Advancing the Science of Health Care Costing

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The preceding articles in this volume amply illustrate and critically discuss the major issues in health care costing. This concluding article has 2 purposes. First, we synthesize and evaluate the main findings. Second, we identify the elements of a research agenda for improving the scientific soundness and relevance of health cost analyses for decision making.

As noted,1 most health cost studies either assess the economic burden of disease or illness, or contribute to the economic evaluation of specific interventions. Whatever the arena of application, a health cost analysis generally proceeds through a sequence of steps that should be tailored to the problem at hand.

• Defining the purpose, scope of included costs, and intended audiences. Most cost analyses are intended to inform decision making. Hence, the analyst should clearly define at the outset the purpose, the scope (types of cost to be included), and intended audiences.

• Identifying the resources used and their economic costs. The analyst must determine how resources (labor, capital, supplies) will be attributed (or assigned) to the disease, health problem, or interventions of interest, and how unit costs will be assigned to those resources. The dual tasks of cost attribution2 and cost assignment3 constitute the “costing out” process, and are closely related to the purpose and scope of the analysis. Most articles in this volume focused on these essential tasks.

• Deriving statistically sound conclusions about costs for the application at hand. Whether the application is a macro-level description of disease burden,4,5 the generation of cost elements for a cost-effectiveness analysis,6 a study of the cost difference between interventions in a clinical trial,7 or an assessment of the determinants of cost variations across disease groups,8 selection of an appropriate statistical framework and modeling plan is essential.9,10

• Reporting cost analyses accurately, clearly, and transparently. Not only the final results, but the important data and methods assumptions made along the way should be made clear.11 Transparency is important to both decision makers and to researchers seeking to advance the science of health care costing.

The sections that follow examine the steps in health costing, with an emphasis on the research agenda. Specifically, we (1) assay ongoing work to extend the boundaries of cost analyses in the major arenas of application, (2) assess the challenges in cost attribution, (3) discuss strategies for enhancing available data and developing new data resources for health costing, (4) identify recent advances and some remaining issues in the statistical analysis of cost data, and (5) consider pathways toward achieving greater standardization in reporting and conducting health cost analyses. In each section, our summary observations appear in italics.
ASSAYING AND EXTENDING THE BOUNDARIES

Important work is underway to develop better measures of disease-specific costs at the population level and to broaden the scope of health care costing at the individual level, with an emphasis on costs incurred outside the health care system.

Refining the National Accounts

Rosen and Cutler12 argue that to assess whether the nation is getting good value for money in health care, the National Health Expenditure Accounts (NHEA) should be augmented in ways that allocate spending to specific diseases and health problems. Aggregate spending on each disease or problem could then be compared with the corresponding changes in population health status. Analytically, this involves 3 major tasks: linking microlevel spending data to national-level totals, defining the disease-based subaccount categories, and then allocating spending to the subaccounts.

As Rosen and Cutler recognize, challenges abound in defining subaccounts that are mutually exclusive, exhaustive, and clinically meaningful. For example, since diabetes predisposes some people to heart attacks, should the cost of a heart attack contribute to the diabetes category, or should it be a separate subaccount? The authors outline encounter-based, episode-of-disease-based, and person-based approaches to this problem.

To better understand how specific diseases and health problems contribute to the overall burden of illness and to facilitate evaluation of the aggregate health payoffs from competing interventions, it is important to develop national-level estimates of cost by disease category. Ideally, such estimates would also be available by subpopulation and even by major categories of disease-specific interventions.

Measuring and Valuing Productivity Costs

The NHEA focuses on expenditures incurred within the US health care system, thus estimating aggregate direct medical costs.13 But it is frequently argued that the burden of illness also includes lost productivity. This “human capital” approach to measuring disease burden incorporates the value of market and nonmarket reductions in productive activity, arising from 2 sources. The first source is disease-related mortality, with productivity costs based on disease-attributable years of life lost and the resulting loss of productivity over those years. The second is disease-related morbidity, with productivity costs computed for those living with the disease.

A recent study on the aggregate mortality-related costs of cancer in the United States underscores the importance of including both market and nonmarket losses,14 including informal caregiving and household work. In this volume, Grosse et al15 present new US data on lifetime market and nonmarket productivity, by age and sex, which should strengthen the empirical base for human capital-based studies. Enhancements include up-to-date, detailed data from the American Time Use Survey on the allocation of an individual’s time across market and nonmarket activities.

However, both theoretical and ethical concerns have been raised about the human capital approach to valuing disease burden.15,16 Medical expenditures and productivity losses do not represent a complete accounting. Individuals value good health per se. Moreover, calculations of disease burden are substantially influenced by income levels, with unemployed and low-earning individuals accorded a smaller “burden” than higher-earning individuals with similar health outcomes. Alternative approaches to valuing life and limb, including willingness-to-pay, may be better grounded in economic theory16 and can yield dramatically different monetary estimates of disease burden.17 But to the extent that willingness to pay is influenced by ability to pay, difficult ethical issues remain. (Note, too, that some critical questions about equity and efficiency have been raised regarding the most common approach to deriving nonmonetary estimates of disease burden—via quality-adjusted life years, typically in the context of cost-effectiveness analyses.16)

While it has long been recognized that estimates of lost productivity based on the human capital and alternative approaches such as willingness-to-pay can yield substantially different results, few comparative analyses have been performed. Head-to-head studies should be conducted to assess the magnitude of the difference in a variety of applications. Of particular interest, in response to ethical concerns, is the extent to which population differences in the estimated burden of disease are influenced by differences in labor market participation (a key driver of human capital calculations) and income level (which may influence willingness-to-pay).

Putting Time into Economic Evaluations

Relatively few cost-effectiveness analyses consider the opportunity cost of the time that individuals contribute in securing and consuming health care services. Russell argues that this omission biases studies in favor of interventions that substitute patient and caregiver time for health system resources.18 She also points to the American Time Use Survey as a rich source of data on time allocation to activities. A viable alternative to survey data is to estimate patient time costs based on service utilization patterns recorded in claims data, medical records, and other sources.19 Russell believes that readily available average wage rates provide a reasonable proxy for the cost of patient and caregiver time. Both comprehensive assessments of disease burden and estimates of total direct cost for economic evaluations should include the cost of time for patients and informal caregivers.

THE COST ATtribution PROBLEM

Whether the focus is on burden of illness or the evaluation of disease-related interventions, most analyses must address a central issue: identifying the portion of health care costs causally associated with the diseases or interventions of interest over a specific time frame.

Prevalence Cost Versus Incidence Cost of Disease

Depending on the application, the focus may be on the prevalence cost of disease. For example, the prevalence cost of stroke in 2008, which includes the cost of strokes occur-
There is a fundamental interplay between economic and epidemiological considerations in disease costing. Estimation of prevalence cost for a given year requires, at a minimum, data on disease prevalence for that year. This may be obtained by direct observation of existing patients or else derived from data on disease incidence and survival. Estimation of incidence cost necessarily requires disease incidence and survival. If, as likely the case, cost varies by disease severity, information may be needed on the time spent at each level of severity, and the costs associated with each level. Many cost-effectiveness analyses have concentrated much more heavily on the epidemiological structure of the costing model than on the resource use and cost parameters. Studies requiring estimates of the attributable cost of disease should focus more intensely on the cost parameters, with no diminution of emphasis on the epidemiological foundations for the costing model.

Aggregate prevalence cost estimates can be obtained by multiplying directly estimated disease prevalence in a specific year by estimates of annual mean cost for those with the disease. But what if one wanted to predict prevalence cost for some future year? It is possible, of course, to simply project prevalence estimates and per person cost forward based on trend lines. An alternative approach is to build what amounts to a dynamic model of the incidence cost of disease over time—which allows for secular changes in risk factors, disease incidence, and survival—and from this model to derive prevalence cost in any desired future year.

In general, deriving prevalence cost from models of incidence cost has the noteworthy advantage of promoting coherency and internal consistency—both logically and empirically—between the 2 approaches. Indeed, one can argue that incidence costing—because it makes direct use of the fundamental parameters of disease incidence, stage duration, and mortality—is the “more basic” of the 2 perspectives.

The incidence cost framework could also help analysts address a long-standing anomaly (in our view) in human capital estimates of disease-attributable productivity loss. While it has been common to compute morbidity costs based on the associated productivity loss during the year of interest, mortality costs are typically derived as the discounted present-value of productivity losses in future years arising from disease-attributable deaths in that year. A fully dynamic model of incidence cost would make it possible for these 2 components of productivity cost to be computed in a time-consistent fashion, we believe.

Studies, in this volume, on the prevalence cost and incidence cost of disease (focusing specifically on cancer) amply demonstrate the insights that can be gained from comparative analyses. Additional head-to-head cost studies should be conducted for the major disease categories to investigate the extent to which findings are robust to the use of alternative data sources and costing methods.

Attributable Cost Versus Net Cost

As the articles in this volume well illustrate, many studies require estimates of the cost that is causally associated with a disease or disease-linked health problem of interest. In this regard, Barlow distinguishes between the “net” and “attributable” cost of a disease. By net cost, he means the observed difference between the (total) costs incurred by individuals with the disease and a statistically similar comparison sample without the disease. Attributable cost refers to those costs incurred by individuals with the disease that are judged to be directly related to the detection or treatment of the disease. Hence, observations on net costs are typically obtained through an epidemiological case-control (or case-cohort) type of study, while attributable costs ordinarily rely on expert clinical opinion or clinical scenarios to sort out disease-related cost from total observed cost.

Three general observations are as follows:

- Obtaining an ideal representation of disease-specific costs may be challenging under either approach. The expert opinion or clinical scenarios used to infer attributable cost may fail to identify all relevant disease-related procedures or services. The causal connections between diagnosis and subsequent costs are complex. Moreover, it is possible that individuals under treatment with a serious disease might forgo routine healthcare they would otherwise receive. If there is such a “crowding-out” effect, attributable cost could overestimate disease-specific cost. This is because such forgone routine care (whatever its impact on health outcomes) represents a genuine reduction in resource use in response to the disease of interest. Hence, if the aim is to determine the impact of the disease on all resource flows, the net cost approach is more suitable. An ongoing challenge in the net cost approach is achieving an appropriate match between patients and controls. Under-matching can result in substantial (nonrandom) heterogeneity between patients and controls, biasing estimates of net cost. Over-matching (analogous to “over-fitting” in regression modeling) may reduce the generalizability of net cost predictions.

- The challenges of deriving valid net or attributable cost typically increase as we move ever more distant in time from the incidence event. As time progresses, the individual with the disease of interest accumulates coexisting illnesses and other health problems. It becomes increasingly difficult to determine what portion of observed cost is due to the disease of interest, particularly at the end of life, regardless of the reported cause of death.
• The approaches discussed by Barlow are designed to identify the costs expressly associated with the occurrence of some disease of interest. Neither approach is structured to analyze the cost implications of preventing cases of the disease from occurring—a key requirement in cost-effectiveness analyses of disease prevention interventions. Note in particular that under the net cost approach above, the comparison sample’s cost per period is essentially subtracted from the cases’ cost per period, with this net cost further adjusted by the cases’ survival probabilities. Hence, the comparison sample’s own expected time profile of costs, which reflects both their cost per period and their own survival probabilities, is not relevant. By contrast, in calculating the cost savings attributable to a prevention intervention, a key ingredient is the algebraic difference between the time profile of costs for the cases and the time profile of costs for the comparison sample. (In a standard decision tree set-up, this cost difference is weighted by the probability of preventing the disease of interest to arrive at the expected difference in cost attributable to the intervention).

Allocating Costs to Diseases for Individuals With Multiple Diagnoses

Among the approaches that Rosen and Cutler identified for allocating aggregate health care costs to specific diseases, the person-based method merits particular attention. This approach lends itself naturally to multivariable regression modeling in which cost is a function of the disease of interest and coexisting illnesses, comorbidities, and other factors. If one believed that 2 or more diseases affect cost synergistically, interaction terms could be included in the model to capture this joint (and possibly hard-to-disentangle) influence.

Such regression-based cost-of-illness analyses conducted at the level of the individual are highly compatible with, and represent natural extensions of current efforts to estimate the prevalence or incidence cost of a particular disease or disease complex, while controlling for coexisting illnesses and comorbidities. However, much additional work will be required to understand the mix and magnitudes of disease-specific costs associated with complex health problems, such as depression, and major risk factors, such as obesity and smoking.

APPROACHES TO ARRIVING AT COST

The focus turns now to the primary task of health care costing: identifying the real resources consumed, and assigning an economic opportunity cost to each resource.

NHEA and Population Surveys of Service Utilization

The NHEA collects data from providers, payers, and multiple other sources to estimate US health care expenditures. However, the NHEA does not report health expenditures by individual, provider, or employer—nor by disease, as discussed earlier. But it does provide reliable estimates, and future-year projections, of expenditures in the aggregate and by various population subgroups and by type of service.

The Medical Care Expenditure Survey (MEPS) obtains population-based information on illness, health care use, and expenditures at the individual level from US households. The MEPS is nationally representative and repeated over time, but it systematically evaluates only certain priority conditions (such as diabetes) and certain important clinical information, such as date of diagnosis, is not available in all years. Consequently, disease incidence (and incidence costs) cannot always be ascertained, and disease-specific prevalence estimates are derivable only for the priority conditions. Additionally, the MEPS population-based sample may be too small to yield reliable estimates in a given year for some conditions (eg, colorectal cancer). MEPS also relies on individual self-reports.

MEPS is a unique national data resource, and it is possible in principle to address some of its limitations for cost analyses, eg, by increasing the number of priority conditions, adding detailed clinical information, and using multiple survey years to enlarge sample sizes within major disease categories.

Microcosting

This is potentially the most accurate method of assessing the cost of health interventions, especially innovative services whose resource requirements are not readily available from secondary data sources. But microcosting studies can be expensive, which likely accounts for why there are comparatively few published applications. Moreover, microcosting methods are insufficiently standardized, so that studies with similar purposes may elect to include (and exclude) different kinds of costs. Accurate determination of labor costs is frequently challenging because of difficulties in measuring how providers spend their time. New technologies, such as personal digital assistants, may significantly improve efficiency and accuracy in data collection.

Thoughtful guidelines for microcosting should clearly identify what costs are to be included and how they are to be analyzed. Increased transparency will promote confidence among decision makers that the estimates are accurate and complete for the intended application.

Activity-Based Costing

Some hospitals and integrated health systems have implemented Activity-Based Costing (ABC) systems that are far more accurate than cost-adjusted charges. These systems differ from traditional hospital cost accounting systems by automatically incorporating detailed information on workload and matching it to the costs of the appropriate department. The workload detail is then used to assign costs to individual stays and outpatient encounters. However, ABC systems are available at relatively few hospitals and healthcare systems, and their cost estimates may be idiosyncratic to a particular site. Estimates sometimes may be regarded as proprietary, useful for contract negotiations but unavailable for research. The expense of these systems may continue to limit their adoption by small-scale providers. (That said, the National Cancer Institute National Community Cancer Centers Program is presently using a tailored ABC system to assess implementation and operating costs across the Program’s 16 geographically dispersed cancer centers. Steven B. Clauser, personal communication, March 17, 2009).

A minimum standard for ABC should be established. Studies are needed to determine how widely ABC systems...
have been adopted, how they compare in terms of data required and methods employed, and how often their findings inform economic evaluations. In the future, a large data set of deidentified ABC cost estimates from a representative sample of providers could be the basis for an improved set of standardized unit costs.

Secondary Data Analysis

Administrative data sources, particularly insurance enrollment and claims data, are widely used to derive dollar-denominated measures of resource use. Because such data are principally used for provider reimbursement, however, they will not necessarily convey accurate information about the economic costs of procedures and services.

For example, charge data are widely available in the US health care system, but raw charges are poor indicators of economic opportunity cost. A corrective long adopted by many analysts is to cost-adjust charges using hospital cost reports submitting routinely to Medicare.\(^{25}\) But such cost-to-charge ratios embody several limitations. As hospitals increase their gross charges to subsidize uncompensated care, cost-to-charges ratios are diminishing, which increases the possibility of incorrect adjustment. Under prospective reimbursement, which is becoming more pervasive, inpatient care is paid according to the admitting diagnosis and outpatient payments are based on patient counts. As charges become less important in reimbursement, their accuracy may tend to diminish or they may no longer be submitted to the payer. Further, cost-adjusted charges are rarely available to characterize outpatient care, which represents one-half of US health care costs.

Reimbursement to providers, which represents cost from the payers’ perspective, has frequently served as a proxy measure of economic opportunity cost in applications to both inpatient and outpatient care. For facility-related services, the proxy for economic cost may be based on payments according to the diagnosis-related group system or other approaches to calculating reimbursement. For physician services, economic cost is frequently approximated by payments under the resource-based relative value system, which necessarily embodies a number of assumptions about the valuation and utilization of inputs comprising such services. A continuing challenge is accounting for all relevant payments comprising the proxy measure, including the copayments and deductibles charged to patients. To the extent that payments are effectively set to approximate economic costs, they may be used in analyses reflecting a societal perspective—a base-case requirement in many economic evaluations.

As measures of economic costs, both cost-adjusted charges and reimbursement to providers (payments) require validation. Better methods are needed to estimate the cost of ambulatory care, especially for surgeries and procedures that can be provided only in specialized facilities. As care continues to shift from the inpatient to the ambulatory setting, this issue is of growing importance.

Gross Costing

A common way of estimating the cost of health care is to multiply information on the quantity of each service by a standard estimate of its cost.\(^{26}\) The strength of this method lies with its simplicity. This is why it is widely used in clinical trials and medical decision models.

However, clinical trials often gather data on a limited number of measures, possibly failing to document use of important services. Utilization may also be missed in medical decision models, which are often based on expert opinion about services use. A related problem is whether the unit cost is consistent with the utilization measure. An average daily cost of hospital care will be too low if it is based only on the facility cost and does not include the cost of physician services. Unit costs for prescription drugs may be incorrect; although average wholesale price is widely used, most payers receive substantial discounts from this amount.

Research is needed on whether estimates from gross costing are consistent with more labor-intensive costing methods and to identify, in particular, the services that explain most of the variance in cost. A list of key measures of utilization, and standard estimates of their unit cost, may improve gross costing accuracy. For prescription drugs, better data are needed on such details as the appropriate discount from average wholesale price and the dispensing fees.

Some general conclusions follow:

- By using 2 or more of these costing approaches in combination, one can enrich the empirical analysis while also cross-validating the approaches. For example, in assigning cost to a given hospital admission, one can compare activity-based costing, administrative data approaches, and gross costing.
- Research is needed to learn if, and how, multiple costing approaches or data sources can be combined, or used in concert, to enhance the information base for analyses. For example, we should further explore drawing observations jointly from survey data, medical records, and administrative files for a richer picture of health resource use.\(^{27}\)
- Given the fragmented nature of health insurance coverage in the United States, an ongoing challenge is developing comprehensive, population-based, patient-level estimates of disease costs. Such estimates would encompass all ages, types of insurance and health plans, and geographic areas.

STATISTICAL ANALYSIS AND APPLICATION OF COST DATA

Statistical modeling is a particularly challenging area of health costing research, though it frequently is essential for accurately identifying the determinants of costs and predicting the cost impact of interventions and policies. The articles by Mullahy,\(^{9}\) Basu and Manning,\(^{10}\) and Huang\(^{28}\) offer a number of recommendations for advancing the field. Based on their work, other articles in this volume, and recent developments in the literature, the following issues especially merit ongoing attention:

- The application of multivariable modeling to cost prediction should be enhanced. Models should be developed that provide disease-specific costs at the macro level, accounting for the presence of multiple competing chronic problems and comorbidities. In addition, more work is needed on cost prediction in decision modeling, specifically on developing cost estimates
that are made conditional on treatment, risk factors, and other determinants.

- Alternative functional forms for cost modeling, including semi-parametric and other flexible forms, have shown promise in improving the accuracy of cost predictions and merit further intensive investigation. For example, generalized linear models may provide notably more robust and reliable estimates than traditional single-part of multipart costing models, with or without log transformation of the cost.\(^6\) In addition, the Cox proportional hazards model, with the hazard parameter defined as total cost accumulated per predefined time period, may provide a promising focal point for such investigations.\(^7\) That the functional form of the cost model can significantly impact cost-effectiveness ratios is well illustrated by Hoerger,\(^6\) who compares regression models with covariates entered multiplicatively compared with additively.

- Approaches to assessing the validity of cost predictions need additional exploration. As Mullahy emphasizes,\(^9\) the decision maker’s perspective should generally be taken into account when planning and executing cost analyses. This line of thinking can be formalized: the decision maker’s utility function should be considered when selecting the statistical criterion (eg, minimize mean square error, minimize mean absolute error) for assessing the accuracy of cost predictions. In most health modeling applications, predictive validity is not formally assessed. When it is – through, say, split-sample techniques – the validation criterion is not always linked to a specific objective function. Formal inclusion of the decision maker’s perspective is consistent with a Bayesian-oriented, statistical decision theory approach to estimation and prediction.

- Right-censoring of cost observations is a common problem in clinical trials and many observational studies, where a substantial proportion of subjects may “outlive” the study’s observational interval, with their out-year costs thus unobservable. In response, Huang\(^28\) proposes 2 approaches, each of which relies solely on cost and survival observations from individuals in the original clinical trial or observational study of interest. For a survey of additional strategies for dealing with censored cost data, see O’Hagan and Stevens.\(^30\)

In many chronic disease applications, not only do a high percentage of individuals outlive the study end date, many will incur a high percentage of their lifetime costs during the censored period. In response, most decision models, including those conducting cost-effectiveness analyses, elect to use cost data from multiple sources to construct a projected pathway of lifetime cost for the statistical individual portrayed in the model.\(^6,7\) For example, data from a clinical trial may be used to estimate cost of the initial treatment, while insurance claims data can be used post initial therapy until death.\(^31\) If the (unobservable) gold standard is the cost generated by a single sample of individuals followed over their complete life course, how close to this cost pathway will be that estimated via such concatenation of cost observations? The validity of this data linkage approach to deriving synthetic estimates of lifetime cost should be examined through simulation modeling using a variety of data sources that can provide longitudinal observations on costs.

### MOVING FORWARD: STRONGER METHODS, BETTER DATA, GREATER STANDARDIZATION

The preceding sections convey a basic theme: significant progress is being made, but additional work is needed in virtually all areas of health care costing.

#### Continue Strengthening the Methodology

Important efforts are underway to extend the ambit and scope of health care costing, both at the macro (national) level and in the conduct of economic evaluations. The underlying intent is to support better targeted, yet more comprehensive evaluation of specific health care interventions and investments. As noted, additional work is needed on how best to attribute costs to specific diseases, health problems, and interventions, and on how best to assign unit cost values to the resources consumed. The challenges in estimating the cost of disease “episodes” deserves more attention.

There are significant opportunities to improve the empirical base for health costing by enriching the set of cost-related variables in existing data sets, linking data sets to obtain a more complete picture of resource use, and creating new data sets to fill current gaps. A recurring message is the urgent need for head-to-head comparative studies to evaluate how cost estimates vary with the choice of data set and statistical approach to estimation and prediction.

#### Identify Key Investments in Research Resources and Data Infrastructure

Existing US data resources are not fully adequate for the key tasks of estimating the economic burden of disease or evaluating the cost-effectiveness of interventions. To address these challenges, the following will prove useful:

- A systematic evaluation of current federal, state, and private sector data resources should be conducted. The purpose would be to assess current capacities and deficiencies; identify strategic data linkages, comparative studies, or other productive synergies; and determine whether new initiatives or greater coordination of activities would be merited. For example, such an assessment might determine whether sources of cost data, such as the Medicare fee schedules, could be harmonized or even synthesized with private-sector fee schedules. Another question might be whether existing federal data resources maintained by a number of agencies could be better coordinated to support head-to-head comparative studies.

- Research is needed to determine whether, and how, to capitalize on health informatics technologies and infrastructure to improve efficiency, accuracy, and comparability in costing.

#### Toward Standardized Approaches to Health Care Costing

As studies proceed, so that the data and methods grow ever stronger, the stage becomes set for greater standardization in conducting and reporting cost analyses. While we do not recommend a particular pathway forward, we can envision a consensus process that would:

- Be conducted at the Federal agency level, or as a public-private undertaking at the Institute of Medicine or another
organization well-positioned to convene a diverse group of experts.

- Embrace approaches to deliberation and decision making that have worked effectively for other consensus efforts in health care, eg, the US Panel on Cost-Effectiveness in Health and Medicine.32

- In the spirit of the US Panel, develop one or more “reference cases” to guide the conduct of health cost analyses. As defined by the US Panel, a reference case is a “set of standardized practices that an analyst would seek to follow…” (32, p xx). While a cost study might incorporate a number of sensitivity analyses, it would always include a “reference” (or base) case analysis.

- Define important elements of the reference case. Standardized cost subcategories are needed (eg, for direct medical, direct nonmedical, and productivity costs). A standardized set of diseases or inter-related disease clusters should be defined. In addition, a standardized “cost catalog” should be designed. Such a catalog would provide the unit cost for a range of health care services, procedures, and products. It would also include mechanisms to adjust for geographic and temporal variations in input prices, as well as the perspective of the analysis (societal, patient, payer). Finally, guidelines are needed on how to aggregate unit costs to arrive at the (reference case) estimate.

- In parallel, develop standards for reporting of health cost analyses. Such standards would emphasize completeness, accuracy, and transparency in communication of cost findings and the underlying analyses.

In these ways, advances in the state of the science in health costing can inform the conduct of analyses. Over time, as the quantity and quality of health cost analyses grow, the science itself will continue to improve—and so will the analyses that follow. With these developments, health care decision makers will have an ever-improving empirical base for evaluating the burden of disease and the economic consequences of health care investments.

A realistic assessment of the time horizon for fully realizing these possibilities is itself a matter for further deliberation. We can conclude, based on the animated and productive discussions at the December 2007 cost workshop and the subsequent articles appearing in this volume, that the time is ripe for an accelerated pursuit of stronger methods, better data, and greater standardization in health costing.

REFERENCES