An Improved Set of Standards for Finding Cost for Cost-Effectiveness Analysis

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Background: Guidelines have helped standardize methods of cost-effectiveness analysis, allowing different interventions to be compared and enhancing the generalizability of study findings. There is agreement that all relevant services be valued from the societal perspective using a long-term time horizon and that more exact methods be used to cost services most affected by the study intervention. Guidelines are not specific enough with respect to costing methods, however.

Method: The literature was reviewed to identify the problems associated with the 4 principal methods of cost determination.

Findings: Microcosting requires direct measurement and is ordinarily reserved to cost novel interventions. Analysts should include nonwage labor cost, person-level and institutional overhead, and the cost of development, set-up activities, supplies, space, and screening. Activity-based cost systems have promise of finding accurate costs of all services provided, but are not widely adopted. Quality must be evaluated and the generalizability of cost estimates to other settings must be considered. Administrative cost estimates, chiefly cost-adjusted charges, are widely used, but the analyst must consider items excluded from the available system. Gross costing methods determine quantity of services used and employ a unit cost. If the intervention will affect the characteristics of a service, the method should not assume that the service is homogeneous.

Conclusions: Questions are posed for future reviews of the quality of costing methods. The analyst must avoid inappropriate assumptions, especially those that bias the analysis by exclusion of costs that are affected by the intervention under study.

Key Words: cost-benefit analysis, costs and cost analysis/methods, hospital costs, hospital charges, research design

Cost-effectiveness analysis (CEA) is an economic method used to determine if health care interventions yield sufficient improvement in health to justify their cost. CEA has the promise of improving health outcomes within the constraints of available funding. An important barrier to greater use of CEA is decision makers’ lack of confidence in its methods. Standardized methods of CEA have been developed to address this concern.

At least 21 different guidelines for conducting CEA have been developed by government panels, specialty organizations, and others. Among the most widely cited works are guidelines from a group from the United Kingdom and Canada and a panel organized by the United States Public Health Service.

The US panel described a “reference case,” a standard method that should be used so that different studies are comparable. Standardization allows the cost-effectiveness ratios of different interventions to be compared without concern that differences are methodological artifacts. Standardization also enhances the generalizability of study findings, allowing them to be applied to new settings.

These various guidelines largely agree on the principles to be used to determine costs. They recommend that all relevant costs be included and that more exact methods be used to determine the cost of services most affected by the intervention under study. CEA should examine the incremental change in cost caused by the intervention, known as its marginal cost.

Resources are to be valued at their opportunity cost, sometimes called the economic cost. The opportunity cost is the value of the resources applied to their next best use (ie, the potential benefit from taking the opportunity to use the resource in another way). Opportunity cost may differ from price or reimbursement; health care markets function imperfectly, and these may not reflect the opportunity cost. CEA guidelines also state that cost should be estimated from the societal perspective.

Cost and benefits are to be measured over a long-term time horizon, usually interpreted as the patient’s remaining lifetime. There is controversy over whether to include the cost of treatment of unrelated diseases when an intervention prolongs survival.

Adopting the long-term time horizon affects the definition of marginal cost. Some costs are regarded as fixed over the short-term. Examples are building construction, equipment purchases, or intermediate-term commitments such as provider staffing. In the long-run, these allocations can be adjusted to the optimal level. Long-run marginal cost includes these costs.
Some analysts feel that the existing guidelines are not specific enough with respect to costing methods. Alternative costing methods, each within CEA guidelines, have been compared. In some cases, results were sensitive to the choice of method.

At least 54 different systematic reviews of economic evaluations of health care have been conducted. Some found modest improvements in the quality of economic analyses since the promulgation of guidelines. These reviews found a number of problems with cost-determination methods.

Many studies did not identify the cost of the intervention being evaluated or failed to provide disaggregated cost information. Others did not describe the source of cost data or provided too little information to judge its quality. Some studies failed to include relevant costs. Most studies excluded overhead cost. Many studies that included overhead distributed it improperly or failed to describe how it was distributed. Many US studies relied on local fee schedules, without considering how these differed from opportunity cost. Few studies included the start-up cost involved in implementing a new intervention. Most studies had failed to report cost over the long-term.

Most reviews adopted a very low threshold for acceptability of costing methods. They employed only 1 or 2 questions to evaluate cost-determination methods.

This article describes costing methods available to US researchers. Problems of each method are discussed. New questions to evaluate cost-determination methods are then proposed.

This article focuses on cost determination for CEA used in clinical trials and decision analytic models. Its intended audience is the economist who creates a CEA and the decision maker who wants to use one. Budget Impact Analysis is a method of finding the effect of an intervention on the budget of a payer or provider in the short-term. Although budget impact analysis is an important, perhaps essential, adjunct to CEA, it is beyond the scope of this article.

**OVERVIEW OF METHODS USED TO ESTIMATE HEALTH CARE COSTS**

The choice between cost-determination methods represents a trade-off between precision and expense. Table 1 lists the principal methods, starting with the most accurate but labor intensive method followed by those that compromise accuracy for ease of use. These methods include microcosting, activity-based cost allocation systems, administrative data (cost-adjusted charges or total reimbursement), and gross costing.

Each method has its limits and its appropriate use. Multiple methods are needed within a single study. Accurate methods are needed to assess services that the intervention is likely to affect. Simpler methods may be employed to avoid spending scarce resources on precise measurement of unimportant services. Each method involves assumptions. The analyst must review whether these assumptions are appropriate. An important additional concern for CEA studies is the wider applicability of study findings to other providers, health plans, or countries.

### TABLE 1. Overview of Costing Methods Available to US Researchers

<table>
<thead>
<tr>
<th>Method</th>
<th>Description of Method</th>
<th>Advantage</th>
<th>Disadvantage</th>
<th>Issues for Concern</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microcosting</td>
<td>Enumerate staff time, supplies, and items used to provide a specific service and estimate their cost.</td>
<td>Accurate, often needed to find a cost of a service intervention.</td>
<td>Method is labor intensive and not useful for finding overhead cost. It cannot be used to find total health care cost.</td>
<td>Need to include all costs: nonwage labor cost, person-level and institutional overhead, cost of development, set-up, screening, supplies, and space. Quality must be evaluated. Cost estimates may not be generalizable.</td>
</tr>
<tr>
<td>Activity-based cost allocation system.</td>
<td>Multistep cost allocation system. Assign cost of staff time, supplies, and equipment to production departments. Distribute overhead. Use relative values to find cost of specific products and assign cost to specific stays or encounters.</td>
<td>The best available estimate of economic costs of health services.</td>
<td>Used by relatively few hospitals, data may not be available to the researcher. Costing system unlikely to capture costs of a novel intervention tested in a research study.</td>
<td>Use of unadjusted charge. Exclusion of cost of physician services to inpatients. Exclusion of patient copayments and deductibles from reimbursement amount.</td>
</tr>
<tr>
<td>Cost-adjusted charges or total reimbursement.</td>
<td>Billed charges are adjusted by the ratio of cost-to-charges in a hospital cost report.</td>
<td>Charges routinely created for most of US health care. Hospital cost reports are available from Medicare.</td>
<td>Requires strong assumptions that charge is proportional to economic cost. Charges difficult to obtain for care received at other sites. Difficult to use to cost ambulatory care.</td>
<td></td>
</tr>
<tr>
<td>Gross costing</td>
<td>Quantities of different services are determined, and cost estimated using service specific unit cost.</td>
<td>Relative ease of implementation.</td>
<td>Strong assumptions about homogeneity of services.</td>
<td>Data on characteristics of service may be inadequate. Use of appropriate unit costs.</td>
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MICROCOSTING

Microcosting, the direct measurement of cost by observation and survey, is needed when administrative data are insufficient. It is needed to find the cost of a novel intervention. It may be required if administrative data are not sensitive to the effect of an intervention. Because microcosting is too labor intensive to use for all health care, its use must be limited to activities most likely to be affected by the intervention under study. The specific considerations in designing a microcosting method have been described previously and in the current supplement. Systematic reviews of economic studies have criticized microcost estimates for failing to include all relevant costs, such as direct costs, overhead, labor, and development cost. When microcost estimates are based on the labor costs and overhead of a particular facility or payer, the analyst will need to justify that they are typical of the health care system as a whole.

Inclusion of All Direct Costs

CEA guidelines recommend inclusion of all costs affected by the intervention under study. All intervention-related activities must be identified. Pretreatment screening should be included as a cost if it would be needed to replicate the intervention in clinical practice, for example, if patients were screened to exclude those who would be harmed by the intervention. The cost of screening that was exclusively for research should not be included.

Institutional Overhead

In the short-run, a small expansion in patient care services does not increase institutional overhead (eg, the cost of nonpatient care hospital departments such as human resources, finance, administration, and environmental services). Over the long-run (the perspective of CEA), the size of overhead departments can be adjusted; adoption of an intervention ultimately increases institutional overhead. For hospitals and other large institutions, it is not feasible to use microcosting to determine overhead. One approach is to apply the ratio of overhead to direct expense for a similar department in the hospital cost report.

Include All Time Spent in Providing the Intervention

Labor cost is often estimated by determining the number of minutes each worker spends in direct activities to provide the service. This effort is measured by direct observation, staff activity logs, supervisor report, or other methods. One important issue is how to allocate activities that have a joint purpose.

When a new provider is hired exclusively to provide an intervention, it is clear that the cost of the intervention includes the full cost of this new employee. Yet no provider spends their full time in direct contact with patients. An activity analysis would find the provider engaged in nonpatient care activities: training to maintain credentials, answering the phone, meeting with colleagues, taking vacation, and going on sick leave. For ease of exposition, these nonpatient care activities are referred to as person-level overhead.

An intervention might also be delivered by a provider who produces other products. For this provider, the person-level overhead activities are a joint cost of producing the intervention and other products. Some of this joint cost is attributable to the intervention. Failure to include the cost of person-level overhead implicitly assigns it to other products, violating the general principal of CEA guidelines to include all cost of the intervention. One method of distributing person-level overhead is in proportion to the time spent in direct delivery of each product.

Labor Costs Should Not Be Limited to Wages

The cost of labor should not be limited to wage costs. It should also include the employer’s share of taxes and benefits. Some studies have excluded these costs, which often exceed 25% of wages.

Development Cost

Adoption of the societal perspective and a long-term horizon requires inclusion of the development cost of all interventions, even if this cost is not repaid to the developer. Payer reimbursement for a pharmaceutical exceeds the short-term marginal cost of manufacture and distribution. In the long-run, the societal cost of a drug includes the cost of manufacture, distribution, innovation, and returns to investment.

Some analysts believe that development costs that are “sunk” (ie, they have been incurred and cannot be recovered) should be excluded from a cost-effectiveness analysis, but this is a controversial point of view. The more common view is that an evaluation that ignores development cost will be biased in favor of the intervention.

The cost of developing new behavioral or organizational interventions may be small relative to the number of potential beneficiaries. If the number of potential beneficiaries is large, the analyst may successfully argue that per patient development cost may be small enough to be ignored.

ACTIVITY-BASED COSTING

Activity-based costing (ABC) was developed in the manufacturing sector and more recently applied to health services. ABC is similar to microcosting, but uses automated data collection, handles overhead expenses, and includes all costs of the enterprise.

An ABC system is more complex than a traditional hospital cost report, identifying costs, services, and products at a much finer level of detail. Although evidence is slim, ABC cost estimates are regarded as more accurate than cost-adjusted charges (described later).

Departments are defined by aggregating similar activities. The cost of staff time, supplies, and equipment is determined for each department. The cost of nonpatient care departments is distributed to patient care departments using a statistical basis (sometimes called a cost-driver) that is appropriate to that service. For example, the percentage of total space may be the basis for distributing janitorial cost. The quantity of health care products is extracted from electronic databases, known as feeder systems. A schedule of relative values is used to give proportionate weights to reflect the different resources used to make different products. Depart-
ment costs are divided by the sum of relative value weights of all products made by the department. This cost per unit of relative value is used to find the unit cost of each product. Unit cost is multiplied by product quantities and product costs summed to find the cost of each stay and encounter.

An example of an ABC system is a proprietary cost allocation system called Decision Support System (also known by the former name of the vendor, Transition Systems International). This system has been implemented in the United States. Department of Veterans Affairs, the health care system that serves 5 million veterans of the US military services. Another example is the Ontario case costing system adopted by 12 hospitals and now being adopted more widely in Canada. ABC systems have also been adopted by the Kaiser health care system and a number of US university hospitals.

ABC cost estimates have been used in a number of studies of the cost of individual hospitals and in some multicenter studies. An important limitation is that ABC systems are used by no more than 5% of US hospitals. ABC estimates can be difficult to obtain, regarded as confidential information needed to negotiate reimbursement rates and contracts.

Several potential sources of errors in ABC estimates have been identified. If important intermediate products are under counted or excluded altogether, inappropriately high cost will be assigned to the products that are being tracked. Distribution of overhead may be flawed. The relative value of different products may be based on external data that have not been validated.

ABC cost estimates may be inappropriately influenced by short-term fluctuations in workload. Implementation of ABC systems is often idiosyncratic, and this surely affects the comparability of ABC data from different sites.

Given these concerns, the analyst must confirm that assigned cost is plausible, determining if they are consistent with alternate estimates. ABC systems can provide a source of unit cost that is superior to a fee schedule or reimbursement rate, but estimates that are based on a single facility may not be representative (a problem whenever unit costs are based on a small sample, as discussed later). The analyst will need to justify why ABC cost estimates are representative of the larger health care system.

**COST ESTIMATES BASED ON ADMINISTRATIVE DATA**

The United States is one of the few countries that assigns charges and reimbursements to characterize care. Although they may not be available for services provided by managed care organizations, they are widely used as a proxy for health care cost.

Cost-Adjusted Charges

Charges are cost adjusted by multiplying by a ratio of cost-to-charges. This ratio may be determined from data in publicly available cost reports that hospitals submit to Medicare. Over an entire hospital, the sum of cost-adjusted charges is equal to the sum of costs in the cost report.

Commentators widely agree that the raw charge should not be used as an estimate of the cost of care. Hospital charges can be twice the actual cost of care. Use of cost-adjusted charges makes the strong assumption that the charge for a specific service is proportionate to economic cost. This assumption may not always be warranted. Hospitals may set their charges without knowing the relative cost of different services. There are strategic reasons to overcharge for some services and undercharge for others.

Some analysts have found costing to be more accurate if cost adjustment is done at the department level. A ratio of cost-to-charges is found for each department in the hospital and applied to charges incurred in that department. Other analysts feel that this extra effort does not increase accuracy. Departments can be defined differently in claims and cost report data; use of department-level charge adjustment may not result in any greater accuracy.

**Physician Services to Inpatients**

Most US physicians who care for inpatients are not employed by the hospital. The charge for their services is not in the hospital bill and their cost is not in the hospital cost report. This cost is an additional 20% above the hospital cost.

It is difficult to identify physician bills associated with a particular stay. The US Medicare program reimburses hospitals using diagnosis-related groups (DRG), categories based on admitting diagnosis, and procedures performed during the stay. The mean Medicare payment for physician services associated with stays in each DRG has been estimated. These values can be used as the cost of physician services to inpatients under the assumption they are constant within each DRG. The recent revision of DRGs will render these studies obsolete.

**Out-of-System Services**

Concerns about patient privacy and the restrictions imposed by Federal law make it difficult to obtain charge data on care received outside of the system where the patient was enrolled. A signed release is usually required. The alternative is to base the estimate on a less precise method of gross costing, described later.

**Ambulatory Care**

Although charges for ambulatory care may be available, physicians do not file cost reports, and there is no source of a ratio of cost-to-charges. Reimbursement may be the only available way to estimate ambulatory cost. It should include any copayment made by the patient. Cost-adjusted charges is the cost incurred by the provider, while reimbursement is the cost incurred by the payer. It is not clear which best represents the societal perspective, or whether they differ by much in the long-run. In the absence of access to an administrative data system, it is rarely feasible to gather ambulatory care charges from providers and gross costing must be used.

**GROSS COSTING**

Gross costing is used when administrative data are not available. The quantity of each service is multiplied by an estimate of its unit cost. Service utilization is often obtained...
from the study participant. Gathering these data involves a trade-off between accuracy and expense. Accuracy can be improved by surveying patients more frequently and by employing logs and other memory aids.35

Inpatient Cost Estimates
Among the unit costs used to estimate the cost of hospital stays are the average daily rate, the specialty-specific daily rate, and the diagnosis-weighted rate.23 Use of an average daily rate makes the assumption that all days of hospitalization have the same cost. The specialty-specific daily rate relaxes this assumption by creating a different rate for different units of the hospital. The diagnosis-weighted rate reflects the effect of DRG on the daily rate. The Medicare DRG relative value weight is an index of cost relative to that of an average stay. In one study, this weight explained 40% of the variation in cost-adjusted charges, while length of stay explained less than 5% of the variation.36

Cost may be estimated as the hypothetical Medicare reimbursement. Medicare payment is not only based solely on DRG, but also includes payments for high cost outliers, capital expenses, graduate medical education, and disproportionate service to unsponsored patients. Patients can provide information on the length of stay, but are unlikely to provide sufficient information to assign a DRG. Patients may be able to provide information on whether the stay involved surgery or was in an intensive care unit. These additional measures of acuity provide information that can be used to determine costs in ways not accounted for by length of stay alone.

Standard Cost Estimates
A set of standard unit cost estimates have been offered as part of the guidelines used in the Netherlands and Australia.37 These unit costs have helped standardize estimates of health services costs in CEA studies of new pharmaceuticals. Such standard estimates have limitations. For example, a standard estimate for an ambulatory visit may include the cost of associated laboratory tests. This would ignore the incremental effect of an intervention that generates additional laboratory orders.

Cost of Ambulatory Care
Outpatient costs can be estimated by multiplying a count of visits by a unit cost. Cost varies by the types of care provided. The analyst can also calculate a hypothetical reimbursement.38 Since Medicare is the largest sponsor of US care, its reimbursement rules are often used. This requires care to be characterized by Current Procedure and Terminology codes, the billing codes used by physicians to identify their services. The complexity of the coding system and reimbursement rules must be respected. Multiple Current Procedure and Terminology codes are often needed to characterize care, but some codes are mutually exclusive. Different payment rates apply when care is provided in a facility (such as a hospital outpatient department or ambulatory surgery facility). When multiple procedures are provided during a single surgery, reimbursement is discounted.

It may be justifiable to characterize ambulatory care as a hospital clinic visit, ambulatory surgery, emergency room care, or a visit to a specialist or office-based primary care physician, and assign a unit cost for each of these types of care.

Outpatient Pharmacy Cost
The cost of prescription medications is rapidly growing, and now accounts for more than 10% of the US health care budget. Few researchers have access to prescription claims data. Estimates of pharmacy utilization are often based on patient self-report. A common source of unit cost is the pharmacy Red Book, an annual publication that provides the average wholesale price of drugs dispensed in the United States.39 Sponsors receive substantial discounts from this price, at least 15% for brand name drugs.40 Payments also reflect a dispensing fee.41 The full average wholesale price should not be used as the unit cost for pharmacy. An alternative source is the Federal Supply Schedule, but the payment rates may be too low for findings to be generalized beyond Federal providers.

Limitations of Gross Costing Approach
CEA findings based on a fee schedule or unit cost of a single provider may not be suitable for general application. If hospital fee schedules are used, economic findings may depend on the choice of hospitals and the number of hospital schedules used.4

An important limitation of gross costing is the need for measures that reflect the effect of the intervention. Even an accurate method of assigning cost to hospital stays, such as a DRG based-costing, will be inappropriate if the intervention affects resource use without affecting the DRG assignment. The analyst must honestly consider whether all effects of the intervention on resource use are captured by the units of measure.

CONCLUSIONS
Standard questions have been used to evaluate CEA studies. These questions have identified quality problems, but they are not sufficiently specific with respect to cost determination.

Table 2 proposes an enhanced checklist for evaluating the quality of cost-determination methods. It represents implementation of general principles in guidelines: to include all cost, adopt the societal perspective, use a long-term horizon, and value resources at the opportunity cost. It considers the weaknesses of each method, as identified in review of the literature.

The questions are designed to help the reviewer identify the analytic assumptions that have been made and whether they are appropriate. The most important consideration is to avoid bias in assessing the cost of services most directly affected by the intervention under study.

The first question addresses choice among methods. Most studies will employ both microcosting and a less resource intensive method. Since no guideline can anticipate the complete range of possible studies, the question simply asks if the analyst has sufficiently justified the choice of methods. The trade-off between precision and research ex-
The choice of costing method(s) justified?  
Were methods, data sources, and assumptions described?  
If cost estimates were based on a specific payer or provider, was evidence presented that they were representative of the health system generally?  
Did the cost of the intervention include person-level overhead, institutional overhead, nonwage labor cost, set-up cost, space, and supplies?  
If a new intervention was being evaluated, was development cost included?  
If the intervention requires pretreatment screening, was the cost of this screening included?  
Did hospital cost reflect differences in diagnosis, surgery, intensive care, length of stay, and setting? (eg, intensive, psychiatric, or long-term care)  
Were charges adjusted for the ratio of cost-to-charges?  
Was the cost of physician services to inpatients included?  
Did outpatient cost reflect heterogeneity of services?  
Was nonphysician ambulatory care cost included?  
Was outpatient pharmacy cost included?  
Did pharmacy cost reflect discounts from wholesale price and dispensing cost?  

### REFERENCES


