However, some EU member states do not have unit costs databases (Oostenbrink 2003).

In the UK, hospital based outpatient and inpatient care costs at the level of healthcare resource groups are published annually by the Department of Health (NHS Reference Costs). Likewise, the unit costs of community care are published annually by PSSRU (Unit Costs of Health and Social Care), and the CIPFA Cost Database provides the most up-to-date average hospital costs by specialty (departments) (Street 2002, Raftery 2005).

One of the advantages of the introduction of unit costs measurement and the publication of comparative hospital costs data is that it has reduced variability in unit costs, partly because of the growing standardisation of costing, including overhead allocation, and partly by indirectly fostering the reduction in clinical practice variation (Llewellyn 2005). However, it is important to bear in mind that the published unit costs are national averages, and the actual unit costs of a particular hospital can vary by volume and case-mix (Jacobs 2005).

Healthcare
Resource Groups

In the UK, the so called Healthcare Resource Groups (HRG) system was introduced in 1995, and used in the contracting process for acute (predominantly surgical) hospital services. According to the National Casemix Office, HRG cost information was used by 68% of Primary Care Trusts for purchasing services (The Change Foundation 2004).

The HRG reference cost comprises the weighted average of several procedures necessary to deliver services grouped together under one HRG. The mixed costing approach is used (bottom-up and top-down) to measure resource use. According to Northcott and Llewellyn S (2004), further increasing the proportion of accurate micro-costing could increase the accuracy of the HRGs' reference cost estimates. However, currently, the costing methodologies used have not been standardised enough in practice to ensure confidence in comparability (Northcott 2004).

Using statistical
modelling to
estimate unit costs

As part of the WHO-CHOICE project, a statistical model was developed to estimate the unit cost of hospital services in countries for which data are not available. The multivariate imputation method also produces reliable estimates of standard error (Adam 2003).

Intensive care units

Intensive care is one of the most costly hospital services consuming 30 % of total acute hospital costs in the USA. Moreover, the unit cost of ICU can be 3-5 times higher than the unit costs of average hospital care. Costing intensive care, however, turned out to be difficult. Studies used either top-down or bottom-up approaches to calculate the unit costs of ICU (average costs per patient day) (Wernerman 2004, Oostenbrink 2003).

Measuring resource use		In the literature, several different methods were used to measure resource utilization and attach monetary value to resource use. However, only a few studies compared two or more methods in determining the actual costs of intensive care services. Lack of standardization of resource measurement and valuation, as well as the reliance on different methods significantly reduced the comparability of results (Elliott 1997, Olshansky 2001).
Top approach	down	The top down approach is feasible, relatively easy and cheap. However, these estimates (average costs and scoring systems) may or may not be useful in economic evaluations or specific cost studies, because costs can vary substantially between individual patients (Edbrooke 1997b, 1999).
Bottom approach	up	The bottom up approach has also been used to cost intensive care for particular type of patients to address these problems. Although this approach may be more accurate and useful for several decision problems, it could be expensive, time-consuming and difficult to validate, especially when no computerised cost-accounting system exists. The source of data can be generated from medical records, hospital computerised databases (Chaix 1999). The account classification method has been used in the Netherlands to calculate the unit costs of ICU services (Oostenbrink 2003).
Attaching monetary value to resources		Several different methods were used to value resource use in studies focusing on intensive care services.
Direct measurement	cost	Direct cost measurement was used by several studies applying the micro-costing approach. Unit cost estimates were generated from purchasing documents, contracts and hospital billing data, as well as the provider accounting system (Chaix 1999).
Using charges	prices /	One of the most frequently used methods for valuing resource consumption in the American literature is using CCR, but other methods are also used.

Cost-to-charge ratio

American studies frequently used the Medicare cost-to-charge ratio to calculate the costs of ICU, but some studies used average bed day price, derived

from the hospital ledger (Auerbach 2000, Gyldmark 1995, Olshansky 2001).

Average bed day price	Using the average bed day price to value hospital services, faces the same pitfalls as other valuation efforts which use charges, fees or market prices (e.g. charges do not reflect costs, and resource consumption is uneven during the hospital stay (usually higher for the first few days)) (Auerbach 2000, Gyldmark 1995, Olshansky 2001).
Using DRG rates	A few American studies compared the costs of ICU using DRG rates and CCR, and found that DRG rates may not cover all the costs of intensive care, because the ICU treats the most severe patients whereas the DRG payment rate covers the costs of an average patient (Gyldmark 1995). One Danish study has also compared CCR, DRG and ABC costing methods and found no significant differences in the total hospital costs of stable angina pectoris. However, compared to DRG or ABC, charges underestimate the costs of short hospital stay (<7 days) and overestimate the longer hospital stays (Larsen 2004).
International comparative analysis	Edbrooke (1999, 2001) and his colleagues developed a top-down costing system for intensive care units in the UK, which was later used for comparing costs of ICU services in England. The method developed is based on cost blocks (such as (a) capital equipments, (b) estates, (c) non-clinical support services (such as hospital management costs), (d) clinical support services, (e) consumables (such as medicines, disposables), and (f) staff). Later this method was used to calculate the unit costs in different European countries, such as Finland, Norway and Hungary, and was used to compare unit costs between Hungary and England. ICU costs were cheaper in Hungary, mainly due to the cheaper human resource costs (Csomos 2005, Flaatten 2003, Parviainen 2004).

Non-acute inpatient care

Cost-to-charge ratios are mainly calculated for acute hospital care, but there are several other types of non-acute hospital-based inpatient care. In this case, insurance claims can be used if they are an acceptable proxy of actual costs.

Hospital based diagnostic services

There are two major types of diagnostic services: diagnostic imaging and pathology services (clinical (or chemical)) laboratories and anatomic pathology (or histopathology). They are relatively independent units inside the hospitals offering services for many other departments. Although laboratory costs can be responsible for 6-9 % of the total costs of a hospital episode, there is significant

variation, and it could be between 15-19 % in the case of organ transplantation and/or coronary bypass surgery. Consequently, the introduction of global budget and DRG financing systems create strong incentives to develop internal accounting systems and calculate the costs of services more accurately (Young 2000).

Pathological services

Pathological services have applied several different costing methodologies in the past. Some of them have based on commercial accounting software packages applying the bottom-up costing approach, while other studies have used CCR to estimate the costs. On the other hand, some pathology services have implemented a modified top-down approach in costing (Bailey 1997, Young 2000).

Bailey (1997) argues that the modified top-down approach can be the practical compromise, because it is less resource intensive and relatively easy to implement and run. His article provides a detailed description of this later approach.

Diagnostic imaging

While economic evaluation studies frequently use official fee schedules and charges to estimate the unit cost of diagnostic imaging services, several American cost analysis studies used ABC occasionally accompanied by TAM studies to calculate the unit costs of different diagnostic imaging services, and found that Medicare charges can under-reimburse some of the services (Enzmann 2001, Nisenbaum 2000, Howkins 2001). Likewise, a British study has used cost accounting method to calculate the unit cost of imaging services (Bretland 1988).

In addition, Howkins et al (2001) successfully implemented ABC system using the existing hospital information system. The authors argue that by the integration of the existing information systems (management and other information systems) with ABC system, more accurate, useful cost information can be generated, and the implementation, as well as the running costs of the systems can be lower than independent self-sending systems.

Nursing care in hospitals

Hospital services can be divided into two major categories: (a) clinical services and (b) hotel services. It may be possible to find no significant difference in clinical services, but substantial variation in hotel services or vice versa. Young et al (2000) found that accommodation, nursing and catering services were responsible for up to 50 % of the total cost of medical wards, and about one third of the surgical wards. Consequently, accurate costing of hospital wards can be important in comparative studies (e.g. comparing private single en-suite medical wards with shared non-en-suite surgical wards' costs could cause a significant bias (Young 2000, Negrini 2004).

Measuring resource use

A recent review found that studies have used different methods to measure resource consumption, including top-down, bottom-up, and its special form activity based costing. On the other hand, studies have included different cost items partly due to the differences in study objectives and perspective applied (Negrini 2004).

Valuing resources

Brent (2003) argues that per diem could be a reasonably good measure of costs of hotel services in hospitals because constant return of scale can be expected. Likewise, Young et al (2000) have used hospital level CCR to attach monetary value to hospital ward services.

On the other hand, Negrini et al (2004) found that costing or economic evaluation studies have used different cost allocation methods including direct allocation, step-down allocation and multiple distributions to calculate the unit costs of hotel services. Furthermore, only a few studies have compared the result of different allocation systems. The authors conclude that due to lack of standardised costing methodology, the results of the published studies are practically incomparable.

Long term care	One group of costing studies tried to develop a scoring or weighting method to estimate the costs of different subgroups of patients treated in long-term care institutions. For instance, Williams et al (1994) found that the activity of daily living scores of the residence correlate relatively well with the overall costs of long term care, and can explain 30 % of the cost variations.
End-of-life care	Seninger and Smith (2004) recently published a detailed recommendation (guideline) for costing end-of-life care.
Hospice services	A special form of long-term care is hospice services. However, hospice services comprise very heterogeneous services, where the actual content of the service may be influenced by the perspective of the study (Seninger 2004).

Costing pharmaceuticals

Identifying resource use	The cost of pharmaceutical products encompasses the direct costs of obtaining, storing, dispensing and administering the product. In addition, the costs of prophylaxis include activities such as regular monitoring to prevent severe side effects, and the treatment of any kind of side effects could be part of the drug's costs (Dranove 1996, van Zanten 2003, Elliott 2005). White et al (1999) found that the cost of drug related side effects (ADE) could be
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substantial, for instance, in hospitals the extra costs due to ADE could be between 2200 – 3300 USD.

Measuring
resource use

Van Zanten et al (2003) highlighted that the total costs of drug treatment should involve the costs of dispensing, administration and time spent on monitoring patients. They used a time and motion (TAM) study to calculate the non-drug costs of IV treatment, and found that the total costs could be 13-113 % more than the drug acquisition costs.

Although one study found that providers' a report could be more accurate about actual pharmaceutical and medical product utilisation than patients' surveys/interviews, current costing studies use several different ways to measure resource use of drug treatments (van den Brink 2004).

Attaching
monetary value to
resource use

Attaching monetary value to drugs used can be relatively straightforward. However, attaching monetary value to time used to administer and dispense the pharmaceutical product could be more problematic.

Attaching monetary value to drugs

Well documented, catalogue prices and / or national tariffs are usually available. Most of the OECD countries publish a National Formulary, which contains the drug prices (Raftery 2000). It is important to know that in the UK separate Drug Tariffs are published in England and Wales, Scotland, and Northern Ireland. The British National Formulary contains the so-called "basic net prices" of the products based on the largest pack size, but excludes professional fees and an overhead allowance. On the other hand, the price of OTC products includes VAT (www.bnf.org). Detailed drug prices can also be found in the NHS Electronic Drug Tariff Book published on the Internet (http://www.ppa.org.uk/edt/August_2005/mindex.htm).

However, several studies used actual hospital acquisition costs, which can be more accurate (Chaix 1999, Dranove 1996, Montagne 2000). Wholesaler prices or acquisition prices do not include dispensing, storing and transportation costs, and retailer catalogue prices may or may not include dispensing fees, therefore, these cost items should be added ex post (Chaix 1999, Dranove 1996, Montagne 2000).

In outpatient settings, pharmacy prices were used in several studies (Dranove 1996).

In comparative studies, a unique problem may arise from the lack of harmonisation of VAT, and wholesale and retailer margins inside the European Union. In addition, prices are officially fixed or maximised in some countries, and may vary regionally in others.

Attaching monetary value to time required to administer or dispense the drugs

Different solutions were used in the literature. One group of researchers used average nurse salaries, while others used a first year registered nurse salary. Some analysts also included the fringe benefits of the salary and others included paid holidays too. These additions can be justified in some cases if they are part of the standard compensation package, but not in others if they are not (Dranove 1996).

International price comparison

Although European Union directives try to reduce the packaging, packet size and dosage differences between member states, international price comparison have to cope with package and dosage differences. For instance, the strength and package size can be significantly different in different member states. Therefore, studies usually use the daily defined dose (DDD) or daily therapeutic dose (DOTs, WHO recommendations) as a basis for price comparison (Heaney 2001).

Blood products

Amin et al. (2003) published a systematic review of allogenic red blood cell transfusion. They found that the costs of blood transfusion increased significantly in the USA, Canada and the UK. Jefferies et al (2001) found that blood transfusion costs could be 1 % of the total surgical hospital costs, but for the most expensive DRGs, it could vary between 5-8.6 %. Despite the fact that Amin et al (2003) only found a very few good quality studies, using blood products could have significant financial implications. Therefore, an appropriate and accurate costing methodology for estimating the costs of blood products will be important.

Using micro-costing methods to estimate the costs of blood products

Amin et al (2004) used micro-costing methods to calculate the societal costs of blood transfusion based on the Canadian case costing methodology (this can be downloaded from the following website <http://www.occp.com/>).

The costs of blood transfusion could be comprised of the costs of the blood products, the costs of hospitalisation, supervision/monitoring (e.g hospital transfusion committees in the UK) and the costs of treatment of transfusion related side-effects. Furthermore, the cost of the blood product may include the cost of collection (e.g. identification and recruitment of donors), production (e.g. processing, testing, QA, storage, etc), distribution between blood centres and delivery to health care providers. However, in several countries blood donation is voluntary and free. Therefore, the costs of any blood products may not include the costs of the blood as “transplanted organ” and encompass only the costs of blood transfusion services (testing,

processing, storing and dispensing blood products) (Varney 2003, Amin 2004, 2003).

Varney (2003) found that total hospital costs could be sensitive to the number of units administered and the length of stay in hospitals partly due to transfusion related complications (Varney 2003, Amin 2004, 2003).

Macro-costing
blood products

Amin et al (2003) found that most of the published costing studies (11 of the 14 studies) used a macro-costing approach to estimate the costs of allogenic red blood cell transfusion, and the majority of the studies applied provider's perspective.

Using hospital bills

American studies have used hospital bills and published studies to estimate the costs of blood products (Chaix 1999, Gupa 1999). Jefferies et al (2001) used cost-to-charge ratio and regional wage adjustment to calculate the unit costs of blood transfusion in the USA. On the other hand, Segal et al (2001) found that relying on hospital bills can lead to underestimation of costs of blood transfusion, because 17 % of the patients receiving transfusion were not billed for the intervention.

International cost comparison

Methodological dilemmas and practical challenges

International, as well as inter-organisational cost comparison follows similar steps to unit cost calculation. The main steps of comparative costing are (Young 1988, Knapp 2002):

1. Portray the decision problem and establish objectives of costing (Selection of study perspective, time horizon and the explicit statement about the assumptions applied are also essential part of this step.)
2. Detailed description of the service for cost comparison. (A common final cost object should be determined)
3. Identification of resource items used to deliver a particular service (or produce particular goods), and Selection of unit of measurement for each resource item The units of measurement (units of inputs) can be an activity (e.g. physical exam) or physical resources, such as disposables or drugs. (Identification of a set of intermediate cost objects is essential to ensure comparability)
4. Resource use measurement in natural units
 - o Classification of recourse items (A distinction between direct and indirect costs should be made in a same way.)
 - o Overheads should be analysed to identify non-counterpart resource items, which have to be excluded.
 - o Selection a mutually acceptable (overhead) cost allocation method.
5. Placing monetary value on these resource items (goods, activities, and/or services) and calculating the unit costs of a particular service;
6. Expressing the result using a single currency; and
7. (Dealing with uncertainties).

Although some of the costing methodologies omit one or more steps, decision problem definition, service description, identification, measurement and valuation of resources used, as well as converting the result into a common currency, are distinct steps of comparative costing. Comparative cost analysis follows similar steps to job order costing used by cost accounting (Young 1988, Luce 1996, Alban 1997).

The following sections will describe these steps in detail. Applying this didactic approach, however, may result in some overlaps between this chapter and former chapters.

Basic principles

Cost comparison measure to amount of resources used in different organisations for the delivery of a comparable product or service. Consequently, costing studies, applied in healthcare, assume more or less explicitly that the services of which costs will be compared will have the same consequences (health benefits and disbenefits) (Young 1988).

On the other hand, in economic evaluations decision makers, in principle, should take both costs and consequences into account. A special form of economic evaluation, the cost minimisation analysis, assumes that the consequences of the compared services are very similar. This is in line with the basic costing principles, mentioned above, that like should be compared with like (Brent 2003, Young 1988).

Many organisations, as well as policymakers can benefit from the results of cost comparisons. However, cost comparison can only be meaningful if costs are measured in the same way (Young 2003). To ensure comparability, costs should be measured consistently within a given analysis, and the costing methodology should be consistent with other comparative costing studies to ensure the comparability and generalisability of the results. However, the costing studies frequently used different methodologies to estimate the unit costs of services, which considerably limit the generalisability of the results (Gyldmark 1995).

Likewise, international cost comparison should also follow the basic costing principles: such as, resource utilization should be measured accurately and comprehensively (costs are calculated on a full absorption bases), and overheads (indirect costs) are allocated and apportioned fairly, charging directly when possible, and costing should avoid cross subsidisation (Kernick 2000, NHS Department of Health 2005).

Furthermore, a costing method /process should be transparent, and report detailed data in a disaggregated, well-tabulated form to allow further analysis from another perspective, as well as to ensure comparability (Kernick 2000, Chunney 2004, NHS Department of Health 2005).

Methodological challenges

There is a widely hold agreement about the basic principles of cost comparison in the economic and cost accounting principles. Applying these principles in practice, however, can be difficult for several reasons. For instance, the definition of the final cost object and/or the selection of the appropriate cost allocation methodology may be challenging. Practical application can become even more problematic when analysts try to compare costs between organisations delivering services in different health systems (Young 1988).

APPLIED COSTING METHODOLOGY

In addition, international comparison of health service costs could be problematic, in part due to (a) lack of clarity of cost concepts and technical terms used in the studies, (b) discrepancies in the interpretation and usage of technical terms and methodological principles (e.g. intangible costs, overhead costs, marginal costs, etc), (c) differences in classification of different cost items, (d) variations in the inclusion and exclusion of cost items, and (e) insufficient details of the methodology used. Differences in the objectives of the studies further reduce the comparability of the results of the studies (Negrini 2004, Peeters 2000, Pugner 2000, Lievens 2003).

In addition, cost comparison could be challenging partly because (a) studies may apply different analytical perspectives, and consequently include different resource (cost) items, (b) studies are using different strategies to deal with joint costs and (c) studies are applying different cost allocation methodologies. Sometimes it is very difficult to share (apportion) costs fairly between services dealing with patients with co-morbidities, for instance medical services for stroke, diabetes, cancer, cardio-vascular disorders, somatoform disorders, etc. (Kotsopoulos 2001, Ekman 2004).

Without standardised methodology, the interpretation of the result of cost comparison could be very challenging, and the result of already published studies incomparable (Edbrooke 1999).

Major steps of comparative costing

Objectives of the study

It is widely accepted in both the economic and the accounting literature that costs depend on the purpose for which they are to be used (Ellwood 1996).

The objectives of the study have significant impact on the perspective, and time horizon, as well as on the methodology used in a comparative costing study. The objectives of the study can also determine the inclusion and exclusion criteria of resource use or cost items. Therefore, analysts should define clearly the aims and objectives of the cost comparison. In reality,

however, several studies are ambiguous about the objectives of the study (Negrini 2004).

SELECTING SERVICES COST COMPARISON

National priorities
versus cross
border priorities

National priorities may favour the following services for cost-comparison

- Frequent (most prevalent diseases)
- Very expensive services
- Very expensive diseases
- E.g. priorities from cost of illness studies in the Netherlands (source: Evers 2004):
- Large disease groups: (e.g. mental health, cardio-vascular disorders, diseases of the digestive system, ...cancer care)
- Individual diagnosis (mental retardation, ill-defined conditions, mental disorders (other), dementia, dental care, stroke)
- Treatment of orphan diseases

Costing studies comparing cross border care may have different priorities, such as:

- Services with long waiting lists;
- Most frequent insurance claims;
- Well circumscribed elective services and a short list of acute services;
- Fast growing insurance claims (potentially most frequent insurance claims (over the next five years))

PERSPECTIVE OF THE STUDY

In theory, adopting societal perspective could facilitate generalisability of the results, which could be essential for comparative analysis. In practice, however, societal perspective may lead to huge variation in costing practices partly due to practical problems and methodological dilemmas such as measuring productivity costs or valuing informal care (Byford 1998).

Narrow versus
broad perspective

Due to the fact that non-healthcare costs could be more than the health care costs of treating a particular patient (e.g. in the case of epilepsy), applying a purchaser or provider perspective could lead to an inappropriate conclusion. For instance, changes in service provision may require more social services for the patient, which could mean lower medical service unit costs (improved technical efficiency from the provider or purchaser point of view) but higher total costs (from a societal or governmental perspective). In other words, applying too narrow perspective may not portray the full economic picture and

could allow providers to exercise (covert) cost shifting policies. An undetected cost shifting policy could force decision makers to jump to an inappropriate conclusion about the real costs of the different available alternatives (Platt 2002). For instance, economic evaluation studies from the UK and US in the field of epilepsy disregarded social service costs (Heaney 2002).

On the other hand, a narrow perspective could improve both internal and external validity of the result partly by avoiding several methodological and measurement problems.

Comparability and generalisability can be enhanced by reporting the results in details to allow analysts to recalculate the results by adopting other perspectives such as a purchaser or provider perspectives (Byford 1998, Drummond 2005).

POSSIBLE IMPLICIT ASSUMPTIONS USED IN COST COMPARISONS

Assumptions and subjective judgements can be inaccurate or biased, and as a result, a cost estimate would be inaccurate. Therefore, costing studies should be explicit about the assumptions applied. Otherwise, decision-makers will not be able to make an informed choice (Hankins 2004).

Comparative costing studies comparing the (unit) costs of services may assume that all dimensions of the particular service (quantity and quality as well as timing) are identical (Brent 2003). In other words, studies may apply the following assumptions:

- All the services provided for the particular group of patients are clinically effective and valuable for the patients and their carers.
- Services, which are compared, have the same consequences (impact on the patients, equal health gains).
- There are no significant practice variations.
- There are no significant differences in patient case mix, or demographic composition, or socio-economic circumstances.
- There is no significant difference in service intensity.
- There is no significant difference between providers in capacity, equipment, staffing and teaching status.
- There is no significant difference in cost shifting (or cost shifting is not possible).

Conversely, comparative costing studies comparing the full costs of treatments can assume that

- Services may or may not have the same impact
- There is significant practice variation
- There is significant difference in service intensity.

On the other hand, there is evidence in the literature that there can be significant practice variation between regions, as well as countries inside the European Union, which can be partly explained by (a) the differences in incentive systems, (b) the structural differences of the health systems, (c) the diverse traditions, and (d) the differences in medical education/clinical guidelines (Lievens 2000a,b). Therefore, it is desirable that assumptions used in the costing exercise are explicit and justified (Drummond 2005).

In addition, Seninger and Smith (2004) argue that analysts should highlight all the possibilities of potential cost shifting to any other party even if the actual value of cost shifting is not estimated, because it helps decision-makers interpret the results of the cost analysis appropriately.

Defining services for international comparison

As mentioned above, valid comparison can only be made between different organisations, if the cost object is the same or very similar. For instance, a rehabilitation service in a day hospital can differ widely in the range of activities included, such as nursing care, physiotherapy, speech therapy, ancillary services (e.g. diagnostic tests), medical visits and other services. Furthermore, a meaningful inter-institution and/or inter-country cost comparison can be made if the same type of intermediate costs objects are used for the service delivery, because different combination of intermediate cost objects (activities) actually represent different services (Young 1988).

In the real world, however, health services are defined either very broadly or inconsistently, which makes cost comparison practically meaningless (Ellwood, 1996). For instance, Gyldmark (1995) found that inter-institutional cost comparison was practically impossible, because studies costed significantly different ICU services. For instance, there were considerable differences in patients' health service needs (morbidity, co-morbidity, severity) and/or the case mix of the ICU units. Furthermore, the main characteristics ICU units, such as capacity, staffing mix, and functions (e.g. teaching, training, and research activities), differed considerably, as well as their speed in adopting new medical technologies. This latter could also have a significant impact on the routine protocols (medical and nursing treatment policies of the units) (Gyldmark 1995).

In addition, the nature of health services make homogenous product / service definition difficult (Ellwood 1996). Wernerman and Flaatten (2004) also argue that the definition of health services as a cost object could be difficult in Europe, partly due to the significant differences in how health care resources are allocated (or reimbursed/financed), and partly due to differences in service delivery and/or patient pathways. For instance, intensive care units are organised very differently inside hospitals in the EU member states.

The identification of a patient group for the particular service should be precise enough to ensure that like is compared with like, because several other studies found significant difference in the cost of one hospital episode or outpatient episode between patients with and without co-morbidities (Currie 2005, Grun 2003). One possible option would be to use ICD 10, DSM IV or a similar international coding system to enhance comparability. However, further refinement is frequently necessary because several medical conditions or diagnoses cover very different and heterogeneous conditions. A vague definition of services could result in significant differences in identified relevant cost items (resource elements) and the total quantity of resource. For instance, depending on the threshold applied, patients with the same condition could be hospitalised and having a surgical operation in one country, while in other countries being treated as outpatients. Consequently, the total costs of services could vary considerably (Drummond 1994, Ekman 2004, Heaney 2004, Wimo 1997).

Moreover, there is growing evidence in the literature that treatment costs of one patient episode with the same clinical diagnosis or DRG classification could be different by age group (e.g. children and adults). Likewise, the hospital costs of managing patients with complications could be significantly higher compared to patients without complications (Young 2000, 2002a, 2002b). In addition, the likelihood of co-morbidity is increasing by age, and depends on the presence of particular disorders. As a result, studies comparing different age groups could have significantly different cost estimates. Furthermore, studies may use different definitions and classifications of costs, which could further limit the comparability (Kotsopoulos 2001, Ekman 2004).

Identification of resource items

The next step of costing is the identification of resource items (cost components) and the most appropriate unit of measurement. The unit of measurement should be relevant to the service (or product). In order to accurately (comprehensively) cost a particular service, especially if analysts will use a bottom-up approach, a detailed description of the service (final cost object) is required. It is important to identify all resource items regardless the feasibility of measurement. Furthermore, a common set of resource items (cost components) and/or set of intermediate cost objects should be specified to ensure like is compared with like (Byford 2003, Young 1988).

The identification of resource items used follows the same principles and tools as unit cost measurement. The principles and tools are discussed in the earlier chapter.

Resource use measurement

The resource use measurement also follows the same principles and tools as unit cost measurement (see more details in the previous chapters).

Economic guidelines recommend that resource use data should be collected and reported separately from the unit cost or price of these resources (Drummond 2005, 2005, Jacobs 2005). In addition, analysts should ensure that the same resource items are included in the comparative costs analysis. Moreover, all the resource items, which may have quantitative importance, should be included. (Quantitative importance can be defined as a resource consumption (and/or unit cost) large enough to have considerable impact on the result of the comparative analysis.) Using standard costing method may ensure that the same resource items are included. Resource use measurement, however, could also be problematic in comparative studies (Grieve 2000, Johnston 2001, Seninger 2004).

Several experts argue, that a complicated (very complex and sophisticated) costing method may not be necessarily an accurate and useful (ensuring comparability between organisations and/or countries. For instance, ABC system can improve the precision of unit costs calculation by using several cost drivers, but not all the overheads behave linearly in respect of a cost driver . Consequently, an expensive and complicated system can yield as inaccurate result as a simple and cheap one (Ellwood 1996).

Measurement tools / techniques

Comparative studies use bottom up, top down or mixed approach in resource measurement. They frequently use standard questionnaires for resource use regardless adopting bottom-up or top-down approach. However, the detailed questionnaire is rarely published in the scientific journals, which could be explained partly by the publisher policy (restriction of the length of articles). Moreover, little is known about the validity and reliability of the resource use measurement instruments used (questionnaires, patient diary cards or interviews). In general, a more detailed bottom-up approach gives more insight into the real differences in resource consumption (Adam 2000, Boonen 2003, Johnston 2001, Wordsworth 2005).

Attaching monetary value to resource items

Although the basic principles of valuation and the most frequently used methods are discussed in the previous chapter, it may be worth to highlight some important issues.

In comparative analysis, analysts should use the same valuation process and ensure that valuation is based on the same type of cost concept, for instance, whether opportunity costs or historical costs are taken into account, or likewise, whether marginal costs or average costs are compared (Seninger 2004).

However, finding a mutually suitable and feasible valuation process could be difficult in part due to (a) the differences in accounting systems used, (b) the differences in recommendations of national guidelines, (c) the differences in health systems including payment systems, and (d) lack of comprehensive cost databases, which is similar enough for being suitable for comparative studies (Boonen 2003, Wordsworth 2005).

Comparison of costs using a single currency

Cost comparison has to deal with two problems: (a) expressing the results using a single currency and (b) expressing the results in the same financial year.

CONVERTING THE RESULTS INTO THE SAME CURRENCY

In comparative studies, it is necessary to express the results using a single currency. Although the growing Euro-zone makes it easier to compare costs and prices inside the European Union, expressing the results in Euros makes it necessary to exchange the local currency to Euros for countries outside the Euro-zone. There are two, frequently used, alternative options here: (a) using exchange rates or (b) using purchasing power parity rate (Evers 2004, Kotsopoulos 2001, Wordsworth 2005).

Exchange rate
versus purchasing
power parity

Both approaches have advantages and disadvantages. The exchange rate is available in the public domain, and it is a transparent way to convert cost results into a single currency, but it does not reflect purchasing power, and it can fluctuate, even monthly. As a result, comparison may not be consistent over time. Moreover, because exchange rate does not differentiate between tradable and non-tradable goods and services, and does not reflect their proportion in the total costs of a particular service, using the exchange rate could exaggerate cost differences between countries, especially between countries with different income (GDP) levels. Therefore, exchange rate could be more appropriate for price comparison of internationally traded goods, such as pharmaceuticals, medical equipments and medical devices rather than cost comparisons of non tradable goods or human resource intensive services (Evers 2004, Gerdtham 1991, Gosden 2002, Kotsopoulos 2001, Wordsworth 2005). Several international comparative studies used the PPP rate instead of the exchange rate, but there are published comparative studies relying on exchange rate (Grieve 2000, Schulman 1998, Evers 2004, Heaney 2001)

Using purchasing power rates could tackle some of the aforementioned problems (e.g. differences in resource utilisation of tradable and non-tradable goods and services), and they may reflect opportunity costs more accurately than the exchange rate, in part due to significant market failures in health care and health insurance market, but they may not reflect price differences. GDP

specific PPP rates are published by the OECD and the World Bank, and can be extracted from OECD statistical databases such as OECD Comparative Health Data, or from the World Bank websites (Evers 2004, Gerdtham 1991, Gosden 2002, Kotsopoulos 2001, Wordsworth 2005).

GDP, healthcare
or technology
specific PPP rate

There are three different ways to convert cost results using purchasing power parities: (a) using general GDP PPP, (b) using medical or health care specific PPP rate or (c) using technology specific PPP. Although selected conversion factor could significantly influence the results, especially where resource mix and prices vary considerably (e.g. comparing Eastern European and Western European costs of health services), the available scientific evidence is inconclusive regarding which method is the most appropriate to convert cost data into a single currency (Goeree 1999, Gerdtham 1991, Gosden 2002, Jefferson 1996, Wordsworth 2005).

Whilst some authors prefer technology specific PPP compared to healthcare or general GDP specific PPP, others argue that there is no significant difference between the methods (Goeree 1999, Wordsworth 2005). Conversely, published studies highlight that using different PPP rates could yield substantially different results in health care. Wordsworth and Ludbrook (2005) argue that technology specific PPP is a feasible and refined alternative compared to the general medical or GDP PPP index. In addition, technology specific PPP can be more accurate because it also reflects the “resource mix” of the particular technologies compared to general medical or GDP PPP indices, which reflect a broad (aggregated) average.

On the other hand, a technology specific PPP index calculation could be data-, time and resource intensive, requiring, for instance, the collection of detailed price and resource use information, which may or may not be available for the analysts, or could be costly to obtain (Wordsworth 2005). Furthermore, the current literature is not consistent regarding the best way to calculate health care and technology specific PPP rates, and these rates may not be available for researchers or analysts (Gerdtham 1991). For instance, Gyldmark et al (1995) used healthcare specific PPPs, but these may not be available for all relevant countries. Wordsworth and Ludbrook (2005) demonstrated the feasibility of technology specific PPP rate usage in the case of renal dialysis costs comparisons between six EU member states.

One might argue that selection may be determined by the decision problems, and the availability of different PPP rates. Whichever method is used, sensitivity analysis should be performed, because costing data are frequently time, institute and place specific. Conversion could multiply these differences. Therefore, policymakers should treat these results with caution (Gosden 2002). Some comparative studies (e.g. Payne 2002) presented the results using both exchange rates and PPP rates as a practical compromise.

EXPRESSING THE COSTS IN THE SAME FINANCIAL YEAR

A common problem is that cost measurement has taken place in different financial years in the different countries to be compared. Analysts, however, have to convert all the results into the same financial year.

There are several possibilities here: (a) using general inflation rate (CPI), (b) using GDP deflators, (c) using a medical inflation rate, or (d) using a technology specific inflation rate. However, inflating all the unit costs to the common year may not eliminate all the effects of time (Payne 2002, Kernick 2002). The published studies used one of the aforementioned alternatives (Verboom 2002, Evers 2004).

Source of
exchange rates
and CPIs

International studies used OECD general or health specific PPP exchange rates and the CPI published by the US Bureau of Labour Statistics (e.g. Kotsopoulos 2001, Payne 2002).

Some studies used internet databases, such as FX History (Historical currency exchange rates: <http://www.oanda.com/convert/fxhistory>), that were offering currency exchange services. Several British studies used the specific price indices published by the NHS Executive (1997) (e.g. Beck 1999).

Practical problems

Significant differences in costing methodologies (especially resource measurement, data collection, and overhead allocation, as well as valuation techniques) applied in costing studies can pose severe limitations on cost comparison between studies and/or organisations. In addition, considerable differences in facilities (technology involved, human resource mix, productivity and unused capacities) could explain 30-50 % of the unit cost differences (Ellwood 1996, Elliott 1997, Goeree 1999). The following section will discuss these practical problems in more details.

Selecting providers / institutions for cost comparison

The decision problems and study perspective selected will have an impact on the selection criteria used for enrolling providers into the study. The unit costs of health services are determined by external and internal factors. If the comparative study would like to compare the technical efficiency of different providers, it is necessary to control external determinants of unit costs.

Geographic /
regional variation
in costs /prices

It is well known from the literature that human resource substitution could significantly reduce unit costs. However, not just the degree of human resource substitution, but the cost of the same human resources and goods can vary notably between regions and, consequently, the unit costs of the same service could differ (Goeree 1999, Luce 1990).

Other socio-economic and health care specific factors could also have significant influence on unit costs, for instance, (a) differences in unionisation of human resources, (b) technologies used (e.g. teaching hospitals usually used more advanced technologies), and (c) practice pattern differences (e.g. specialist hospitals may have different practice guidelines) (Goeree 1999, Luce 1990).

Type of hospitals

Moreover, studies highlighted that hospital overheads are determined by the volume (e.g. number of discharges), hospital overall capacity and the complexity of hospital (number of specialities, tertiary care services, etc). In other words, economics of scale and scope can have significant influence on unit costs especially in the case of acute medical care and emergency services including ambulance services. As a result, the unit costs can be different between secondary and tertiary institutions as well as specialised and non-specialised providers. In addition, there could be considerable difference in the result of cost comparison depending on whether the study compares a single procedure in isolation or part of a particular service (Brent 2003, Smet 2002). Therefore, to compare like with like, it is important that hospitals have the same, or very similar, occupancy rate, that their degree of specialisation is similar (e.g. having the same type of specialty units, such as cardiology or eating disorder unit, etc.), and that the provision of care is similar (Jacobs 2005, Young 2003).

In addition, there is growing evidence that the quality of care, including timing of services, as well as the type and number of resources used, is significantly influenced by the payment mechanism. Furthermore, the market structure could have a significant impact on the unit costs, but the actual effect varies by services. In general, because quality competition could be the dominant form of competition between healthcare providers, increased competition could push costs upwards rather than downwards (Smet 2002).

At the same time, little is known about the impact of these factors on unit cost variation: (what is the size of the variation, which can be explained by these factors?). Therefore, the most appropriate selection methods are debated in the literature (e.g. random or systematic selection, sample size, etc.) (Goeree 1999, Luce 1990).

Selection method

Goeree et al (1999) estimated that the selection method could have significant impact on the unit cost estimates, and therefore analysts should pay attention to the selection method used in comparative studies.

Drummond et al (2005) suggested that site selection should be representative of those whose jurisdiction will bear the consequences of the decisions which are to be informed by the result of the economic evaluation, including factors such as geographical and socio-economic circumstances, reimbursement method, institutional characteristics (e.g. volume of services, bed occupancy rate, etc.).

Measuring and comparing resource use

Case-mix and differences in health service needs

Comparability can be improved by careful selection of sites (both hospital and outpatient organisations) with similar clinical, geographical, socio-economical and financial (payment / reimbursement) characteristics. Since variability in unit costs depends in part on (a) the case mix of the patients, (b) socio-demographic characteristics including social deprivation, (c) the age, location and technical sophistication of the providers' facilities, and (d) geographical (regional) differences in costs, including labour costs, careful site selection is essential to ensure that like is compared with like (Dodel 2004, Grieve 2001, Northcott 2004, Truelsen 2005). For instance, the average length of stay could be significantly different in hospitals with adequate social work support and discharge planning compare to hospitals without these services. Likewise, outpatient clinics' specialisation and service provision should be very similar in order to ensure that like is compared with like (Young 2003).

On the other hand, information about the case-mix of hospitals or a department, as well as outpatient clinics, may not be available (Oostenbrink 2003).

Using different databases

Because there is considerable inter-country variation how health care utilisation (resource use) data are collected, comparative studies sometimes have to rely on different databases in different countries.

However, collecting data from different databases (e.g. hospital based outpatient database versus community-based registers) could result in significant differences in case mix (Boonen 2003).

Small sample size and representativeness

The optimal sample size depends on (a) the estimated size of cost difference between the compared alternatives, (b) the distribution and (c) variability of resource use, as well as the intention of subgroup analysis. Furthermore, separate sample

size calculation is needed for measuring statistical differences between different resource consumptions. Consequently, the sample size calculation may require considerable prior knowledge. Previously published studies can be helpful (Johnston 2001).

Several costing studies, however, used relatively small sample size, based on one or a few institutions, which could make generalisability very limited partly because the distribution of costs as well as resource use are usually skewed, and there could be significant differences between organisations (heterogeneity in resource use) (Johnston 2001, Truelsen 2005).

Inclusion and exclusion of resource items

The results of published studies could differ significantly, due in part to the lack of consensus about cost classification and which costs should be included and excluded in a (comparative) costs analysis (Negrini 2004, Wimo 1997). For instance, in the case of hospital cost comparison, analysts should decide in advance and be consistent whether the costs of hospital based outpatient services and physicians' visits, which relate directly to the treatment of the same patients, will be included in the costing exercise. Hospital bills may or may not include these items. Therefore, costing studies exclusively relying on patients' hospital bills may omit physicians' visit costs (Young 2003, Gyldmark 1995).

Moreover, Gyldmark (1995) found that cost comparison using published studies could be difficult, because studies do not have enough detail to decide which cost component was included or excluded and/or check that all relevant cost components were included. In addition, studies may differ considerably regarding whether they included capital costs, overhead costs or fixed costs in general.

Costs of research and training

In addition, there is little agreement between studies on whether the costs of research, postgraduate medical education, clinical audit, and training of nurses should be included or excluded in the costing

exercise. There are arguments for excluding them, but some of these costs could be joint costs, and it may take time and resources to allocate them fairly.

A “quick and dirty” solution could lead to arbitrary allocation of any overhead costs (Gyldmark 1995).

Cost of fixed assets and capital

Studies also vary considerably in dealing with costs of fixed assets/capitals. In some cases the inclusion or exclusion can be debateable, for instance in the case of dual financing (the local or the national government covers the costs of capital and other fixed assets separately).

Incidental costs and seasonal variation

Inclusion of “incidental costs” could also cause problems and unintended differences in unit cost estimates. For instance, a high rate of sick leave could cause a transient increase in human resource costs (locum health professionals may be more expensive). Likewise, seasonal variation of workload can also lead to a considerable increase or decrease of unit costs. Little is known about how comparative studies have tried to control for these factors (Oostenbrink 2003).

Lack of published data

One potential source of information of resource use for costing health services is published cost of illness studies. Although several cost-of-illness studies use a so-called bottom-up approach, data may not be detailed enough if available. Costing, and cost of illness studies may not be available from several EU member states, especially those in Central and Eastern Europe. Thus, the English language literature may cover a few OECD countries such as Australia, Canada, France, Germany, Norway, Sweden, the UK, and the USA (Forsgren 2005, Wimo 1997).

Differences in time horizon

Comparability can be hampered by differences in the time period of data collection or by using published studies as a source of resource measurement, although their results are based on different time periods. For instance, medical practice could change significantly over time, which could have a significant impact on resource utilization (Payne 2002).

Measuring non-health service costs

This review critically assesses the published literature about cost methodologies from a provider or public purchaser point of view, and therefore non-health service cost measurement is not included. Cost comparison, however, may suffer from similar obstacles to cost comparison of health care costs, such as lack of uniform methodology, limited interpretation due to differences in health systems, and non-availability of data (van Roijen 1995).

Missing data

Using standard costing methodology, including standardised resource use measurement, could lead to two types of missing data: (a) resource consumption data, which do not exist in a disaggregated form and (b) data about a particular resource use, which have not been collected or are missing (e.g. doctors are paid separately or particular data were not recorded). The

third type of missing data is (c) missing unit cost estimates. The problem of missing data could be substantial, especially in large studies, in part because information about the costs of services especially from Central and Eastern European countries is very limited in the English language literature (Oostenbrink 2003). Treulsen 2005).

Dealing with missing data

Before data analysis, it is important to assess the data set for the amount and pattern of missing data. The first step in the case of missing data is to identify the possible cause(s) and assess the implication of missing data on the result. Unfortunately, data are rarely missing at random; therefore, without addressing the issue the result can be biased. Based on the result of this assessment, analysts should select the most suitable approach to handle missing data (Johnston 2001, Patrician 2002).

Published studies tried to handle missing data in different ways, including exclusion of observations, estimating the missing data using relative weights or using simple averages. All these strategies have advantages and disadvantages (Johnston 2001).

Excluding incomplete observations

One approach to dealing with missing data in micro-costing is the exclusion of those patients (observations/records) where key data are missing (e.g. case-mix severity) (Grieve 2000). However, this approach could lead to other problem. For instance, the reduced sample after exclusion of patients with missing data can be unrepresentative. Therefore, other methods are needed to fill the gaps of missing data. One possible alternative could be statistical modelling (Porsdal 1999).

Using relative weights

If the relative weights are available from the country, prediction model can be used to estimate the missing (resource use) data. In this case, the relative resource use (or cost) weight of the country compared to other countries is calculated by using existing data.). In other cases, the relative weights from other countries can be used. For instance, one study used the Medicare DRG values to predict the unit costs of European countries. Using two or more counties' data to estimate the missing data can give more accurate results than data from a single country. However, the accuracy of the estimated resource use depends on several factors, including the practice pattern differences between specialities and technologies (Gandjour 2002, Glick 2003)

Using inter-country averages

Another way to cope with missing data is the use of average resource use data of other countries. There is two ways here: using the simple average or the weighted average. The disadvantage is that the average may or may not be a reasonable good estimate of the resource use in the specific country (Gandjour 2002, Glick 2003).

Statistical modelling – multiple imputation

If data are not missing in a systematic ways, statistical models, such as multiple imputation, can be used to impute missing data. As part of the WHO-CHOICE project, a statistical model was developed to estimate the unit cost of health services in countries for which data are not available. The model is based on the behavioural cost function. The multivariate imputation method also produces reliable estimates of standard error, because repeated estimations are used. Moreover, it is relatively easy to use (straightforward/simpler computation) compared to other statistical approaches. However, multiple imputation approach can be more time- and resource consuming than other methods. Moreover, this method was criticised because it used simulation and added random noise to the data, as well as the reproducibility could be poor. Furthermore, the accuracy of the imputation may depend on the appropriateness of the assumption applied. Despite the potential methodological weaknesses, WHO team used the model to estimate missing hospital unit costs with reasonable success (Adam 2003, Patrician 2002, Sinharay 2001).

Statistical analysis The sample size should be powered on the predicted cost difference intend to measure. However, large variation in resource use and skewed distribution of resources may need relatively large sample size to maintain statistical power. Consequently, there could be a trade-off between the level of statistical significance and the overall costs of measurement (Reed 2003).

Attaching monetary value to resource consumption

Differences in costing methodologies Comparability of unit costs depends in part on the compliance of the same “standard” cost methodologies. However, current studies show some inconsistency in using costing methodologies, as well as technical terms (Ekman and Forsgren 2004). Moreover, Ellwood (1996) found that cost accounting systems, including cost allocation methods used in practice are tailored toward political and organisational factors rather than economic factors. Therefore, meaningful cost comparison would be possible after significant modification of the cost accounting systems used by provider organisations.

Differences in allocation and apportionment of costs

Appropriate cost comparison is possible if the compared organisations classify costs in the same way and use very similar cost allocation techniques. However, especially in inter-country comparison, it is likely that institutions classify costs differently and may use different cost allocation techniques. For example, electricity and/or human resources may be classified as direct in one institution, and indirect in another. Analysts should identify these differences and correct the results accordingly (Young 1988).

Furthermore, Negrini (2004) argues that one of the major obstacles of international comparison of costs of services is the considerable difference in cost allocation methods. Allocation and apportionment rules are usually based on national or country specific accountancy practices and local traditions. For instance, in some countries the ICU is integrated into another department and, as a result, several costs are joint costs or are not recorded separately from the rest of the department. Moreover, other service units such as a diagnostic imaging department or physiotherapy unit also treat the same patients in the ICU, but the costs of these interventions are not always available or are difficult to estimate (Wernerman 2004).

In addition, it is important to ensure that capital costs (depreciation), and several overhead cost items such as training, clinical audit, and the medical library are measured and allocated in the same way (Young 2003).

Northcott and Llewellyn (2004) suggested that comparability could be improved if studies compared direct costs and overhead (indirect) costs separately, and did not rely on an aggregated total cost comparison alone. This method could reduce the problem of differences in overhead costs allocation.

Joint costs

A further challenge could be the allocation of joint costs. Several patients suffer from more than one disorder. Patients with co-morbidities can be classified differently (e.g. a diabetic patient with hypertension, or a hypertensive patient with diabetes). Furthermore, a patient with co-morbidities might need more and/or different treatment regimes. As a result, several activities could be carried out during the same medical visit or during the same hospital episode or diagnostic test. Therefore, without appropriate allocation, the unit costs of a treatment episode could be significantly different (Wimo 1997).

Unit costs estimates based on cost accounting methods

According to the literature, more than 40 % of hospital costs are overhead costs. Using different overhead allocation methods may result in very different unit costs estimates. Therefore, comparative studies should use the same allocation methods to ensure comparability. Furthermore, cost classifications should be very similar, because hospitals could vary significantly with regard to how they classify different cost items as direct or overheads (Llewellyn 2005).

In addition, there may be a trade-off between accuracy of unit cost measurement and comparability of unit costs. Although both objectives, accuracy and comparability, ought to be achieved to inform policy makers, in the real world, more precise measurement may require considerable

adjustment to local socio-political and organisational environment, which may reduce the comparability of unit costs based on the organisation's own cost accounting system (Ellwood 1996).

Using internal prices / transfer prices	Some studies costing hospital-based services such as ICU used internal transfer prices to assign monetary value to intensive care. However, these prices could differ considerably between institutions depending on the cost accounting systems and costing policies used. For instance, these prices may or may not include overheads, fixed costs and/or capital costs (Gyldmark 1995).
Using DRG rates	Some studies found that American DRG relative weights might be good predictor for hospital unit costs in some European countries (Glick 2003, Reed 2003). However, one of the potential problems in using DRG values in comparative studies may be that the DRG values could be based on either charges or costs. For instance, the Belgian DRG was based on charges in the early 1990s (Drummond 1994).
Regional and inter-institutional variation in unit costs estimates	<p>It is well known from the literature that the unit costs of different types of institutions can vary, for instance the unit costs of the same intervention in large teaching hospitals, district hospitals, and small, specialized hospitals can be significantly different. A significant difference in unit cost could be the result of differences in institutional arrangements. For instance, private or public doctors can carry out outpatient operation/day surgery in a freestanding small, specialised institution or in a private or public hospital (Rulf 2000).</p> <p>Likewise, significant regional variations can be observed in unit costs between the same types of hospital. However, there is no standardised methodology for sample size calculation and/or national average calculation by random samples (Brouwer 2001).</p>
Reimbursement rate and unit costs	Using insurance databases to attach monetary value to resources could be misleading in comparative studies because the reimbursement rate (cost sharing rate) could differ significantly between countries (Boonen 2003). Furthermore, the incentive systems embodied into the purchaser payment system could significantly influence the internal cost allocation system (cost accounting policies) of the providers, the adaptation of new technologies as well as the practice patterns (referral patterns). As a result, the insurance payments may or may not be reasonably good estimates of opportunity costs and may or may not reflect actual resource utilisation (Gandjour 2002).

Quality checklist of comparative studies

Comparing costs of health and social services can be challenging partly because studies may (a) apply different perspective and (b) use different costing methodologies. Moreover, studies may (c) include different patient groups (age, sex, co-morbidity and disease severity), and may select organisations with (d) different treatment patterns (practice variation). Furthermore, studies may compare providers under considerably different (financial and non-financial) incentive systems and providers with different ownership structure such as public, private non-profit and for-profit organisations. Consequently, studies may include or exclude different resource items, apply different assumptions, and use different strategies dealing with joint costs and overhead costs (Ekman 2004, Kotsopoulos 2001, Peeters 2000, Pugner 2000, Wimo 1997).

In addition, comparability requires (a) detailed and separate reporting of resource use data and unit costs, as well as (b) validation of cost estimates. However, costing and economic evaluation studies frequently provide insufficient details about resource consumption and unit costs as well as the methods of validation. Therefore, it is difficult to assess the validity of cost estimates (Ekman 2004, Hutubessy 2001, Kotsopoulos 2001, Peeters 2000, Pugner 2000, Wimo 1997).

One way to cope with the aforementioned difficulties is the development of methodological and reporting guidance for international cost/price comparison of health services / health service costs. A quality checklist for international comparative studies could be an essential part of this initiative (Drummond 2005, Ekman 2004, Kotsopoulos 2001, Peeters 2000, Wimo 1997).

Table 13: Methodological quality checklist of comparative costing studies (modified from Kotsopoulos 2001, Ekman 2004, Evers 1997, Georee 1999, Johnston 2001, Wimo 1997)

1.	Main methodological criteria	Special focus
2.	Study objectives	The purpose and the objectives of the study is explicit and clear
a.	Description of the decision problem	All the possible alternative solutions is taken into account. Justification of omission of any alternative solution
b.	Perspective of the study	The perspective of the study is clearly stated and justified
c.	Time horizon of the study	Explicit or implicit
3.	Definition of compared services	Detailed enough to ensure that like is compared with like
a.	Target patient population:	age-group, morbidity, co-morbidity (health service needs), diagnostic criteria, type and severity of the illness,
b.	Setting	Outpatient, inpatient, home care, or free standing provider,
c.	Institutional characteristics	Teaching / research functions (Inclusion or exclusion of teaching, training and research costs) Rural / urban location

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		Capacity and occupancy rate, specialty level (degree) including routinely used medical equipments, staff mix, etc Annual volume of the services
d.	Common patient clinical pathway	Treatment thresholds, cut-off points, indication for hospitalisation, operation, etc.
4.	Description of costing methodology	Whether sufficient details is given to make it possible to repeat the costing exercise
a.	Type of costing methodology used	E.g. marginal versus average costing methodology used
b.		
5.	Identification of resource elements	Explicit inclusion and exclusion criteria, adequate justification of exclusion and inclusion of any cost items
a.	Methods / tools used to identify resource items	E.g. clinical care pathways, literature, etc. Sources are explicitly stated.
b.	Sample size calculation	described in sufficient details
c.	Resource items are clearly identified and listed	Separate, detailed reporting of cost items by cost categories, unit of measurement is clearly stated
d.	Classification of cost items	Direct costs, overheads, fixed, variable, etc.
e.	Identification of joint-costs	Dealing with costs attributed to co-morbid conditions.
f.	Subgroup analysis	“Sub-grouping” patients by disease severity, prognosis and/or co-morbidities
6.	Resource use measurement	
a.	Estimation basis	Sample selection and characteristics described in sufficient details
b.	Measurement method / design	Bottom-up, top-down or mixed retrospective, prospective design using statistical/mathematical modelling
c.	Source of resource use data	Data source explicitly stated
d.	Selection of providers for costing	Any potential biases (e.g. non-random selection)
e.	Reporting the result of resource measurement	Resource consumption is measured in physical units and reported separately from unit cost valuation.
f.	Sub-group analysis	E.g. by disease severity/prognosis and co-morbidity
g.	Assumption regarding resource use measurement	Explicit, implicit or not stated
h.	Dealing with uncertainties	Sensitivity analysis / statistical tests used
7.	Valuing resource items	Clear description of the method and the source of unit costs data
a.	Direct measurement	Whether the methodology is described in details
b.	Prices for marketable items	Competitive or non-competitive market prices were used
c.	Fees/tariffs / charges	Justification
d.	Source of cost estimates	Explicitly stated (e.g. literature or other source)
e.	Assumptions regarding attaching monetary value to resource use	Explicit and justified, explicit but not justified, implicit or not stated
f.	Sensitivity analysis	Assumptions applied in the study: Practice pattern variation within a particular country and between countries (resource consumption).
8.	Health system specific factors	
a.	Practice pattern variation	
b.	Organisation of health service delivery	
c.	Financial arrangement	Who pays for the services and how, opportunities of cost

	(reimbursement / payment mechanism, other incentive systems)	shifting, existence of cost sharing
d.	Economic development / health care expenditures	Total health care expenditures, health care expenditures regarding the technology in question

Conclusion

There is a consensus in the literature that international comparison of health technologies, including their costs and cost-effectiveness, is feasible and useful. However, a prerequisite of this type of undertaking is mutually accepted methodological guidance (the standard costing method) and reasonably good compliance to it. However, consensus on the basic scientific principles will not be enough to ensure comparability. It is important to standardise the most important and frequently used methods/techniques such as resource use measurement, cost allocation methods and valuation techniques as well as the standard capacity utilisation rate. In addition, the upgraded guidelines should provide more details about how to use these methods in practice. In some cases, the development of national standard unit costs lists using (internationally accepted) standard methodology would be suffice (Adam 2003, Chaix 1999, Drummond 1994, 2005, Grieve 2001, Jacobs 1996, 2005, Negrini 2004).

Harmonisation of costing methodologies is essential but may not be sufficient to ensure comparability. Comparing costs of the same service between institutions assumes that all dimension of the particular service (quantity and quality as well as timing) are identical. Standardisation could reduce method biases, but other type of biases such as scale bias, case mix bias or site selection bias should also be controlled to ensure comparability. The samples selected should also be representative and very similar to each other to ensure that like is compared with like (Brent 2003, Goeree 1999, Jacobs 1996, 2005).

After controlling all the aforementioned factors, the unmeasured case-mix as well as institutional differences could cause some “unexplainable” differences in the unit cost estimates (Grieve 2001). However, presence of any bias is necessary but not sufficient to invalidate the result of the analysis. The is important to assess whether the bias could have had significant (sizeable) impact on the result (Brent 2003).

Current experience shows that top-down approach could be useful and reasonably accurate in those cases where marketed health technologies (pharmaceuticals, medical devices and other consumables) are responsible for most of the resource use. Bottom-up approach may yield very similar result, but could be more expensive and time consuming. On the other hand, bottom-up approach could be more accurate in those cases where service provision is based on complex organisational arrangement (input mix could

vary significantly), human resource costs and overheads responsible for large portion of the total costs (Wordworth 2005).

There is a need to validate several widely used (simple and cheap methods) by comparing them with the gold standard to develop valid, reliable as well as inexpensive data collection and valuation methods (Adam 2003).

Quality of costing studies

This chapter will cover three important issues, such as (a) quality of methodological guidelines, (b) adherence to guidelines, and (c) quality of reporting, regarding the quality of costing studies, including independent costing studies, cost-of-illness studies and costing health services and technologies for economic evaluation.

Quality of methodological guidelines

Although it may be difficult to develop a standard costing methodological guideline suitable for all the wide-ranging objectives of costing studies and economic analysis, current recommendations of methodological guidelines vary partly due to non-compliance with fundamental economic and accounting concepts, as well as leaving important areas uncovered (Jacobs 2005).

In addition, Adams et al (2003) argue that guidelines disagree in several fundamental costing questions, such as (a) the perspective of the study, (b) the measurement and valuation of informal caregiver time, and productivity costs, and/or (c) cost incurred in added years of life. Moreover, their recommendation varies or ambiguous (not sufficiently detailed) on several technical / methodological issues, including (d) resource use measurement, (e) cost allocation methods, (f) capacity utilisation and (g) shadow price. Furthermore, guidelines frequently recommend methods without discussing the validity of the particular method compare to gold standard (if exists). Likewise, the recommended “gold standard” may be expensive and/or infeasible in real practice. These disagreements and unclear guidance coupled with non-compliance with established methodological guidelines are responsible for significant variation in costing in published studies.

Table 14: Agreement and disagreement between guidelines (adopted from Johnston 2001)

Agreement	Disagreement
Studies should have an explicitly stated perspective which is in line with the objectives of the study	Which perspective to adopt (different economic theories suggest different approaches)
Separate measurement of resource use (in natural units) and valuation of unit of resources	The best way of measuring productivity costs
Studies should have detailed description method used to measure resource use	Optimal way to measure resource consumption (e.g. determining appropriate recall period, or determining the validity and reliability of data collection instruments)
Studies should explicitly state which resource items will be included and excluded	Which productivity cost, future costs should be included
Using prior knowledge to design the costing exercise (including the calculation of sample size)	The best way to calculate sample size
The valuation method and source of unit cost estimates should be explicit	How to adjust market prices, when and how to use shadow price approach, how to value informal care
Uncertainties should be addressed by sensitivity analysis and statistical tests	Whether to adopt hypothesis testing or estimation approach How to deal with missing and censored data
The results should be generalisable	Generalising and adjusting results from published studies and databases
Transparency of the whole costing exercise	Development of common reporting format

Adherence to guidelines and basic costing principles

Although studies assessing compliance to methodological guidelines concluded that it was frequently difficult to ascertain the overall degree of compliance due to the “poor reporting quality” of the results, it seems that costing studies and economic evaluations do not often comply with (a) all the basic economic / accounting principles, and/or (b) methodological guidelines of costing. Moreover, their costing methodologies can vary widely and some of the studies used new, untested techniques based on questionable principles (Adam 2003, Balas 1998, Byford 1998, Chang 1999, Graham 1997, Halliday 2003, Jacobs 1996, 2005, Neumann 2000, Stone 2000, Slothuus 2000, Thompson 2004).

For instance, Beddow and Cohen (2001) found that Health Authorities and Trusts did not always adhere to economic principles in calculating the marginal costs of services. In addition, Jacobs and Bachynsky (1996), after reviewing 48 Canadian studies, found that bias due to non-compliance with accepted accounting techniques is very frequent. The authors suggested that standard national unit cost lists and better quality reporting could reduce the number of biases, as well as improve the transparency and generalisability of the studies. Likewise, Adam et al (2003) found that economic evaluation and costing studies frequently divert from guideline recommendations and (a) apply non-recommended perspective, (b) include non-relevant and/or exclude relevant resource items, and (c) report only the aggregated cost results. Similarly, Stone et al (2000) concluded that despite guidelines recommendations studies did not include non-health care costs and time costs into the cost-utility analysis. Furthermore, the source of valuation of cost estimates was frequently unclear or unreported.

Costing Quality checklist

There are several costing quality checklists, some used for economic evaluation of health technologies, some used for costing health services or cost analysis. Yazbeck (2001) suggested the following checklist for costing methodologies:

Table 15: Costing quality checklist (modified from Yazbeck 2001)

	Criteria
1.	Are the costing objectives clearly identified?
2.	Does the methodology selected match the objectives of the costing study?
a.	Is the methodology suitable for calculating marginal or average costs?
b.	Does the methodology address opportunity costs or just accounting costs?
3.	Does the study clearly (explicitly) state the perspective of the costing?

4.	Does the study define the time horizon (time span) of the costing study?
5.	Are appropriate data collection methods used?
6.	Does the methodology account for overhead costs?
7.	Does the methodology correctly apportion joint costs?
8.	Does the methodology distinguish between fixed and variable costs?
9.	Does the methodology distinguish between recurrent and capital costs?
10.	Does the costing study take advantage of all data sources?
11.	Are all the assumptions clearly and explicitly stated and realistic (plausible)?
12.	Are all the assumptions realistic and/or plausible?
13.	Were sensitivity analyses undertaken to test the robustness of the assumptions?
14.	Were the resource utilisation, unit costs and results separately presented, in a well tabulated form?

Quality of reporting cost(ing) information

Recent reviews of the quality of published economic studies found that most of the studies did not fully explain (and/or justify) the costing methodologies applied, nor report the cost data in detail (Adam 2003, Balas 1998, Barber 1998, Evers 1997, Goodacre 2002, Graham 1997, Gyldmark 1995, Halliday 2003, Jegers 2002, Kotsopoulos 2001, Neumann 2000, Seninger 2004, Stone 2000, Slothuus 2000, Thompson 2004).

For instance, 10 out of 22 studies comparing ICU costs did not report the costs of ICU separately (Gyldmark 1995). Graham and McGregor K (1997) reviewed the unit costs of GP consultation in the UK. They found that half of the relevant studies (n=20) did not describe the methodology used to estimate the unit costs of GP consultation, and less than half followed the necessary steps to derive unit costs. Moreover, Stone et al (2000) found that the year of currency was not reported in 38 % of the CUA, and the source of valuation of cost estimates was not clear or not reported in 43 % of the studies.

Furthermore, specialty specific issues can also affect the quality of cost-effectiveness studies. For instance, Evers et al (1997) found only a few good quality publications in the field of mental health care. One possible explanation for this could be the lack of consensus about appropriate diagnosis and treatment options.

In addition, Balas et al (1998) also found significant variation in both costing methodology and the reporting of the results of economic evaluation. For instance, economic arguments are used without supporting evidence in the published article, and general overheads and start-up costs (implementation costs) are ignored in the costing exercise. Finally, the authors conclude that a more systematic approach is needed to produce replicable and generalisable results.

Without greater consistency in methodology used and reporting of results the interpretation of the results of cost analysis, as well as economic analysis remain difficult (Stone 2000). Likewise, Jegers and his colleagues argue that it is important that studies report explicitly and clearly (a) the aim of the costing exercise, (b) the perspective applied in the study, (c) the type of resources/costs included and measured; and (d) the time horizon of the study. Without this information, it could be difficult to understand the study and assess the quality of the costing exercise (Jegers 2002).

Huge variation in unit costs

Gyldmark (1995) found huge variations in the cost of ICU. Cost per patient ranged between \$1783 and \$48435. This relatively significant variation in unit

costs can be partly explained by (a) differences in technologies used (in different countries or changes in technology during the time of the studies), (b) different patient population (case mix (severity and diagnosis) and age/gender differences), (c) differences in IC units' workload (surgical medical patients, or both), (d) differences in IC units' characteristics (size, or number of beds, staffing, research and training activities), and (e) medical practice variation as well as (f) differences in costing methods (cost-to-charge index, average bed day price, cost figures do not represent the same cost components, inclusion/exclusion of major cost components).

Moreover, Adam et al (2003) argue that disagreement between guidelines and unclear recommendation could contribute to the considerable variance in cost estimates. In addition, Kotsopoulos (2001) argues that one of the reasons behind the huge variation of per capita costs of services and the annual costs of illnesses is the lack of stratification by disease severity (or case-mix). Furthermore, different studies may use different stratification methods, which further limit comparability.

There is a need for improved consistency (uniformity) and transparency in costing health care technologies. Standardisation is particularly important for policy makers addressing the issues of cross border care, as well as for shaping the public health policy debate inside the EU (Adam 2003, Gyldmark 1995).

Need for a single glossary and taxonomy of services

There is some unique technical jargon used by different professions in the member states, and, at the same time, there are several technical terms used in different ways (e.g. revenue costs, peripatetic staff, overhead costs, hidden costs, full absorption costing, indirect costs, intangible costs, etc.) (Ekman 2004, Finkler 2001, Negrini 2004, Petitti 2000, Young 1988).

A single glossary of technical terms can enhance the comparability, transparency and standardisation of costing practice. Therefore, this review contains an appendix, which describes most of the technical terms used in this review in details. In addition, adopting some of the OECD or EU technical terms may offer long term advantages.

Determining the best approach

Finding an optimal (acceptable) compromise

Research questions

The appropriate method of costing selected services depends on the reason for costing, the type of services and the ease / feasibility of calculation. In other words, different decision problems require different costing methodologies (Bean 1994, Finkler 1994). Therefore, any study involving costing should contain the following steps:

1. Clear statement of the objectives of the study (costing exercise). This part usually encompasses the explicit statement of study objectives, perspective, time horizon and assumptions applied;
2. Accurate (detailed) description of health service or healthy technology (final cost object). The description should make it possible to envisage the relevant cost categories (and intermediate cost objects);
3. Classification of resource items (e.g. direct or indirect costs, and variable or fixed costs), and identification of units of resources utilised (units of measurement);
4. Measurement of resource consumption, such as human resources or pharmaceutical utilisation, etc.;
5. Allocating overheads to the final cost object;
6. Placing monetary value on all goods and services used for delivering a particular health technology (service);
7. Addressing uncertainties
8. Detailed and clear reporting of the results

Selecting services for international cost comparison

Potential criteria for selecting interventions for international cost comparison would be the following:

- Well-defined services or product used for a well-defined patient group in a well-defined setting for a well-defined time period (a single GP visit could be a broad term).
- An appropriate clinical care pathway (process of care) is identifiable and it is based on sound scientific evidence (potentially minimal praxis (pattern) variation can be expected both in the same country and internationally).
- Intervention without “cost-shifting potential”, (and/or significant impact on productivity costs).
- Providers enjoy economics of scale relevant to the particular services.
- Services for comparison are provided in non-teaching and non-research institutions (avoiding site selection bias).
- Services provided for a “reasonably” prevalent condition, and there is no significant different in the prevalence and incidence between countries.

Selecting costing methodology

Although this review highlighted that different costing methods has been used for costing the same health services, the most suitable costing method will be partly determined by (a) the objectives of the costing exercise (what sort of cost information is needed to make a better decision?), (b) the timeframe (deadline) for the costing exercise, (c) resource availability (human resources, infrastructure and money), (d) degree of precision / accuracy of cost estimates needed, and (d) the availability/accessibility of reliable, as well as valid data (Yazbeck 2001).

Competing objectives and trade-offs

However, trade-offs between objectives may be unavoidable. Therefore, optimal balance should be found between the following competing objectives (Beecham 1995, CCOHTA 1996, Dickey 1999, Finkler 1994):

- The costing exercise should be cost-effective (good value for money). (There is a resource scarcity for costing, including time, human resources and cash.)
- Costing study should be based on detailed, comprehensive and representative resource use and unit cost data.
- The cost measurement should be accurate (precise).

- The cost measurement should be reliable and valid. Analysts should minimise the likelihood of potential errors, biases.
 - Lack of methodological biases (Measurement and valuation biases)
 - Lack of case-mix and service mix bias
 - Lack of site selection bias

Although micro-costing is the theoretically correct way to estimate service costs, this approach may not be practical in all cases, and the resources necessary for the micro-costing could outweigh the benefit of more accurate costing. Moreover, a less precise cost estimate may be sufficient for the particular decision. Therefore, Negrini (2004) suggested that (international) comparative studies should use a top-down approach, in particular using the “cost-block-costing-type” approach in costing. This approach uses 3-6 large blocks of costs and measures resource utilisation in natural units for each block separately. However, current experience with this approach is limited, and widespread standardised usage may need clear guidance.

One might argue that using 3-6 resource use blocks could help to isolate the differences in resource use by different organisations, and help to recognise whether the inter-organisational or inter-country differences exist in the kind and quantity of resources used or in the input prices (CCOHTA 1996).

It is important to keep in mind that whatever method is selected, the inclusion and exclusion of resource items as well as the costing method should be consistent with the objectives and the perspective of the study.

Conclusion and recommendation

Cost information is essential to improve the economic efficiency of health care and ensure value for money purchasing, especially in cross border care in any EU member states. Decision space, however, is usually limited. Therefore, appropriate costing methodology is vital to reduce the negative impact of ill-informed decisions.

Summary of findings

UNIT COST MEASUREMENT

Shared principles	There is no universally accepted appropriate costing methodology. There are several appropriate methods to estimate the (unit) costs of a particular service. Depending on the purpose of cost data to be used, different cost concepts and different costing methodologies should be used. In general, accountants define costs in terms of the historical value of economic resources, while economists use a different concept of costs, frequently described as opportunity cost.
Main steps of costing	Both accountant and economic literature agree on the basic principles of costing. Costing exercise starts with the (a) formation of a well-defined decision problem, including the objectives of costing, the perspective of costing, and the time horizon, as well as (b) the description of a particular service (cost object). After a service for costing have been defined in detail, the costing methodologies follow three distinctive steps: (c) the identification of resources used to deliver the service, (d) the measurement of resource utilization in natural units, and (e) attaching monetary value to resource use. In

addition, there is a consensus about that the robustness of the result should be addressed by (f) sensitivity analysis and statistical tests.

There are several ways to calculate unit costs, although most methods follow the full absorption cost principles. This means that all costs (direct and indirect) relating to the provision of a particular service are included into the cost calculation.

Identification and Measurement of resource use

In the identification phase, all relevant resource items should be identified, regardless of their expected impact on the total costs and of their measurability. Ideally, resource utilisation measurement should be comprehensive, reliable,

valid and representative. In principle, micro-costing (activity based costing or the bottom-up approach) is the preferred resource use measurement approach, in part because this can be more reliable, accurate and flexible. The final step in determining costs is to place a monetary value on each of the resources that were utilised. The general principle is that values for assigning monetary value to health services should be extracted from a database that reflects the perspective of the study. As a result, there are several equally appropriate sources for the monetary value of resource use depending upon the study perspectives.

There is a consensus about the fundamental principles of cost allocation. Ideally, costs should be traced directly if it is possible in an economically feasible way. Indirect costs (overheads) should be allocated to service areas based on actual utilisation or cause-and-effect bases. However, this may require a complex information system and additional resources.

Valuing resource use

In practice, costing studies use five general ways to value resources: (a) direct measurement of costs, (b) cost accounting methods, (c) standard unit costs, (d) fees, charges and/or market prices, and (e) estimates/extrapolations. All have their advantages and disadvantages.

Dealing with uncertainties

There are two main methods for analysing uncertainties: (a) statistical analysis and (b) sensitivity analysis. These two methods have complementary roles. In sensitivity analysis, the selected range across

which parameters will be varied, should be clinically meaningful, as well as economically plausible. Because the distribution of cost data can be highly skewed, non-parametric test, log-norm parametric test and bootstrapping can be used to test the cost difference between sites.

Selection of a costing method

In general, the choice from costing methods depends on (a) the purpose of costing (the decision problem), (b) the perspective of the study, (c) the type and complexity of health service / health technology, (d) the precision requirement, (e) the requirements of generalisability (external validity) and representativeness (internal validity), (f) the cost-accounting method used by the institutions compared, (g) the availability of reliable and valid data, (h) the

feasibility of measurement (e.g. existing information/activity recording systems), and (i) the estimated impact of the unit costs (uncertainty about the unit costs) on the total cost (precision requirement), (j) the type of service users, as well as (k) the number and range of different service activities. In addition, the choice of resource use and valuation methods should be closely linked.

Practical challenges There is a trade-off between cost information accuracy and the cost of attaining cost information. Consequently, analysts, decision-makers and policy-makers should consider whether the benefits of more accurate and detailed cost information justify the additional costs incurred to obtain that information. For instance, the opportunity cost concept is the theoretically preferred way to estimate costs for decision-making, but this approach can be very costly and time consuming. Accounting costs can provide reasonably accurate estimates of opportunity costs relatively cheaply and quickly. However, accounting costs are not opportunity costs, partly because they are based on historical costs. Likewise, the theoretically sound and most accurate overhead cost allocation method could be, in practice, difficult to use and expensive.

Disagreement on best practice The review found two types of disagreement: (a) disagreement on best practice principles and (b) disagreement on practical application or non-compliance with agreed principles in practice.

Disagreements on best practice principles Current methodological guidelines' recommendations vary partly due to non-compliance with fundamental economic and accounting concepts. For instance, guidelines disagree about (a) the best way to attach monetary value to resource use, including fixed assets, and (b) the recommended perspective of the study, (c) the appropriate measurement and valuation method of informal caregiver time, (d) the measurement and valuation of productivity costs, and/or (e) the cost incurred in added years of life. Furthermore, there is no consensus in the literature on (f) the best technique to use in practice to allocate all support centres costs to mission centres. Likewise, the literature disagrees on (g) the most appropriate way to deal with uncertainties.

Disagreement on practice Although guidelines sometimes agree on the fundamental theoretical questions, they do not provide detailed guidance how to translate the principles into practice. Consequently, costing practice show considerable variation in practice.

Moreover, their recommendation varies or ambiguous (not sufficiently detailed) on several technical / methodological issues such as resource use measurement, cost allocation methods, capacity utilisation and shadow price. Furthermore, guidelines frequently recommend methods without discussing the validity of the particular method compare to gold standard (if exists). Likewise, the recommended "gold standard" may be expensive and/or infeasible in real practice. Moreover, there is

no clear guideline how to calculate the useful lifetime of fixed assets. These disagreements and unclear guidance coupled with non-compliance with established methodological guidelines are responsible for significant variation in costing in published studies.

Practical problems

Although studies assessing compliance to methodological guidelines concluded that it was frequently difficult to assess the overall degree of compliance due to the “poor reporting quality” of the results, it seems that costing studies and economic evaluations do not often comply with (a) all the basic economic / accounting principles, and/or (b) methodological guidelines of costing. Moreover, their costing methodologies can vary widely and some of the studies used new, untested techniques based on questionable principles.

(INTERNATIONAL) COST COMPARISON

Agreement on basic principles

Cost comparison measure to amount of resources used in different organisations for the delivery of a comparable product or service. Consequently, costing studies, as well as cost minimisation analysis, applied in healthcare, assume that the services, of which costs will be compared, will have the same consequences (health benefits and disbenefits). This is in line with the basic costing principles that like should be compared with like. Consequently, valid comparison can only be made between different organisations, if the cost object, as well as the intermediate cost objects are the same or very similar, because different combination of intermediate cost objects (activities) actually represent different services. Therefore, the sine qua none of comparative cost analysis is the detailed description of the particular service, including the case mix of the target population, settings, and financial arrangement.

In addition, there is a widely hold agreement in the literature that cost comparison can only be meaningful if costs are measured in the same way (standardised costing methodology and reasonably good compliance to it). Likewise, international cost comparison should follow the basic costing principles, such as resource utilization should be measured accurately and comprehensively (costs are calculated on the full absorption bases), overheads (indirect costs) are allocated and apportioned fairly, when possible charging directly and costing should avoid cross subsidisation.

Furthermore, costing method should be transparent, and reporting detailed data in a disaggregated, well-tabulated form to allow further analysis from other perspective as well as ensure comparability.

However, consensus on the basic scientific principles will not be enough to ensure comparability. Standardisation could reduce method biases, but other type of biases such as scale bias, case mix bias or site selection bias should also be controlled to ensure comparability. The selected samples should also be

representative and very similar to each other to ensure that like is compared with like.

Moreover, it is important to standardise the most important and frequently used techniques and measurement tools, such as resource use measurement, cost allocation methods and valuation techniques, as well as the standard capacity utilisation rate. Likewise, the upgraded guidelines should provide more details about how to use these methods, techniques and tools in practice.

Lack of consensus

The current guidelines do not provide enough details about the best way to select providers (sites) for cost comparison and how to deal with missing data. Moreover, there is no agreement about the best method to convert cost estimates into the same currency.

Applied costing methodology

Current experience shows that top-down approach could be useful and reasonably accurate in those cases where marketed health technologies (pharmaceuticals, medical devices and other consumables) are responsible for most of the resource use. In these cases, a bottom-up approach (micro-costing) may yield very similar result, but could be more expensive and time consuming. On the other hand, a bottom-up approach could be more accurate in those cases where service provision is based on complex organisational arrangement (input mix could vary significantly), and human resource costs and overheads responsible for large portion of the total costs.

Main steps of cost comparison

International, as well as inter-organisational cost comparison follows similar steps to unit cost calculation. The main steps of comparative costing are:

1. Decision problem definition, including the objectives of costing, perspective of the analysis, time horizon and the explicitly stated assumptions
2. Detailed description of a particular service (final cost object).
3. Identification of resource items used to deliver a particular service (or produce particular goods). Identification of a set of intermediate cost objects (or a set of activities) is essential to ensure comparability.
4. Resource use measurement in natural units
 - a. Classification of resource items using a common method
 - b. Identification and exclusion of non-counterpart resource items.
 - c. Applying standard cost allocation method.
5. Placing monetary value on these resource items (goods, activities, and/or services) and calculating the unit costs of a particular service;
6. Expressing the result using a single currency; and
7. (Dealing with uncertainties).

Practical
difficulties

International comparison of health service costs could be problematic, in part due to (a) lack of clarity of cost concepts and technical terms used in the studies, (b) discrepancies in the interpretation and usage of technical terms and methodological principles (e.g. intangible costs, overhead costs, marginal costs, etc), (c) differences in classification of different cost items, (d) variations in the inclusion and exclusion of cost items, and (e) insufficient details of the methodology used, as well as (f) studies are using different strategies to deal with joint costs and allocate overhead costs. In addition, cost comparison could be challenging, in part because (a) studies may have different objectives, (b) apply different analytical perspectives, and (c) consequently include different resource (cost) items.

Moreover, international cost comparison can be difficult in practice, because finding a mutually suitable and feasible valuation process could be difficult in practice, partly due to (a) the differences in accounting systems used, (b) the differences in recommendations of (national) guidelines, (c) the differences in health systems including payment systems, and (d) the lack of comprehensive cost databases.

Furthermore, European cost comparison may be hindered by the scarcity of good quality (published) studies.

Without standardised methodology, the interpretation of the result of cost comparison could be very limited, and the result of already published studies incomparable.

Conclusion

There is a need for detailed good quality costs data from most of the European member states. Standardisation of costing methodologies, and adopting uniform approaches to major issues could foster international and inter-institution comparative costing studies. However, the real life adaptation of the theoretically most appropriate costing methodology could be expensive and/or not acceptable. Therefore, researchers should find the optimal balance between scientifically sound and feasible costing methodology.

Recommendation

For policy and
decision makers

A standardised costing methodology can provide improved information for purchasing decisions about traditional and cross border care if the methodology is used with caution and consistently. From a provider perspective, more standardised costing methodology would allow fairer comparison with other institution. Moreover, a detailed cost analysis can highlight areas where cost reduction is feasible and justifiable. Furthermore,

appropriate comparative data allows managers to justify considerable cost differences.

However, reasonably disaggregated comparative data is needed to accomplish the aforementioned objectives. Without an improved and standardised costing methodology, decision and policy makers may have to rely on misleading and potentially unfair comparisons, as well as flawed policy proposals based upon the results.

For further research Further research, including methodological research is needed in the next couple of years to enhance standardisation of costing methodologies as well as patient classification (subgroup definitions) for costing and economic evaluations. Moreover, there is a need to validate several widely used methods by comparing them with the gold standard to develop valid, reliable as well as inexpensive data collection and valuation methods.

Recommendation for analysts The prerequisite of international cost comparison is the mutually accepted methodological guidance (standard costing method) and the reasonably good compliance with it. However, consensus on the basic scientific principles will not be enough to ensure meaningful comparability. It is important to standardise the most important and frequently used methods/techniques such as resource use measurement, cost allocation methods, including allocation base and allocation techniques, and valuation methods, as well as capacity utilisation. In addition, the common guidelines should provide detailed instructions on how to use these instruments in practice.

The harmonisation of costing methodologies is essential, but may not be sufficient to ensure meaningful comparability. Standardisation could reduce method biases, but other type of biases such as scale bias, case mix bias or site selection bias should also be controlled to ensure meaningful comparability. Therefore, it is important to determine in detail the final cost object, which is common to all providers being compared. Likewise, it is important to specify the same set of potential intermediate cost objects to ensure that all important dimensions of the particular service being compared are identical.

Current experiences show that top-down approach could be useful and reasonably accurate in those cases where marketed health technologies (pharmaceuticals, medical devices and other consumables) are responsible for most of the resource use. Bottom-up approach may yield very similar result, but could be more expensive and time consuming. On the other hand, bottom-up approach could be more accurate in those cases where service provision is based on complex organisational arrangement (input mix could vary significantly), human resource costs and overheads responsible for large portion of the total costs.

The most appropriate statistical method and sensitivity analysis for cost analysis and cost comparison is debated in the literature, uncertainty in resource use and input prices should be assessed by statistical test and sensitivity analysis. Because the distribution of cost data can be highly skewed,

non-parametric test, log-norm parametric test and bootstrapping should be used to test the difference.

Limitations of the study

This review has several limitations. This is based on the English language literature. Furthermore, the electronic database search may not be able to find all the relevant publication in part due to (a) the partial coverage of the databases, (b) changes in indexing and keywords in the past two decades, and (c) lack of built-in filters. Moreover, the English language literature is dominated by North American studies. The generalisability and transportability of the American experiences in costing may be limited. Consequently, the findings should be interpreted carefully.

Quality checklist of comparative studies

Moreover, costing is a relatively complex exercise, which can apply several assumptions and use multiple sources to estimate the cost of a particular service. Furthermore, costing data are frequently time, institute and place specific. Expressing the result using a single currency could multiply these differences. Therefore, researchers, as well as decision-makers should interpret the results with caution. Critical appraisal of existing studies is recommended by using quality checklists.

Table 16: Methodological quality checklist for critical appraisal of comparative costing studies

1.	Main methodological criteria	Special focus
2.	Study objectives	The purpose and the objectives of the study is explicit and clear
a.	Description of the decision problem	All the possible alternative solutions is taken into account. Justification of omission of any alternative solution
b.	Perspective of the study	The perspective of the study is clearly stated and justified
c.	Time horizon of the study	Explicit or implicit
3.	Definition of compared services	Detailed enough to ensure that like is compared with like
a.	Target patient population:	age-group, morbidity, co-morbidity (health service needs), diagnostic criteria, type and severity of the illness,
b.	Setting	Outpatient, inpatient, home care, or free standing provider,
c.	Institutional characteristics	Teaching / research functions (Inclusion or exclusion of teaching, training and research costs) Rural / urban location Capacity and occupancy rate, specialty level (degree) including routinely used medical equipments, staff mix, etc Annual volume of the services
d.	Common patient clinical pathway	Treatment thresholds, cut-off points, indication for hospitalisation, operation, etc.
4.	Description of costing methodology	Whether sufficient details is given to make it possible to repeat the costing exercise
a.	Type of costing methodology used	E.g. marginal versus average costing methodology used
b.		
5.	Identification of resource elements	Explicit inclusion and exclusion criteria, adequate justification of exclusion and inclusion of any cost items
a.	Methods / tools used to identify resource items	E.g. clinical care pathways, literature, etc. Sources are explicitly stated.
b.	Sample size calculation	described in sufficient details
c.	Resource items are clearly identified and listed	Separate, detailed reporting of cost items by cost categories, unit of measurement is clearly stated
d.	Classification of cost items	Direct costs, overheads, fixed, variable, etc.
e.	Identification of joint-costs	Dealing with costs attributed to co-morbid conditions.
f.	Subgroup analysis	“Sub-grouping” patients by disease severity, prognosis and/or co-morbidities
6.	Resource use measurement	
a.	Estimation basis	Sample selection and characteristics described in sufficient details
b.	Measurement method / design	Bottom-up, top-down or mixed retrospective, prospective design using statistical/mathematical modelling
c.	Source of resource use data	Data source explicitly stated
d.	Selection of providers for costing	Any potential biases (e.g. non-random selection)
e.	Reporting the result of resource measurement	Resource consumption is measured in physical units and reported separately from unit cost valuation.
f.	Sub-group analysis	E.g. by disease severity/prognosis and co-morbidity
g.	Assumption regarding resource use measurement	Explicit, implicit or not stated

h.	Dealing with uncertainties	Sensitivity analysis / statistical tests used
7.	Valuing resource items	Clear description of the method and the source of unit costs data
a.	Direct measurement	Whether the methodology is described in details
b.	Prices for marketable items	Competitive or non-competitive market prices were used
c.	Fees/tariffs / charges	Justification
d.	Source of cost estimates	Explicitly stated (e.g. literature or other source)
e.	Assumptions regarding attaching monetary value to resource use	Explicit and justified, explicit but not justified, implicit or not stated
f.	Sensitivity analysis	Assumptions applied in the study: Practice pattern variation within a particular country and between countries (resource consumption).
8.	Health system specific factors	
a.	Practice pattern variation	
b.	Organisation of health service delivery	
c.	Financial arrangement (reimbursement / payment mechanism, other incentive systems)	Who pays for the services and how, opportunities of cost shifting, existence of cost sharing
d.	Economic development / health care expenditures	Total health care expenditures, health care expenditures regarding the technology in question

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Definition of common technical terms

International and inter-organisational cost comparison as well as economic evaluations are hindered by the lack of clarity in technical terms and cost concepts. Although there is increasing consistency in some fields, still the usage of technical terms is frequently inconsistent, and/or contradictory. Without a distinct clear definition of technical terms, reader may not be able to interpret appropriately the result of the review. Therefore, it is necessary to define the most common technical terms in advance to improve generalisability as well as transparency of the review. However, the understanding of the concept behind the technical terms is far more important than the actual choice between the currently used terms (Ekman 2004, Finkler 2001b, Negrini 2004, Petitti 2000).

Cost terms

Because cost has several different meanings, not just in the everyday language, but also in economic literature, several cost terms have multiple meanings, or have been used differently in the literature. Therefore, it is useful to define briefly the cost terms, which will be used in this paper to avoid misinterpretations and misunderstandings (Culyer 1985, Yates 1996).

Cost

Cost can be defined as the amount of expenditure (actual or nominal) incurred on or attributable to a particular good or activity (e.g. production or service delivery) (Lucey 2002). In other words, cost can be defined as resources (cash or other assets) that must be surrendered in order to achieve a particular objective. In both definitions, costs relate to past activities (historical costs)

(Zimmerman 2003, Green 1999). Conversely, opportunity cost, which is a cost concept used by economists, is forward looking, estimating the forgone benefits that could, but will not, be undertaken (Zimmerman, 2003).

Cost comprises two major components, the quantity of resources used and the value of these resources. However, the word cost is rarely used on its own rather it is usually qualified in some way or other (Lucey 2002). Resource use (cost) is usually expressed in monetary terms to ensure comparability (Zimmerman 2003, Green 1999).

Costs should be differentiated from prices. Some health and social services (e.g. informal care) may not have prices or market value, but require resources for provision (see later), while some other services do have prices but their prices do not reflect actual resource use (Green 1999).

Opportunity costs

Opportunity cost or economic cost measures what the insurance company or the health service provider forgoes when it chooses to spend money on a particular service or provide a service for a particular patient. In other words, opportunity cost is the (total) value of the benefit forgone because of alternative use of resources (including money). For example, resources used for cancer prevention will not be available for mental health programmes, or public money used for health care will not be available for council housing programmes (Creese 1994, Culyer 1985, Perrin 1988, Petitti 2000)

Because opportunity cost is the sacrifice of the best alternative use of resources, opportunity cost may or may not be the same as payments or historical costs or accounting expenses. For instance, half of a unique medicine used for a patient may not be useful for other patients, and can have zero opportunity cost regardless of the acquisition cost (expenditure) of that drug. It means that the same resource could have very different opportunity costs in different decision contexts. Therefore, the calculation of opportunity costs could be time-consuming and resource intensive, and may require a special study for every occasion (Zimmerman 2003).

On the other hand, on several occasions, accounting costs can be very good estimates of opportunity costs. Although an accounting system is backward looking (recording the historical costs of resource use) over a particular time, market conditions do not change significantly. Therefore, historical costs (accounting costs) can be reasonably good estimates of opportunity costs. However, cost accounting systems, in general, cannot, and do not, focus on opportunity costs, partly because they cannot foresee all the future decisions (Zimmerman 2003).

Opportunity cost should not be seen as a special type of cost accounting or costing system, but rather as a particular approach to decision making under resource scarcity. In other words, the opportunity cost approach emphasises that under resource scarcity all feasible alternatives should be taken into account. (Perrin 1988) An opportunity set comprises all practically feasible alternative actions. The opportunity cost can be determined only within a

specific decision context or within a specific opportunity set (Zimmerman 2003).

Historical cost	Historical costs or accounting costs are costs that are incurred to acquire resources. An accounting system measures historical costs. Unfortunately, in the literature, the term cost could refer to either accounting costs (historical costs) or opportunity costs (benefit forgone by a decision).
Relevant costs	Relevant costs are those costs that change as a result of a decision. In other words, relevant costs are those that will be incurred if the service is provided. Conversely, costs which will not be affected by the decision are usually called non-relevant costs (Finkler 1994, Pyke 1998). One type of non-relevant costs is sunk cost, which has already incurred; therefore, sunk costs are non-relevant for a particular decision making, partly because decisions are always about the future. Likewise, book value of assets, committed costs and several times depreciation or fixed costs could be non-relevant costs (Dranove 1996, Lucey 2002).
Sunk costs	<p>Sunk cost is expenditure in the past, which is a non-recoverable cost such as aborted research and development expenditure, but it appears in the full expense report (Zimmerman 2003, Young 2003). These costs are usually associated with fixed assets that have not been fully depreciated, but have no future use (no future economic benefit for the company) such as obsolete medical equipment (Hankins 2004, Young 2003).</p> <p>From a decision-making point of view, these costs will not be affected by any decision to be taken, because decision making always looks toward the future. In other words, they are irrelevant for the decisions someone will take now or in the future, because these costs cannot be reversed. Consequently, sunk costs are excluded from differential cost analysis. However, the inclusion or exclusion of any costs classified as sunk costs (e.g. depreciation) ultimately depends on the decision problem (Culyer 1985, Pyke 1998, Young 2003). Sunk cost may or may not have an opportunity cost (Finkler 1994).</p>
Incremental versus marginal cost	Although the technical terms, incremental and marginal cost, are frequently used interchangeably, their meaning is slightly different. Both, marginal cost and incremental cost is defined as the change in cost related to a change in activity. However, incremental cost is the additional total cost incurred as a consequence of changes in activities, while marginal cost is the additional cost incurred for producing one extra product or delivering one extra service (Horngren 2003).
Marginal cost	To an economist, marginal cost is the cost of producing one more unit (of service). To an accountant, marginal cost is average variable cost (conventionally linear variable cost). In addition, marginal cost per unit is

constant in the short run in the relevant range. Conversely, to an economist, marginal costs vary by the volume of services (Lucey 2002, Zimmerman 2003). Furthermore, marginal cost could refer to the marginal costs per unit or the total marginal costs of the department, operation or batch. However, the difference in meaning usually becomes clear from the context (Lucey 2002).

Whether decision makers are interested in marginal costs or average costs (full costs) is depends on the specific decision problems. If decision makers would like to expand a particular inpatient or outpatient activity (especially inside the relevant range), marginal costs could be more important. On the other hand, if policy makers are concerned with regional or inter-country variations of costs of services, average or unit cost estimates could be more useful. Full costs or average costs can be more generalisable than marginal costs (Yazbeck 2001, Brouwer 2001).

Unit costs or
average cost

Costs are usually measured in total and/or per unit. Unit cost is the cost of one unit of service, while the full cost or total cost is the sum of all costs associated with a particular cost object. The unit cost can be computed by dividing the full cost of a particular cost object by the number of units of service provided. In other words, unit cost is the average cost per unit of service or the “mean” cost of a particular type of service. For instance, cost per case or cost per day is a unit cost. It is calculated by dividing the total cost by the number of services provided (number of units). Some textbooks differentiate between “unit cost” and “direct unit cost”. The latter only takes the direct costs into the account (Dyson 2001, Horngren 2003, Finkler 1994, 2001).

Moreover, there is not one “true unit cost” of a service or product, in part because unit cost calculation is based on (a) several explicit and implicit assumptions, and (b) frequently applies relatively crude cost allocation (apportionment) methods. Consequently, the unit cost of a service is an approximation (Dyson 2001).

Although unit costs are frequently cited in financial reports, other cost information, such as total cost, total variable cost, and total fix cost, are equally important information for decision makers. This is because unit costs are not constant, they depend on several factors, such as volume (number of treated patients) and/or available capacity (Horngren 2003, Finkler 1994, 2001b).

Most health sector activities are service oriented, although some services, such as pharmaceutical/pharmacy services, artificial limb development, other orthopaedic devices, etc., are more or less product based. In the product-based sectors, units of service can be relatively easily defined compared to in the service-based sectors (Horngren 2003, Finkler 1994, 2001).

In addition, health care services are usually human resource intensive, and therefore, the unit of service is frequently defined in time (for instance, long or short psychotherapy or new patient visit or recurrent visit is measured by time used for the services). However, several services are defined as a specific activity (e.g. abdominal MRI scan), and therefore unit of service can be defined as one MRI scan. Another common way to define a unit of service is the per

patient approach, such as per hospital admission or per case (DRG) (Finkler 1994, 2001).

Moreover, most health care services are labour intensive, and therefore, human resource costs are responsible for 70-75 % of total costs. In several European countries, most of the human resource costs are fixed costs; therefore, the unit cost of a particular service could be sensitive to the volume of services provided. As volume increases, the average cost per patient (unit cost) can decline (Finkler 2001). Unit cost is necessary but not sufficient for most of the management decisions because unit costs alone cannot give enough information regarding how costs will change with changes in volume of services.

Costs
charges

versus

Sometimes in the literature, technical terms, such as cost and charge, are used interchangeably as synonyms. However, in economics they have different and distinct meanings. Charges are the amount expressed in monetary terms that providers ask for products sold or services provided, and these charges may or may not reflect actual resource consumption or costs. For instance, charges could be the result of political bargaining, or distorted by cross-subsidisation or cost shifting (Elliott 2005, Hankins 2004, Luce 1990).

On the other hand, American hospitals were reimbursed according to their reported costs for treating Medicare patients. This Medicare payment was called a cost-based payment, which might have contributed to the misleading use of charges as a synonym for costs in the English language literature (Elliott 2005, Hankins 2004, Luce 1990). (Cost-to-charge ratios are described in the previous chapters.)

Cost classification systems

When using costs for decision-making, it can be useful to classify them. However, a useful classification system can depend on the nature of the decision problem, as well as the type of costing methods and techniques used to calculate the relevant costs. There are two major types of classification system according to (a) how costs can be assigned to a cost object and (b) how costs behave. However, there are other cost classification systems, such as relevant and non-relevant costs; sunk costs and recoverable costs, marginal and average costs; controllable and non-controllable costs (Pyke 1998). Moreover, a separate classification system is used in the economic evaluation literature (Johnston 2001, Petitti 2000).

CLASSIFICATION BASED ON TRACEABILITY

Direct and indirect costs	The total cost of a service comprises “direct costs” and “indirect costs”. Direct costs are those costs, which can be directly linked to the use of particular resources or cost objects, and can be traced to the cost object in an economically feasible way. A cost object can be a good, a job or a service. Traceability (directly attributable to a cost object) in an economically feasible way is the crucial characteristic in this classification system. Cost tracing can be defined as an assignment of direct costs to the particular cost object. There are several resources which can be directly associated with a particular cost object, but they cannot be traced without substantial extra costs. Therefore, these resources use (costs) are classified as indirect costs (Clewer 1998, Dyson 2001, Finkler 2001b, Horngren 2003, Millichamp 1997, Zimmerman 2003).
Direct cost	Direct cost can be materials, labour or expenses. For instance, nurses employed, or drugs used, etc. can be directly linked to a particular service, and therefore, they are direct costs. The health professional that provides a service (treating a patient) is classified as direct labour cost. Although the direct/indirect classification is almost completely independent from the fixed/variable classification, direct costs are usually variable costs, but can also be fixed costs (Clewer 1998, Horngren 2003, Millichamp 1997, Zimmerman 2003). Direct costs are sometimes called separable costs, but this review will not use this term (Clewer 1998).

Direct and indirect cost in accountant and economic evaluation literature

It is important to bear in mind that indirect cost has two different meanings in the literature. On the one hand, indirect cost is used to specify overhead costs or non-directly-allocable costs in cost accounting. On the other hand, indirect cost is also used to refer to productivity losses related to diseases by economists evaluating health technologies. Moreover, in the economic evaluation literature direct costs describes direct medical and non medical costs used by the patients undergoing medical care (see later). To avoid confusion, direct and indirect costs will describe only the traceability of the cost to the cost object, and most of the time, “accounting indirect costs” will be referred to as overheads and “economic indirect cost” as productivity cost (Jegers 2002, Millichamp 1997, Perrin 1988, Slothuis 2000, Wimo 1997).

Indirect cost

On the other hand, indirect costs have no direct relationship to the cost object; therefore, they cannot be traced to the cost object “easily” or in an economically feasible way. Indirect cost may also be materials, labour or expenses. For instance, the cost of catering or cleaning in a hospital, as well as the cost of clinical audit, is classified as indirect costs of health services. The (cost of) cleaning personnel or security is usually classified as indirect labour (costs). The (costs of) materials used to clean the wards are classified as indirect material (costs) (Horngren 2003, Zimmerman 2003). Indirect costs and overheads are synonym words, and often used interchangeably. Indirect costs are sometimes called common costs or joint costs, but this review will not use these terms (Baker 2004, Finkler 2001b).

Indirect materials, indirect labour and indirect expenses are collectively known as overheads (or manufacturing overheads or indirect manufacturing costs). Cost allocation is used to describe the process of assigning indirect costs to a particular cost object. When the appropriate share of the indirect cost is assigned to the cost object, it is usually said that that particular cost object absorbs it (Horngren 2003, Millichamp 1997, Zimmerman 2003, Young 2003).

Depending on the objectives of the economic analysis or the decision problem, decision makers may be interested only in direct costs or in total costs. In these cases, the definition of direct and indirect costs should be straightforward and explicit. However, the distinction between direct and indirect costs can be difficult or problematic. For instance, one English study found huge variation in how hospitals classified their costs. For instance, one hospital classified 43 % of the costs as direct compared to 78 % for the other. Likewise, the percentage of capital costs varied from four to 20 % (Elwood 1992, (Zimmerman 2003) Furthermore, cheap direct materials (gloves, bandages) could be treated as indirect costs in a hospital, because the cost of tracking and reporting them separately outweighs the benefits (Zimmerman 2003).

When decision makers are interested in the full cost of services (direct plus indirect costs), a fair allocation of indirect costs could also be essential (Zimmerman 2003).

Indirect costs and overheads Dawson (1994), Horngren (2003) and Perrin (1988) argue that costs can be either “direct” or “indirect”, depending on how they are measured, but the level of precision and detail of measurement is more or less determined by the cost accounting / information system implemented. Furthermore, a particular cost can be both a direct cost of one cost object and an indirect cost of another object. In addition, several factors could influence the classification of a cost as direct or indirect: large cost items, for instance, are more likely to be measured separately, and it is more easily feasible to trace them to a specific cost object. Conversely, tracing small cost items directly to a particular cost object may not be either efficient or feasible. Furthermore, the nature of the contract also affects the classification of costs.

Prime costs, overheads and total costs The sum of direct materials, direct labours and direct expenses is usually called prime cost. The total of an indirect materials, indirect labours and indirect expenses is known as overheads. The total of the prime costs and overheads is known as total cost. In other words, the total (absorption) cost of a product (service) is the sum of direct costs (prime costs) and the appropriate proportion of indirect costs (overheads) (Dyson 2001, Lucey 2002, Millichamp 1997).

MacKerrell (1993) argues that the health care equivalence of prime costs could be specialty costs (the total direct costs of delivering a specialist service) and specialty unit cost can be calculated by dividing the annual total of specialty costs by the number of finished consultation episodes. Some authors, however, question the usefulness of specialty unit costs in contracting /purchasing.

Overhead costs Overhead cost is an umbrella term covering a wide range of cost items such as accommodation, telephone, support services, marketing, borrowing and general management. In other words, an overhead cost involves indirect labour, indirect materials and indirect expense costs, as well as other types of costs that cannot be directly traced in an economically feasible way (not worth to trace to cost objects). In practice, overheads are usually divided into subcategories such as administration overheads, production overheads, selling and marketing overheads, etc. Furthermore, accountants differentiate between fixed and variable overheads (Hankins 2004, Zimmerman 2003, Lucey 2002).

Overheads are sometimes called “burden”, “on-cost” or “common cost”, but these terms will not be used in this review (Zimmerman 2003, Lucey 2002).

On the other hand, there are publications that use overhead costs as a special subcategory of indirect costs for instance the costs of support services (Department of Health 2005). Furthermore, studies may differentiate between indirect and direct overheads (Trisoloni 1987). In this review, overhead costs are used as a broad umbrella term to include all sorts of indirect costs, and further subdivision of overheads to direct and indirect overheads will not be used.

Overheads could be a large proportion of the total costs. For instance, 40 % of hospital costs could be classified as overheads (MacKerrel 1993). However, the actual content of the overhead cost could vary significantly between organisations. Overhead costs are usually fixed costs (fixed overheads) and involve a mix of controllable and uncontrollable costs (Hankins 2004).

Several cost accounting methods have been developed to allocate overhead costs into service unit costs. All of these apportionment and allocation methods have their strengths and weaknesses. In order to successfully and correctly absorb all the different types of overhead costs, institutions may use different allocation methods. The selection could be determined by the nature of the overhead costs. (Bean 1996) The choice of allocation method could have a significant impact on unit costs (MacKerrel 1993).

Joint costs and non-joint costs

Joint costs are those costs that are required for the provision of several types of services or several different types of patients. In other words, joint costs occur when two or more outputs (services) are produced from the same input. Overheads and joint costs have a similar definition, but overheads occur in both assembly and disassembly processes, while joint costs are incurred only in disassembly process (=using few inputs to produce several outputs). For instance, the cost of automated diagnostic tests is a joint cost, because a central laboratory machine checks several patients blood samples at the same time (Brent 2003, Finkler 1994, Zimmerman 2003).

On the other hand, non-joint costs are those resources that are used for one activity (intervention) such as an intrauterine device, single-use syringe and needles (Dranove 1996, Yazbeck 2001, Zimmerman 2003).

Although many different ways and allocation base are used to allocate joint costs (e.g. volume, realisable value, etc.), the allocation or apportionment of joint costs should preferably be done on a cause-and-effect basis. In reality, however, it could be problematic or challenging. However, current experiences show that in several cases allocation could be more or less arbitrary (inappropriate) (Finkler 1994, Zimmerman 2003).

CLASSIFICATION BY TYPE OF COST BEHAVIOUR

Another classification of costs depends on the behaviour of costs in relation to changes in volume over a given time period. Several managerial decisions, such as flexible budgeting and cost-volume-profit analysis are based on assumptions about cost behaviour. Usually decisions making is short run in nature. Therefore, analysts focus on the short term behaviour of costs, but the definition of short term depends on the particular problem / product or service. Short term can mean 3 months, 6 months or a years, but usually less than 3-5 years (Finkler 2001, Lucey 2002).

Variable and fixed costs

The two major types of cost-behaviour patterns are variable costs and fixed costs, but the literature also differentiates between fixed and stepped-fixed costs, as well as variable and semi-variable costs (Pyke 1998).

The full cost of any services encompasses fixed and variable costs, as well as semi-variable and stepped-fixed costs. This distinction between costs implicitly assumes that there is a well defined relevant range of activities (e.g. volume of services provided per month), and describes cost behaviour in the short term, because over a longer time period all types of costs are subject to change (Finkler 1994, Lucey 2002).

Variable costs

Variable costs change by the volume of total activities (e.g. patients treated), while fixed costs remain unchanged in total despite wide changes in volume. Examples of variable costs include drugs, diagnostic services, disposables, bandages, patient transport, patient food, nurses recruited from locum agencies to cover short-term peaks, etc. Although variable costs and direct costs are determined by different principles, direct costs are frequently variable costs. However, there are direct fixed costs too (Clewer 1998, Lucey 2002, Young 2003).

Variable costs are usually assumed to behave linearly in respect to volume change, but this is not always the case. Therefore, accountants differentiate between linear and non-linear variable costs. Linear variable costs increase proportionally by volume within the relevant range (Finkler 2001, Lucey 2002).

Accountants usually rely on the assumption of linearity, and therefore, variable costs equal marginal costs. On the other hand, the economic concept of marginal costs is based on the curvilinear cost function where marginal costs could change significantly by volume. However, in the short run, these two approaches may yield very similar results (Lucey 2002).

In Activity Based Costing (ABC), variable and fixed costs are defined slightly differently. Short-term variable costs (in ABC) would be classified as variable costs, while long-term variable costs (in ABC) and fixed costs (in ABC) would usually be classified as fixed costs in the traditional classification system mentioned here. This refinement was necessary, because the conventional fixed cost definition is time and (relevant range), not activity, related (Lucey 2002).

Fixed costs

Fixed costs do not vary with service output (level of activity) or workload over a period of time (either short run or the time-period under consideration) within certain output or volume limits (relevant range). In other words the cost of resources is independent from the amount of service activity in a given volume range (in the short run). For instance, the cost of a salaried practice nurse, rent, capital charges, insurance premiums, or a maintenance contract for

the organisation could be constant regardless of the amount of services undertaken (Bean 1996, Clewer 1998, Lucey 2002, Young 2003).

Dranove (1996) estimated that about 20 % of the provider's typical total costs are allocated fixed costs of property, land, building and durable medical equipment. However, fixed costs can change over time. For instance costs of rent or support services could change year by year (Bean 1996, Clewer 1998, Lucey 2002).

Indirect costs (overheads) are frequently fixed costs including items such as rent, maintenance and capital costs, but overheads may also include variable or semi-variable costs (Bean 1996). Furthermore, there are some direct costs, which can be classified as fixed costs. For instance, decommodificated human resource costs can behave as fixed costs. However, fixed cost does not mean either that it is constant and cannot be changed or that it is well known in advance with certainty (Zimmerman 2003).

Semi-variable and semi-fixed costs

There are costs that cannot be classified as fixed or variable costs because they either contain both fixed and variable cost components, or they have a much narrower relevant range than all the other fixed cost.

However, it is important to bear in mind that several textbooks and articles do not differentiate between semi fixed (step-fixed, step-variable, semi-fixed or step-function costs) and semi-variable (mixed or semi-fixed) costs. These publications frequently classify both as semi-variable costs or semi-fixed costs, but some publication may not use the semi-variable classification at all (Clewer 1998, Department of Health 2005, Elliott 2005). Furthermore, Baker (2004) argues that semi-fixed and semi-variable costs are two different subcategories of mixed costs. However, this review will use different names for these two types of costs.

Semi-variable costs

Finkler (2001), Pyke (1998) and Young (2003) define semi-variable cost as mixed cost, which contain some fixed and some variable cost components. A portion of these costs is fixed, but the total cost increases by volume. Semi-variable costs can further sub-divide into linear and non-linear semi-variable costs, depending how the variable part behaves in relation to the increase of volume. For instance, some telephone costs or electricity bills can only be classified as semi-variable costs. In this case, there is a fixed monthly charge for the line rental including a specific number of free calls, but the rest of the utilisation has to be paid as variable costs (Zimmerman 2003). Another example of semi-variable costs include vehicle costs where there is an annual fixed cost (e.g. car insurance, annual road tax, and MOT) and variable costs such as monthly fuel costs (Lucey 2002, Millchamp 1997).

Semi-fixed costs

Some fixed costs may change as a result of an increase of workload or volume of production. Semi-fixed (or stepped-fixed or step-variable or stepped or

step-fixed or step-function) costs refer to those fixed costs which remain constant for a particular range of activity. However, when activities increase further costs may change considerably, because they have a much narrower relevant range than the rest of the fixed costs (Young 2003). In other words, they behave as fixed cost over a particular interval, which is shorter than the relevant or normal volume range (Finkler 2001). Consequently, these costs are fixed over a particular range of output (volume of services), but increase sharply in a stepwise manner after exceeding a specific volume of services. In other words, semi-fixed costs can be defined as costs which vary by volume of services (or outputs) but not in a constant proportion (Baker 2004, Department of Health 2005, Millchamp 1997, Perrin 1988).

Many costs in health care belong to this category. For instance, rent, nurse staff costs, monitoring, administration costs or information technology costs can be semi-fixed cost (Zimmerman 2003, Millchamp 1997).

Table 17: Cost classification by Horgen, Datar and Foster 2003

		Assignment of costs to cost centres	
		Direct costs	Indirect costs
Cost behaviour pattern	Variable costs		
	Semi-variable		
	Step fixed costs		
	Fixed costs		

Classification in practice

Research evidence shows that the classification of particular expenses can vary widely in one specific country and between countries. One reason for this could be that the behaviour of a particular cost can be significantly different. For instance, labour costs could behave in a significantly different way from country to country depending on the degree of decommodification of human resources (Zimmerman 2003). (table 18)

Table 18: Variation of classification of particular cost items (%) (Zimmerman 2003)

	Variable costs			Semi-variable costs			Fixed cost		
	Korea	Japan	USA	Korea	Japan	USA	Korea	Japan	USA
Production labour	41	48	71	13	5	5	27	40	7
Maintenance	29	8	23	25	18	36	26	58	24
Energy	40	38	21	20	28	36	15	25	23
Supervision	10	3	3	15	3	22	52	75	58

NOTE: numbers do not add to 100.

In addition, especially in health care, costs could behave in a very complex way. As a result, the classification of different cost items into fixed and variable can be very difficult. For instance, adopting a new technology may require opening of new medical wards, which will have a significant impact on cost behaviour both in the short and long term. Although human resource costs are often classified as fixed costs, less specialised personnel could easily be redeployed elsewhere. In addition, the degree of commoditisation of less specialised employees may be higher in health care. As a result, the human resource costs of less specialised employees could behave as variable costs (Brent 2003, Brouwer 2001, Jegers 2002).

Furthermore, in the long run all costs behave as variable costs. Therefore, costs can only be fixed over a relevant range. Over the relevant range, fixed costs remain fixed and most of the variable costs increase proportionately. As a result, the unit cost of a particular service can vary substantially by volume (Finkler 2001).

Short term versus long term

The definition of short term and long term is critical for classifying costs as being either fixed or variable. The distinction between short run and long run is also crucial for costing and pricing decisions, in part because there are several cost items, which are usually fixed cost in the short term, but, in the long term, they become variable costs. For instance, depreciation, staff costs, or maintenance can be classified as fixed cost in the short run, but could be variable or semi-variable costs in the long term (Finkler 1994). Moreover, decision-making is usually short run in nature. Therefore, decision makers, as well as most of the cost studies focus on the short-term behaviour of costs (Lucey 2002).

The definition of short term, as well as long term depends partly on the particular decision problem, and the characteristics of the individual product or service. Short term can mean 3 months, 6 months or a year, but usually less

than 3-5 years, because over longer period, significant uncertainty, due partly to technological and environmental change, could make considerable impact on cost behaviour (Byford 2003, Lucey 2002). In other words, short run is a time period over which minimum one resource item is classified or behave as fixed cost (Byford 2003).

The practical answer to the question “what is short time span”, from a financial accounting point of view, is that short run is one financial year or the operating life-cycle of the particular service. Operating life cycle is the time between the beginning of payment for a particular service delivery and the actual collection of revenues for the provision of services (Finkler 1994). However, this definition may or may not be acceptable for medical / surgical services. For instance, for the depreciation of new medical equipment, short term could be 5-10 years, while for staff nurses the short term can be 2-3 months. In addition, Finkler (1994) emphasises that the distinction between short run and long run depends on specific decision problems.

Long run marginal costs

Economic evaluations usually prefer to calculate the long run marginal cost (LRMC), the additional cost of delivering one more service or producing one more product, partly because long run marginal cost takes the initial investment costs (cost of capital and fixed assets) into account. However, in practice, it can be difficult to estimate LRMC with reasonable certainty, and therefore, the short run average costs (SRMCs) are used as a good proxy for LRMC (Byford 2003).

Relevant range

“Relevant range encompasses the rates of output (e.g. volume of services) for which the sum of fixed and variable costs closely approximates total cost.” Furthermore, the variable cost is a close estimate of marginal cost. In other words, the variable costs per unit are a close estimate of the marginal cost per unit. This is one of the reasons why in the literature the technical terms marginal and variable costs are frequently used interchangeably (Zimmerman 2003). To avoid confusion, this text will not use these terms interchangeably.

CLASSIFICATION BY THE FREQUENCY OF EXPENDITURES

Capital cost and revenue cost	Costs are frequently categorised as capital costs and recurrent costs. Capital cost is also known as non-recurrent cost, while recurrent cost is also called revenue cost (Millichamp 1997).
Revenue expenditures	Revenue expenditures or recurrent costs are consumed within one financial or accounting year. It can be direct costs such as costs of goods, services and expenditures, or overheads including rents, insurance, salaries, etc (Millichamp 1997).
Capital expenditures	On the other hand, capital expenditures are the costs of acquiring fixed assets. Fixed assets are those assets, which are expensive, and give economic benefit to the health care provider for more than one accounting/financial year (Millichamp 1997).

COST TERMS USED IN COST ACCOUNTING

Committed cost	Committed cost cannot be changed within an accounting period (e.g. one financial year), usually because of contractual obligations. Fixed costs are usually committed costs (Hankins 2004).
Cost objects	Costs are always related to particular functions (services delivered or good produced), for instance the cost of hip replacement, cost of nursing staff, or cost of CT scanning. These particular services can be called cost objects. In other words, cost objects are those products (service or job) whose costs are to be measured. Cost targets and cost units are sometimes used as synonyms for cost objects. They can be identical or dissimilar. Furthermore, one provider could use several cost objects depending on the purposes for which cost information is used (Lucey 2002, Hankins 2004). On the other hand, Finkler (1994) used cost objectives instead of cost objects or cost units to describe any particular service or product for which someone would like to know the total or marginal costs. This review will use the cost object technical term.
Product cost versus period cost	Internal accounting systems usually differentiate between product costs and period costs. Product costs include all the expenditures incurred to produce a product or deliver a service (e.g. direct material, direct labour and overheads). Product costs are inventoried and expensed only when the services are delivered / or the product sold. One part of the product cost that encompasses the direct labour and overhead costs, and is called conversion cost (see table 19) (Zimmerman 2003, Young 2003).

Table 19 Relationship between cost terminologies (adapted from Dyson 2001, Zimmerman 2003, and Young 2003)

Direct cost (manufacturing cost)	Direct materials	Prime cost		Total service costs / full production costs	Full cost	Selling price
	Direct expenses		Conversion costs			
	Direct labour					
Overhead costs (indirect manufacturing cost)	Variable overhead costs					
	Fixed overhead costs					
Sales and marketing, general and administrative costs (S&M, G&A)	Variable		Period costs			
	Fixed					
Profit						

On the other hand, period costs are those costs that are expensed in the same period in which they are incurred, and encompass all non-manufacturing or non-service-delivery accounting costs such as marketing, distribution, etc. Both the product cost and the period cost include fixed, semi-variable and variable costs, and both are historical costs. Although they may or may not be good estimates of opportunity costs, they are not opportunity costs. Moreover, the unit cost of a product could exclude period costs. Therefore, it is important to report both product and period costs for decision makers (Zimmerman 2003).

Product cost and period cost in health care

Although the product cost and period costs classification is originated in manufacturing industries' accounting systems and the service industry does not manufacture a product, as well as does not create an inventory, the distinction

between the two types of costs remains important for health care organisations. Product costs can be seen as the costs of service delivery whereas period costs are the costs necessary to support the existence of the organisation (Baker 2004). Conversely, Dyson (2001) argues that the aforementioned classification may not be relevant for all organisations, for instance, the service sector may not have any production costs.

On the other hand, the medical supply department and the pharmacy department have inventories. For these departments the distinction between these two types of costs is more straightforward, as well as useful (Baker 2004).

Cost drivers

A cost driver (in accounting literature) or cost-generating event is a variable, such as medical visits, that casually affects costs over a given time period. Fixed costs in the short run have no cost drivers (Horngren 2003). In other words, cost drivers are activities which can be directly linked to changes in costs (Young 2003). It is important to identify the most important cost drivers or cost-generating events, because it is essential to collect data about all the

relevant cost drivers. Sometimes it is sufficient and/or practical to limit data collection (or costing) to the key cost-drivers (Johnston, 2001). Cost drivers can be used to allocate direct and indirect costs (Vance 2003).

Activity based costing (ABC) tries to improve the accuracy of cost estimation by using multiple cost drivers. ABC can differentiate cost drivers by level of organisational hierarchy. For instance unit-level, batch level, production-level and facility level cost drivers. In health care organisations, unit-level cost drivers can involve staff time or hospital days. The latter could incorporate drugs, essential diagnostics, nursing and food. Batch-level cost driver could be admission / discharge office and / or cleaning personnel. Product-level cost driver could include the dedicated time and activity of the clinical audit office and/or the medical director. Finally, facility or institution-level cost driver can incorporate the hospital management (Zimmerman 2003).

It is important to bear in mind that cost driver as a technical term is used differently in the financing literature. In the financing literature cost drivers are those resources that mainly determine the total costs of the services or products. Identification of cost drivers make it possible to improve technical efficiency (Vance 2003).

Standard costs

Services are delivered in a dynamically changing health care environment. Therefore, a reasonably precise estimate of the unit cost of any services may or may not be valid in the next month or the second half of the financial year. Standard costs can help to cope with these uncertainties. Standard costs are target level costs per unit of activities, which have been calculated or agreed as a fair. As a result, standard costs are usually attainable, but challenging. In other words, standard costs are benchmarks, representing the expected (desired) level of unit costs. Standard cost is also used for product (service) pricing decisions (Millichamp 1997, Perrin 1988, Zimmerman 2003).

Standard cost(ing) is seen as a cost control tool. Managers can implement proactive measures to contain costs by analysing and monitoring the variance (difference) between actual cost and standard cost, and taking corrective action in time if necessary. Standard costs system, however, could be very costly to maintain, requiring regular updates (Millichamp 1997, Perrin 1988, Zimmerman 2003)

Controllable and uncontrollable costs

Costs (resource use) that can be halted without significant delay (e.g. straight ahead) are called controllable cost. On the other hand, a cost (resource use) which cannot be halted without delay by the decision of the budget holder and so have to be paid for is called an uncontrollable cost. In other words, costs, which cannot be influenced by the budget holders, are non-controllable costs. Although there are several exemptions, variable costs are usually controllable whereas fixed costs are generally uncontrollable in the short term. There are some costs, which fall between the two categories, and they are called semi-controllable. For instance, telephone bills usually encompass an annual

contract cost for the line rental, but the number of calls can be reduced significantly (Bean 1996, Pyke 1998).

Capital costs

Any health services had to be started sometime in the past and required so-called start-up costs. Start-up costs encompass all the initial activities and expenditures necessary to develop a new service. Start-up costs usually include capital costs (building, field, equipments, furniture, etc.). The initial financial investment has to be financed, therefore the start-up costs, including the capital costs, have to be taken into account when the total cost of a particular service is calculated (Bean 1996).

Capital costs are usually seen as a one-off expenditure (non-recurrent input) or an input that lasts more than one year (Green 1999, Creese 1994). Therefore, capital costs are usually fixed costs in the short run. However, it may or may not be controllable, depending on the initial financial arrangement (Bean 1996). In the long run, all costs become variable costs, including capital costs, partly because all the equipment and buildings eventually require replacement. Although there is no universally applicable and accepted rule to classify capital (non-recurrent) and recurrent expenditure, in general, it is accepted that if the replacement of equipment is necessary within a year, it can be classified as recurrent costs (Green 1999).

Cost classification in economics evaluation of health and social programmes / technologies

Traditionally costs in economic evaluation were classified as direct, indirect and intangible costs. Direct costs were subdivided into direct medical and direct non-medical costs (Luce 1990, Earl-Slater 1999). Several recent publications and textbooks are still using this classification system (Elliott 2005, Santerre 2004). However, due to the “growing confusion” of the interpretation of indirect and intangible costs, a new classification of costs in economic evaluations were suggested by several authors. Johnston (2001) and Petitti (2000) suggested the following classification:

- Health service costs (costs paid by the purchaser)
- Non-health service costs (incurred by other sector budget and/or patients/carer)
- Non-resource costs (transfer payments)

Likewise, Byford et al (2003) and Sefton (2002) suggested very similar classification in economic evaluation of social services:

- Programme costs (full costs of providing a particular service)
- Non-programme costs (including costs of uncovered services, and any resulting service effects such as savings)
- User (patient) and family costs (user fees/out-of-pocket expenditures, child care arrangement, travelling costs, and/or costs of informal care)
- Productivity costs (loss of income due to impaired health state/disability)

Health service costs

Health service costs include direct (medical) costs of all services utilised by the patients, general illness costs and future costs.

Direct medical costs include the costs of the intervention and the costs of the treatment of side-effects. They also include overheads, capital costs and equipment, for example, hospital costs, costs of pharmaceuticals, medical devices, etc. This definition broadens the scope of the costing exercise to include all the resources utilised for the delivery of a particular service (Johnston 2001).

Table 20 Type of costs used in economic evaluation by Johnston 2001

Health service costs (formerly called direct health service costs)		
	Direct health service costs of the intervention including medical and non-medical resource costs (e.g. medical visits, hospitalization, drug, diagnostic services, patient transport, etc.)	
	General illness costs (cost of treating other illnesses both unrelated and related to the intervention in question, all co-morbidities)	
	Clinical trial costs	
	Future medical (health service) costs	
Non-health service costs		
	Out-of-pocket expenditures, including patients travel costs	
	Costs incurred by other public sector budget (e.g. social care)	
	Informal care (e.g. the value of time of informal caregivers)	
	Patient time costs incurred receiving treatment (e.g. wages lost)	
	Productivity costs	
	Future non-health service costs (e.g. social service costs)	
Non-resource costs		
	Transfer payments	

Induced costs

There could be several sub-categories of health service costs. For instance, Petitti (2000) differentiate between “traditional” direct health service costs and induced health service costs. All the additional resource use attributable to the intervention in questions is categorised as induced costs, but they are an essential part of health service costs. For instance, the cost of the treatment of side effects of the new intervention is an induced cost.

General illness costs

General illness costs are the costs of being treated for another disorder or condition on top of being treated for the intervention in question. General illness costs encompass costs of treating existing conditions (e.g. co-morbidities) instead of future possible diseases. (Johnston 2001)

There is a question regarding whether or not to include the extra costs generated by special regulation (e.g. services provided exclusively on an experimental basis or in research).

Future health service costs

Future health service costs are the additional costs of treatment for diseases occurring in the future either during natural life expectancy or during years gained by the initial interventions. Guidelines usually differentiate between costs related to and unrelated to the initial interventions. Future costs of illness in years gained by the initial intervention usually occur in the case of prevention programmes. Economic evaluations frequently

include all the consequences of prevention programmes; therefore, it could be argued that future illness costs should be included. There is no consensus in the literature, however, as to which type of costs should be included. Several guidelines argue that the impact of future costs should be estimated through sensitivity analysis instead of including them in the base case (Johnston 2001).

Non health service costs

Non-health-service costs include the cost of social care and or other public sector budgets as well as informal care. In addition, travelling costs, other out-of-pocket expenditures, patient time costs and productivity costs as well as future costs are also classified as non-healthcare costs (Johnston 2001).

Although including non-health service costs in an economic evaluation could prevent cost shifting or make it visible, current methodological guidelines may differ substantially. Formerly published studies used different methodologies to include non-health service costs in the evaluation (Johnston 2001).

Productivity costs

Productivity costs can be the product of three elements: (a) productivity loss due to time associated with treatment, (b) productivity loss due to time spent on sick leave (morbidity productivity costs) and (c) productivity loss incurred by premature death (mortality productivity costs). There are several methodological debates about productivity costs including debate about inclusion, measurement and/or valuation. Significant disagreement exists around productivity costs. For instance, some authors argue that productivity costs are mainly or partly captured by comprehensive health outcome measurement (e.g. QALYs), and therefore, should not be included in the costs (numerator in the cost effectiveness analysis) to avoid double counting. On the other hand, omission of productivity costs could have a significant impact on the results especially in the case of medical conditions which lead to severe disability in young adult life or childhood without significantly shortening life-expectancy (Johnston 2001, Luce 1996, Petitti 2000).

Non-resource costs

Non-resource costs may encompass two major resource subcategories: (a) transfer costs and (b) transaction costs. For instance, a means-tested sick leave involves (a) sick leave and (b) the administrative costs of running the sick leave programme. The study perspective could determine which part of the non-resource costs should be included in the analysis (Luce 1996).

Studies conducted from societal perspectives

Non-resource cost involves social transfers, which are the redistribution of resources (money) between two or more groups of society (Johnston 2001). Because income transfers are not real costs to society, they should be included in the cost of health services in economic evaluations applying societal perspectives. For instance, social security payments and/or sick leave are social transfers, but they do not change the aggregate value of resources available for welfare generating activities to the society. However, the inclusion of transaction costs (administrative costs) of social transfers can be justified theoretically regardless

of the fact that the total value of the transaction costs may or may not have any impact on the results (Luce 1996).

Studies conducted from purchaser or provider perspectives

On the other hand, studies conducted from purchaser or provider perspectives should include transfer costs if they represent lost resources (or extra resources). For instance, in the case of a social security fund, which is responsible for health care, sick leave and disability pension, some of the social transfers represent real resource use. Furthermore, the administrative costs of the social security programme should also be included in the calculation (Luce 1996).

FREQUENTLY USED MISLEADING TERMS

Intangible costs	Intangible cost is an umbrella term describing costs which are difficult to measure. However, the literature uses this term in several different ways with meanings including impairment in health state (difficult to measure) or savings and losses difficult to tackle (Earl-Slater 1999, Elliott 2005, Heaney 2002). Due to the diffuse meaning and the threat of double counting, this review will not use this term (Heaney 2002).
True cost	True cost implies that there is one, valid single value which can be assigned to a particular resource. However, the cost of a particular resource depends on the specific decision context and several other factors. Therefore, the use of this term should be avoided (Hankins 2004).

Costing terms

What is costing?		Costing is the process of estimating the monetary value of inputs, which are necessary to deliver a particular service (product). The total cost of services is determined by (a) the resource consumed and (b) the unit costs of resources. Costing therefore involves (a) measuring the quantity of inputs (resources) which are needed to deliver particular services in natural units, and (b) the valuation of inputs in monetary terms. It can be retrospective or prospective. Methodological guidelines recommend the measurement of these two elements (a and b) separately (Green 1999, Abedian 1998, Johnston 2001).
Standard costing		Standard costing is a technique which estimates the costs of a service or product in advance, and then compares the actual costs with the estimated (predetermined) costs. The estimated or predetermined cost is called a standard cost (Lucey 2002).
Target costing		A product cost estimate is derived by the subtraction of the target profit margin from the competitive market selling price. The result is the long term target cost of the product or service. Target costing can have a significant impact on (early stage) product development and service design (Lucey 2002).
Departmental costing		The departmental costing approach tries to calculate the unit cost of a particular service by calculating the total departmental costs, and later share out the total departmental costs between different services. The costs assigned to one unit of service or one patient will depend on the number of patient treated or services provided (Finkler 1994).
Product costing	line	The product line costing method focuses on the costs of one type of service or the costs of treating (serving) one patient.
Capital costing		Costing of resource items of which lifetime is longer than one financial year is referred to as capital costing (Abedian 1998).
Reduced costing	list	Reduced list costing is a pragmatic approach, which carefully select the most important cost drivers (resource items), which have considerable impact on the result of the cost analysis or economic evaluation, and it limits the cost calculation on these carefully selected cost components (Byford 2003).
Gross costing and micro-costing		Gross costing (top-down costing) and micro-costing (bottom-up costing) are not mutually exclusive methods, but can be seen as two ends of the “costing spectrum”. They can be used jointly in the same study. Gross costing can be

cheaper and faster, but less accurate, because it expresses the average cost of all encounters that share the same characteristics (Smith 2003, Raftery 2000)

Selecting from micro-costing and gross costing depends on (a) the decision problem, (b) the objectives of the study, (c) the level of accuracy required, (d) data availability, (e) the resources available for the study, and (f) the timeframe (deadline) of the analysis. Micro-costing can be very accurate, but costly and time-consuming. It can also be context specific (transferability is limited). However, several studies use both methods; using micro-costing to assess the direct costs of the services and gross-costing to estimate the indirect costs. Furthermore, gross costing can be used to estimate those cost items which are only responsible for a small proportion of the total costs (Beecham 1995, Raftery 2000, Smith 2003).

Gross cost method Gross costing (or top-down costing) methods allocate the total budget (expenditures) of a particular department of a hospital to a particular service using predetermined allocation rules such as those suggested by the NHS Costing Manual 2005. The top-down approach may be less accurate, but cheaper and quicker than the micro-costing approach. This method is also called an average costing approach, as well as departmental costing (Orlewska 2003, Finkler 1994, Phibbs 2003).

“Average costing” method

Average costing is a synonym for gross costing. “Average costing” as a technical term was introduced by Health Economics Resource Centre (HERC) staff, because they felt that gross costing is a misleading term (Smith 2003, and http://www.herc.research.med.va.gov/ACM_summary.htm)

However, in accounting, the same term is used slightly differently: The average cost method is “an inventory cost method that assumes the cost of inventory is based on the average cost of all goods available for sale.” In other words, “average cost method is an inventory costing method that uses the weighted average unit cost to allocate the cost of goods available for sale to ending inventory and cost of goods sold”. (<http://www.accd.edu/sac/slac/ppointshows/acct/glossary/a.htm>) Therefore, this review will not use this technical term as synonym for gross costing.

Micro-costing Micro-costing (also known as the bottom-up approach or activity based costing) refers to the detailed bottom-up measurement of resource utilisation, similar to time and motion studies (Orlewska 2003, Phibbs 2003). It can be seen as a “gold standard” for costing, which encompasses three different approaches: (a) direct cost measurement, (b) preparation of pseudo-bills, and (c) estimation of a cost function (Smith 2003, Raftery 2000).

Direct measurement method

Direct measurement is used by HERC (Veteran Administration, USA) to determine the cost of new services. All the inputs (activities) are directly measured in detail to develop an accurate cost estimate. Resource utilization is measured by a variety of different ways using patient records, surveys, direct observation, etc. Finally, the unit cost of a particular service is calculated (Smith 2003).

Pseudo bill method

The pseudo-bill method measures resource utilisation and attaches monetary value to the cost elements by combining the provider's own utilization measurement with "external" unit costs (determined by a non-VA organization such as Medicare, or health providers) to assess the cost of a particular service. Due to the similarities to the fee-for service hospital bills, this method is called the pseudo-bill method. It is frequently used for costing services for a special patient group or subgroup for which gross costing results are not available. It is used for costing in kind services in countries where these services are free at the point of utilisation (Smith 2003).

Cost function method

The cost function method requires detailed cost and utilization data for a particular service to simulate the cost of a comparable service provided by the host organisation. Usually resource use data and costs are adjusted to the local practice. It may require less data than the pseudo-bill method.

Cost analysis

Management science, cost and management accounting usually focusing on the relationship between profit (revenues) and expenditures (costs). Therefore, cost measurement concentrate on the relationship between (a) resources used and procedures (activities), as well as (b) resources used and outcome (e.g. services provided or product produced). These types of analysis are called cost analysis (Yates 1996).

Cost techniques

Marginal costing

Marginal costing methodology is used to calculate the cost of one additional unit of service. The marginal cost of a product or service is a variable cost in the relevant range. In a given range of volume of services the fixed costs are constant, therefore the marginal costs are equal to the variable costs (=direct labour + direct material + direct expense + variable overheads). Therefore, marginal costing requires splitting the total costs into fixed and variable

components (Lucey 2002). “Relevant costing” is used sometimes as a synonym for “marginal cost analysis”, but this review will not use the term “relevant costing” (Finkler 2001b).

Marginal costing is useful for the short term (tactical decisions) such as accepting a special order (special order or marginal cost pricing), dropping a product or service, and/or making “make or buy” decisions, because the fixed costs remain unchanged. On the other hand, in the long term and/or when fixed costs are expected to change, the differential costing method should be used (Lucey 2002, Millchamp 1997).

Differential costing Differential costing has a broader focus compared to marginal costing. Differential costing assesses all the differences in revenues and costs between relevant alternatives and informs decision makers about the best possible option. Differential cost is calculated for make-or-buy decisions, keep-or-discontinue decisions, and special price decision making (Young 2003).

Absorption costing Absorption costing is the basis of all financial accounting systems. It means that all costs are absorbed (allocated or shared out) into production and operation statements do not distinguish between fixed and variable costs. In other words, both fixed and variable costs are included in the cost calculation. Conversely, fixed costs are not absorbed into production when marginal costing is used. Marginal and absorption costing could yield different profit (surplus) figures because they differ in stock valuation (Lucey 2002, Zimmerman 2003).

Because in absorption costing the cost objects are usually the final products (services or jobs), the absorption cost system is widely used to value the costs of products manufactured or services and jobs delivered in manufacturing firms as well as in service sectors, including health care. Although there is no substantial difference in the absorption costing used in service and non-service industries, defining a product (service or job) could be difficult in the service industry (Zimmerman 2003).

There are two major (basic) types of absorption costing: (a) job order costing and (b) process costing. Job order costing estimates the average unit cost for each job delivered. Process costing assesses the average unit cost for each service provided in a given time period. It is important to keep in mind that absorption costing allocates historical costs, and therefore the unit costs estimated by this system may or may not be reasonably good estimates of opportunity costs (Zimmerman 2003).

Absorption costing and unit costs accuracy

The absorption costing system can produce inaccurate unit cost estimates partly due to the biases embodied in the overhead allocation methods applied. If the overhead allocation method does not represent the cause-and-effect relationship between the final product (service or job) and the overheads, the unit cost estimates could be more or less inaccurate especially in multi-product plants such as a

hospital. Activity based costing was introduced to improve the accuracy of unit cost estimates, but it has its limitations (Zimmerman 2003).

Marginal costing versus absorption costing

Although SSAP 9 required that absorption costing should be the basis of financial accounting, planning and decision-making are usually based on marginal costing. Both techniques (marginal and absorption costing) have their advantages, and accountants should select those, which are best suited to the organisation (Lucey 2002). The advantages of using marginal costing versus absorption costing in routine cost accounting are shown in the following table:

Table 21: Comparative advantages of marginal and absorption costing (Lucey 2002)

Advantages of marginal costing	Advantages of absorption costing
Simple to operate	Fixed costs, which could be a large proportion of the total costs, are taken into account.
No arbitrary overhead cost apportionment	Where stock building is necessary, absorption costing can be more suitable
Regardless of whether production fluctuates, it shows a constant net profit	Regardless of whether sales fluctuate, it shows less net profit fluctuation compared to marginal costing
Under- or over-absorption of overheads is mainly avoided.	May allow better pricing practice, because fixed costs are taken into account.
Fixed costs are handled differently	More suitable for financial accounting.
Accounts show actual cash flow more closely	

Standard costing Standard cost can be seen as one form of planned unit cost and usually used for cost control. Standard costs can be used as benchmarks or part of the performance measurement / incentive system (Bean 1996).

Variable costing The real difference between absorption costing (see above) and variable costing is the treatment of fixed overheads (or fixed manufacturing overheads). While absorption costing treats fixed overheads as product costs, variable costing treats it as period costs. One of the advantages of variable costing is that it is easier to understand. For instance, sales and net income usually move in the same direction. On the other hand, variable costing underestimates the unit cost of the product (full production cost is lower, because fixed overheads are treated as period costs). Because many organisation use production costs for pricing, variable costing could lead to unrealistically low prices (Young 2003).

Absorption costing
versus variable
costing

According to GAAP, absorption costing should be used to value inventories for financial statements as well as for tax purposes. However, management frequently use variable costing for internal use. Furthermore, most health care providers do not have inventories, and therefore they may not need to choose between absorption and variable costing. However, the medical supply, medical equipment and pharmaceutical industries, as well as pharmacies, do have inventories. Therefore, they should consider selecting from variable and total absorption costing methods (Young 2003).

Cost accounting terms

Cost object	Cost object is the unit of good or service for which accountants would like to estimate the costs. Cost object could be a hospital day, or a patient episode, or a diagnostic test (Young 2003).
Cost Centre	Cost centres are well-defined services, products (departments or service units) for which costs are accumulated (Lucey 2002). Organisations having multi-cost-centre structure usually differentiate between mission centres and service centres (Young 2003, Finkler 2001). Some textbooks and publications use the technical terms “cost centres” and “revenue centres” as synonyms (Dyson 2001).
Production cost centres or mission centres	Production cost centres (departments or smaller organisational units) are directly involved in the production process or service delivery process. These centres are also called mission centres. In health care, mission centres are also referred as revenue centres, because these departments charge costumers (patients or third party payer) for the services provided (Finkler 2001b, Young 2003).
Service cost centres or support centres	<p>Service cost centres in accounting mean those cost centres which provide a service to the production cost centres (mission or revenue centres). For instance, maintenance, clinical audit department, and medical personnel departments are support centres or service cost centres (Dyson 2001, Finkler 2001b, Lucey 2002). This term should be differentiated from the term cost centre of a particular service frequently called final cost object (or cost units or cost objects).</p> <p>Primary apportionment is used to calculate the costs of the service cost centres, and secondary apportionment is used to allocate these costs to cost units (cost objects). All costs allocated to the service costs centres should be shared out among the other cost centres, including other service centres and mission centres. Ideally the apportion base should be one that ensures a fair (equitable) allocation of service costs over departments which use the services. In practice, the choice of apportionment base also depends on the type of services, the purpose of costing and the economical feasibility (Dyson 2001, Lucey 2002). Several secondary apportionment techniques has been used to share out the costs of service cost centres, including direct allocation, step-down allocation, step-down allocation with iteration and simultaneous allocation (Drummond 2005).</p>
Cost allocation	Cost allocation is used differently in the cost accounting literature. Lucey (2002) argued that cost allocation could be used for assigning both direct and indirect costs if the whole item of costs can be assigned to one cost centre. On

the contrary, Horngren et al (2003) used the term slightly differently and argued that while direct cost can be traced to the cost objects, indirect costs should be allocated. In addition, Young (2003) argue that cost allocation means only allocating costs from support centres to mission centres.

Cost distribution
versus allocation

On the other hand, cost distribution can be defined as a procedure to place costs into both mission and support centres, whereas cost allocation is the process to place costs from support centres to mission centres. However, cost assignment, cost apportionment, and cost distribution are frequently used as synonyms for cost allocation (Zimmerman 2003, Young 2003).

Cost allocation requires the following steps (Zimmerman 2003):

1. selection and description of cost objects (e.g. a particular service)
2. identification and accumulation of overheads to be assigned to the cost object
3. Choosing a method and allocation base for overhead allocation.

Cost
apportionment

If the whole cost item cannot be allocated to one cost centre, costs have to be shared between several costs centres. The method used to divide or share costs between cost centres is called cost apportionment. The basis upon which the apportionment is made depends on the type of costs and sometimes on the nature of the decision problem (Lucey 2002).

Overhead
absorption or
overhead recovery

Overhead absorption is the term for how overheads are shared out (or included) in the total cost. Overhead absorption could be very challenging for an organisation providing several very different services, or for firms producing a variety of different products. The overhead absorption rate is equal to the total overheads of the cost centre divided by the number of units of absorption base applicable to the cost centre (Lucey 2002).

Absorption costing
and full absorption
costing

The process by which overheads are absorbed into product or service costs is known as absorption costing. If only production overheads are absorbed to products or services, the process is called absorption costing. If all the overheads, including non-production overheads, are absorbed into product or service costs, the process is called full or total absorption costing (Dyson 2001).

Full absorption
costing versus
variable or
marginal costing

The process by which total overheads are absorbed into production or service delivery is known as (full) absorption costing. Full absorption costing or the absorption costing method is used to cost products or services for inventory valuation, and to cost goods and services. It is called full absorption costing because it fully “absorbs” all manufacturing overheads (including fixed and variable overheads). Conversely, variable costing or marginal costing addresses only the incremental or marginal cost of the next unit of services provided or goods produced. In marginal costing the same absorption principles and

techniques are used, but costing excludes fixed costs from the absorption. Variable costing is used in break-even analysis and production volume optimization (Lucey 2002).

Capturing costs	It is important to ensure that all the “relevant” or “correct” costs, in their respective proportions, are taken into account during the costing exercise. Cost accumulation is the collection of costs in an organised (systemic) way with the help of an accounting information system. Cost assignment is a general term that covers both cost tracing and cost allocation to a cost object. Cost allocation may require the appropriate apportionment of joint costs (e.g. overheads) between several cost objects. Cost object is a health technology (medical device, drug, service, etc.) for which a measurement of costs is desired. The total cost of a particular service can be established by capturing all of the relevant costs (Bean 1996, Horngren 2003).
Under-costing	A service (or product) under-costing occurs when a service (or product) consumes a high level of resources, but according to the cost system, its resource utilisation is low. It may lead to cross-subsidisation. One of the reasons for under-costing could be an unfair allocation of indirect costs. The solution could be (a) the refinement of a cost system, which may require additional direct cost tracing, (b) the development and usage of more homogenous indirect cost pools, and (c) changes in the cost allocation base (Horngren 2003).
Over-costing	A service (or product) under-costing occurs when a service (or product) consumes a low level of resources, but according to the cost system, its resource utilisation is high. It may lead to cross-subsidisation. One of the reasons for under-costing could be an unfair allocation of indirect costs. The solution could be the refinement of the cost system (Horngren 2003)
Activity based costing (ABC)	Activity based costing is a “new” approach to costing services and/or products compared to the traditional approaches. Traditional approaches frequently use flat rate (broad average) or output as a basis for overhead allocation and uniformly assign (spread out) the overhead costs to services and products. In practice, overheads are allocated to the service (hospital or outpatient) departments using a single allocation base. No attempt has been made to find specific cost drivers to refine overhead allocation. As a result, high volume services absorb most of the overheads, but in reality, they may or may not use most of the overheads. The consequence of this can be under-costing or over-costing. In other words, traditional approaches could over-cost or under-cost services, because overhead costs could vary with complexity of service delivery (or production) and not with volume of services or products. The risk of over- or under-absorption is higher for organisation where the non-production overheads are an increasing proportion of the total costs (Hankins 2004, Lucey 2002).

ABC tries to overcome this shortfall of traditional approaches by using (a) more homogenous indirect cost pools, and (b) cost drivers instead of volume or budget as cost-allocation bases to allocate overheads to products or services. ABC recognises that in the allocation of overhead costs there is a closer cause-and-effect relationship between activities and costs than product or service volume and costs. The basic assumption of ABC is that the delivery of (health) services requires a particular set of activities, but activities consume resources. Therefore, it puts more emphasis on the identification of cost generating activities. It helps not just in refining costing but also in reducing costs and identifying non-value-added activities (Lucey 2002, Ridderstolpe 2002).

Both the traditional approach and ABC allocate direct costs and some overheads in the same way. The real difference is in the allocation of overheads by using cost drivers (e.g. activities that cause the cost). Therefore, the ABC system is likely to yield benefits when indirect costs are a high proportion of the total costs of services (or products). However, the ABC system could be more resource-intensive than traditional systems (Horngren 2003).

The accuracy of ABC depends on the assumption that costs in each cost pool are proportional to an activity driver that links costs with the cost object (e.g. health service, treatment, etc.). Furthermore, effective cost allocation requires overhead costs to be separated into homogenous cost pools that are identified with specific resources (West 1996).

Short term and long term variable costs in ABC

Some experts argue that overhead allocation in ABC can further refined by the introduction of short-term and long term variable costs. Short term variable costs are similar to traditional variable costs, but long term variable costs are those which do not vary with production volume but vary with other measures of activity such as support activities, set-ups, etc. Experts consider most support overheads to belong to this latter category (long term variable costs) (Lucey 2002).

Cost pools

Cost pools are used in ABC. Ideally, cost pools are homogenous and have a single cost driver, which relates directly to the amount of overhead resource use (Lucey 2002).

Cost pools are very similar to cost centres, but cost pools may or may not reflect traditional departmental boundaries. For instance, if the cost driver is a chest x-ray, all costs relating to this activity will be pooled (collected) into one cost pool. As a result, one cost pool may not include all the activities of a particular department, but could encompass some activities from several departments. Furthermore, the number of cost pools could be far more than the number of departments, due to the fact that one department delivers several activities (Lucey 2002).

Integrated versus interlocking cost accounts	An integrated cost account is a single comprehensive accounting system with no distinction between cost accounts and financial accounts. Conversely, the interlocking cost account encompasses two separate accounts, a financial and a cost account. The latter makes periodic reconciliation necessary. Whatever system is used, proper double entry standards are maintained in the accounting systems. (Lucey 2002)
Revenue expenditures and capital expenditures	Health care providers could have at least two types of expenditure: (a) revenue expenditure (recurrent costs) and capital expenditure (capital costs or non-recurrent costs). Revenue expenditures or recurrent costs occur more than once during a given financial year, while capital expenditures are the costs of acquiring fixed assets which occur less frequently. For instance, the acquisition of a fixed asset can give economic benefit to the provider for more than one accounting year. On the other hand, acquisition of items of very small value, irrespective of their life-span, are not classified as fixed assets (for instance a stethoscope, a tourniquet, scissors, etc) (Millichamp 1997).
Revenue cost	Revenue cost can be defined as expenditure charges to the profit and loss account as incurred (Millichamp 1997).

Pricing

Costs and prices are different economic concepts. Costs are determined by the inputs/resources used and the value of resources used (or prices of inputs). On the other hand, prices are often determined by demand (number of potential costumers) and their willingness to pay. In the real world, however, prices are determined not just by the market situation, but the characteristics of the product, the short and long-term objectives of the firm (provider). Consequently, the pricing policies of health care providers vary considerably. Reliable information about unit costs, however, is essential to determine the lowest acceptable price (fees/charges) both in the short and long term. Consequently, unit cost calculation is an integral part of pricing policy development, as well as the planning process (Glautier 2001, Beddow 2001, List 2002).

Perfectly competitive markets tend towards technically efficient level of output, because the possibility of extra profit creates an incentive for other forms to enter the market. The equilibrium price is reached through adjustments in both price and demand. Health care and health insurance market, however, have special characteristics, such as for-profit firms have a limited role in publicly funded health care systems in Europe; the market can be monopolistic or oligopolistic; and prices are frequently regulated and (cross)subsidised, as well as reimbursed. In addition, sometimes the real demand for, and/or supply of, a particular service is uncertain, difficult to estimate, or could change substantially (Beddow 2001, List 2002, Goddard 1995, House 1981).

Although classical economic theories hold that the price, which maximise the profit, is the optimal price for a profit maximising firm, classical economic theories have limitations in health care, in part because they assume that the volume of sales is predominantly determined by the price, and there are not any significant information asymmetry. Despite the aforementioned limitations, economic theories have contributed considerably to the currently applied price policies (Glautier 2001).

COST-BASED PRICING

Charging the fair price (accurate full costs plus profit) may put the health care provider out of the market, but without fair pricing providers cannot see whether a particular service is viable under the current conditions. Furthermore, without accurate costing the management cannot control the costs of health service provision. Moreover, it is important to include all the relevant costs in the cost calculation, because in the long run none of the services is sustainable without adequately covering all the costs, including overheads (depreciation, genera administration, etc.) (Zimmerman 2003).

Although marginal analysis is the theoretical basis for pricing in economics, it is difficult to apply in the real world, partly due to imperfect information. As a result, several organisations apply some sort of cost-based pricing policy. Cost based pricing theories are focusing on two elements of price: (a) the relevant costs and (b) the profit margin. The most common cost-based pricing policies are the following (Glautier 2001):

- Full cost plus pricing
- Rate-of-return pricing
- Marginal cost plus pricing

Full cost plus pricing

Full cost plus pricing is based on full absorption costing. The objective of a cost exercise is the calculation of the total costs of a particular product or service. After that, a profit mark up is added to the total costs to arrive at a (ex-manufacturing) selling price. The profit mark up can vary with products or services (Glautimer 2001, Lucey 2002, Vance 2003).

Although the “fair profit rate” is debated in the literature, there is a relationship between profit rate (mark-up percentage) and the rate of return, which is determined partly by the price elasticity of demand and partly by the short and long term strategy of the firm (health care provider) (Glautimer 2001).

Cost plus pricing was used by one third of the American providers in the early 1980s (Ellwood 1996).

Advantages and disadvantages

This method is widely used, partly because it is a straightforward method, it can be delegated, and it is easy to monitor (audit) (Glautimer 2001, Lucey 2002, Vance 2003).

One of the disadvantages of this method is that it does not take demand into account, and may assume that prices are simply the function of costs. Furthermore, it may not lead to profit maximisation, in part because price is selected according the estimated sustainable volume of services or goods. Moreover, the price calculation may depend on (a) the fairness of overheads apportionment and (b) precision of the estimated sustainable volume of services. Providers should achieve the same volume of sales as the volume was used for the price calculation to be able to recover all the costs and ensure that the target profit will be achieved. In addition, full cost plus pricing is based on a long-term time horizon, while several decisions in health care apply short-term timeframe and have to cope with relatively rapid changes in the healthcare market (e.g. technological changes) (Ellwood 1996, Glautimer 2001, Lucey 2002, Vance 2003).

Rate of return pricing This is a variant of full cost plus pricing, where the minimum price is calculated by using the minimum return on the capital employed figures. The advantages and disadvantages are similar to the full cost plus pricing. This method was used by NHS organisations in the early 1990s (Ellwood 1996, Lucey 2002).

Marginal cost plus pricing The calculation is similar to full cost plus pricing, but instead of adding a percentage to total costs, this method adds a percentage to the marginal costs. This method puts more emphasis on the real contribution to the total revenue by a particular product or service (Lucey 2002).

One of the advantages of this pricing method is that marginal costs are practically based on variable costs, therefore, analysts do not need to apportion fixed costs, which makes the costing exercise easier, faster and cheaper (Ellwood 1996).

On the other hand, all fixed costs should be covered, and profit should be generated to make a viable business case. Therefore, marginal cost plus pricing should be used carefully. For instance, health care providers with reserve capacities could use this method to generate extra revenues by targeting a special market segment (Lucey 2002).

MARKET CENTRED PRICING

Market-centred pricing Cost-centred pricing does not adjust the price calculation to market forces. Market centred pricing would like to address this issue. A market-centred price is the unique function of the relevant marketplace. Market prices are more dynamic, following the changing demand of the market (Vance 2003).

OTHER PRICE STRATEGIES

Opportunistic pricing Opportunistic pricing can occur when the price set by the company is below the target price. It may happen when the company would like to boost up sales. An opportunistic price is usually higher than variable costs, but the profit margin could be different compared to the target price (Vance 2003).

Target pricing Target pricing is based on the opposite logic than the cost-based pricing. In this case, the target price is established by the provider (firm) using market research prior to designing and introducing a new service or product. Then the target costs (standard cost) will be calculated by deducting the desired profit margin. The price is usually set at a level that will ensure that the organisation

can achieve a target market share and sales volume. If the product or service cost is higher than the target price, the organisation tries to redesign the production or service delivery process in order to reduce costs. This type of costing is widely used by Japanese firm. Moreover, this pricing technique could fit well with the public purchaser's objective to reduce costs and improve value for money (Ellwood 1996, Glautimer 2001).

Financial and management accounting

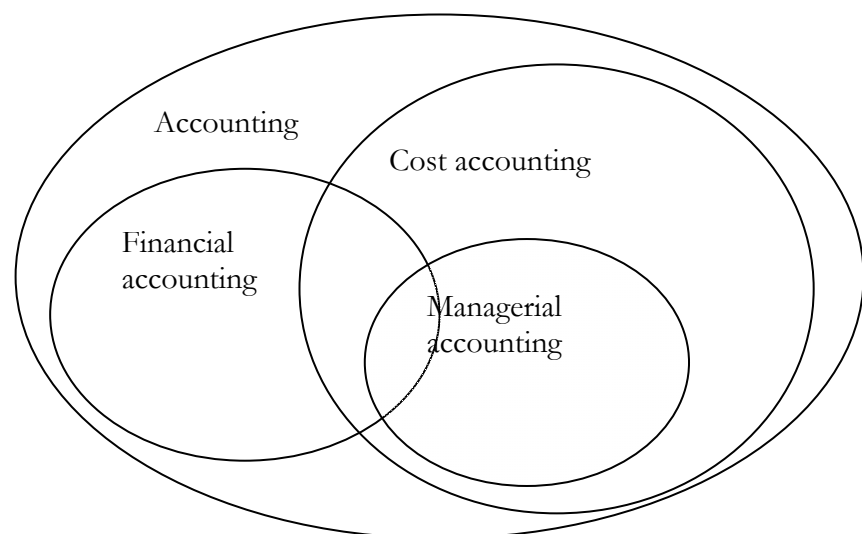
Accounting systems identify, measure, analyse and communicate economic information to decision makers. Accounting is usually subdivided into cost accounting, financial accounting and management accounting.

Financial accounting provides information for external clients / individuals / organizations such as banks, government agencies, or shareholders in the form of different type of financial statements. These reports usually have to comply with legal regulations and follow the generally accepted accounting principles (GAAP). Most of the time, it is a retrospective report (Baker 2004, Finkler 1994, Hankins 2004).

On the other hand, management accounting generates information to support decisions internally and help to manage and control the organization effectively. In addition, management accounting facilitates (strategic) planning and performance management, and has a crucial role in pricing services. As a result, management accounting reports can be prospective and retrospective. Because managerial accounting reports are intended for internal use, they are not governed by GAAP (Baker 2004, Finkler 1994, Hankins 2004).

Cost accounting could provide useful information for both financial and management accounting. At the same time, cost accounting could be essential for cost control, costing/pricing decisions, and strategic planning, as well as profitability analysis, because its main objective is to measure the resource consumption associated with the delivery of each service as accurately as possible. The following graph illustrates the relationship between different accounting systems (Finkler 1994, Hankins 2004).

Figure 3: The relationship between different accounting systems (Finkler 1994)



Potentially relevant articles not included into the review

(e.g. full text article was not available at the time of data extraction)

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