For Goodness’ Sake: Expected Therapeutic Benefit as a Basis for Healthcare Delivery

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The current debate on our healthcare system has focused primarily on the cost of care. Because of drastically rising costs and their burden on our economy, government and the private sector have developed many approaches to reduce these costs. Managed care, special contracting arrangements, and government fiat have all been used to stem the tide of rising costs—with variable success. We propose that the primary goal of healthcare is the provision of patient benefit, and we describe a model that calculates an expected benefit in terms of survival and quality of life. We have applied this model to a cohort of patients undergoing coronary angiography to determine the distributions of benefit. Furthermore, we describe a reimbursement strategy that relates the expected therapeutic benefit to the reimbursement received for that therapy—the greater the benefit, the greater the reimbursement. The future of our healthcare system lies in keeping the patient at the center of the debate on the delicate balance between optimal care and societal cost.

Indexing Terms: coronary angiography/medical decision making/medical economics

The current healthcare crisis is primarily financial. Annual healthcare costs now are estimated to be >15% of the Gross Domestic Product, exceeding $1 trillion in 1994 (1). Various approaches, both public and private, have been advocated to control these rising costs. Some prefer government control by fiat; others see the private sector as the only salvation for healthcare. Both sectors have had limited success in cost control through new contracting methods, new relationships between payors and providers, and intensive use of competition among providers of healthcare. Costs for some payors are starting to moderate (2-4). Because the primary focus of payors and regulators has been cost, some have expressed concern that the patient is no longer the most important part of the healthcare equation (5). This identifies a fundamental conflict in the healthcare debate. How do we maintain excellent individual patient care while wrestling with high societal cost?

In this review, we will explore the reasons for rising healthcare costs and enumerate some of the responses by payors. We will then discuss the philosophical tenets of healthcare and describe a proposed system that keeps the patient central, while maximizing value to both the patient and society.

The National Cost of Healthcare

In 1991, the US spent $752 billion on healthcare, distributed among eight segments of our healthcare system (Fig. 1A) (6). More than 45% of the healthcare dollar goes to hospitals, 23% to physicians. The remainder is divided among other professionals, drugs, nursing home care, other types of medical expenses, home care, and research. But the more important question is, how are the cost increases distributed? Fig. 1B shows that 44% of the increase in costs is attributable to natural inflation, 21% to direct increases in healthcare prices, 25% to increases in the use of services, and only 9% to changes in population characteristics (7).

Given the assumptions that (a) there will always be a natural inflation rate for medical care and (b) changes in population characteristics are not controllable, we can affect only 46% of the rate of rise of healthcare cost—the 21% due to increases in the cost of care above inflation, and the 25% to increased service use. How can we attack that 46%?

There are only three ways to reduce cost: prevention, elimination, or reduction. The most successful methods for illness prevention are already in place throughout our healthcare system (immunization, smoking reduction, exercise programs, Pap smears, and mammography). Unfortunately, these programs will probably not have a significant cost impact in the near term. Elimination of some aspects of healthcare is an option, and it has been attempted in Oregon (8). Given the constantly increasing demand for healthcare services, formal rationing of any kind will probably not be popular if applied to the general population. Finally, reduction in services or the cost of those services has been the major method to reduce total costs. Managed care, guidelines, and appropriateness criteria (9-12) are attempts to decrease overall utilization while guaranteeing that patients who need services receive them. From these limited possibilities, what specific mechanisms have been developed thus far to reduce cost?

The Response to Rising Healthcare Costs

Since the campaign leading to the 1992 federal elections, the American healthcare system has been the focus of a fierce debate, resulting in the Clinton administration's proposal for change (1). The response from the American public and Congress was poor, and the plan is now dead. It is doubtful that a heavily bureaucratic, centrally controlled medical system will be possible in the near future. Although a major re-
The structuring of healthcare by government was not successful, the government has made many attempts at cost control through Health Care Finance Administration (HCFA) regulations, Diagnosis-Related Group reimbursements, Resource-Based Relative Value Scale, and a multitude of other, smaller initiatives. All the data are not yet in, but costs seem to be moderating.

Private health insurance companies and self-insured corporations have had some success in controlling the rising costs of healthcare (13). First, they have set maximal rates of payment for specific procedures. For example, some insurance companies tie their payments to HCFA fees such that the phrase “x% of Medicare allowable” is common contracting language. Second, large corporations have used the clout of their size to negotiate contracts with providers. A large automobile manufacturer may contract directly with a provider and will bring to that provider their 30,000 employees. Arrangements such as this are advantageous to the payor because of competitive rates, while also being advantageous to the provider through economies of scale. Furthermore, groups of smaller corporations can combine into what are called “business coalitions” to generate the same leverage with providers as the larger corporations have.

Perhaps the most dramatic recent development in healthcare is the concept of financial risk (14). Under a fee-for-service system, the payor pays for all services performed by the provider—the provider receives payment, no matter what. Because of concerns regarding overutilization of services, payors are now placing providers at risk by paying fixed amounts for specific types of care. For the provider, it is financially advantageous to give only care that is necessary, given that the pool of money is limited. If a provider overutilizes on a managed care contract, then money will be lost.

The concept of risk has been embodied in a variety of contracting methodologies. First, health maintenance organizations, the oldest example of risk-taking, accept the total member premium to cover the cost of all care, using the Law of Large Numbers to assure that expenses are covered. Second, “global fees” or “carve-outs” have become popular, in which a payor will pay a fixed amount for a particular procedure (from a simple procedure up to an entire “episode of care”). An efficient provider is profitable; a provider who is inefficient or who has complications will lose money. There are often provider protections for extreme outliers, but the provider, on average, is at risk.

Capitation represents the most radical example of risk. In this case, the provider receives a fixed amount of money each month for each patient enrolled in that care system. For example, a large cardiology group might receive $0.95 per member per month for the care of 10,000 patients. All care provided by the group would be covered by that monthly payment; the group cannot submit additional bills to the provider. If the group is efficient, then it will make money; if it is inefficient or has negotiated the contract based on incorrect assumptions, then it will lose money.

Unfortunately, the driving force for all the above-described reimbursement strategies is cost, not optimal patient care. In these systems, patient concern is modulated only through utilization review and quality assurance oversight. We believe that the pendulum may have swung too far toward cost concerns and away from optimal patient care. Is there a reimbursement strategy that can optimize the value of healthcare delivered to an individual patient?

Clinical Benefit is the Goal of Clinical Care

The provision of healthcare is fundamentally a humanitarian activity with the goal of providing improvement in survival and (or) quality of life to individual patients. Healthcare is also a commercial activity in that it must be profitable to continue its pursuits. One problem with our healthcare system is that we have been unable to link these two conflicting points of view. This link is crucial to defining the “value” of health care—the relationship between benefit and cost. To measure the value of care, we must be able to measure

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**Fig. 1.** (A) The 1991 distribution of total dollars spent in the US healthcare system; (B) the distribution of cause for the rates of increase in healthcare costs (1989).

(A) Hosp, hospital; MD, all physician payments; Prof, all non-MD professionals; Drug, drug costs; NursHome, payments to nursing homes; Home, home care; Res, research and development; Other, miscellaneous costs. (B) Infl, natural inflation; Prices, medical price increases above that of inflation; Other, increase in use of healthcare; Popul, changes in the population (e.g., age) that require increased healthcare expenditures.
the individual patient benefit from medical care and relate that benefit to the long-term costs.

A Model to Quantify Benefit

To quantify the value of a particular therapy in an individual patient, one must be able to objectively estimate that therapy's benefit in terms of survival and quality of life. Furthermore, value must be linked in some way to an economic measure, such that an individual benefit has an associated "cost" or "return on investment." We have developed such a model for patients with chronic stable angina being considered for coronary revascularization, and the model has been described previously (15). Fig. 2 presents the basis of the benefit calculations. Using data from the demographic and medical literature, one can construct a survival curve for an individual patient based on age and sex. This survival curve is adjusted downward for the presence of comorbidity, according to the method of Charlson et al. (16), corresponding to curve A in Fig. 2. Based on specific patient characteristics such as severity of ischemia, coronary anatomy, exercise physiology, ejection fraction, and other noninvasive tests, the maximal survival curve is adjusted downward, giving an individual patient's estimated survival for their present cardiac state (Fig. 2, curve C). Given these "maximal" and "minimal" survival curves, we now interpolate between them to estimate a therapeutic survival curve for bypass surgery (Fig. 2, curve B), based on a large metaanalysis by Wong et al. (17). Where each curve crosses the median survival line (Fig. 2, points a–c) defines the median survivals, from which we calculate a crude benefit. The time difference between point c and point b defines the crude expected benefit (marginal survival) for bypass surgery. We have validated this crude survival curve against the cardiothoracic surgery long-term follow-up database at Cedars–Sinai Medical Center.

As a separate calculation, the model then adjusts each curve for the impact of quality of life with angina. A curve is shifted down for the presence of angina and shifted upward for its expected relief from bypass surgery (18). These shifts define new median survivals and thus a new benefit, termed quality-adjusted benefit of bypass surgery. Based on the method of Barnoon and Wolfe (19), each median survival can be converted to a "utility" (varying between 0 and +1), which adjusts the survivals for age. Subtracting two utilities (just like subtracting two median survivals) derives a benefit in terms of utility that varies from −1 to +1. This adjustment is necessary to remove the inherent age bias of survival estimates. For example, the therapeutic benefit derived from bypass surgery on a 50-year-old may be many years, whereas for the same severity of ischemia and coronary anatomy an 80-year-old will have a much smaller level of benefit, being limited by a shorter maximal survival. Making the adjustment by "utility" removes the inherent bias against older patients such that, in the previous example, the utility for the 80-year-old could be equal to, or even greater than, that for the 50-year-old. The decision as to which benefit to use in decision making—years or utility—is philosophical and political.

Economic Value Model

The link to economic value of a procedure is provided by a model that estimates a return on investment, or the cost to society. In simple terms, it is possible to determine a value of life at any age based on previously published econometric models (20). From this value, we subtract the procedural costs and long-term costs associated with follow-up care (21); the result is termed "return on investment." Young patients, who are more likely to earn money over a longer period of time, have much larger returns on investment than older patients with equivalent illness. We can now determine the relation between benefit to an individual patient and the cost of that benefit to society.

Model application. We have applied this model to a set of 457 patients undergoing coronary angiography for stable coronary artery syndromes and calculated the coronary bypass crude and quality-adjusted expected benefits for each patient. Fig. 3 shows the frequency distributions of crude and quality-adjusted survival benefits for this cohort. Crude survival benefits are small, ranging from −0.8 to +3.8 years, with a mean of 0.3 ± 0.8 years. This small magnitude of crude benefit is expected, because the largest demonstrated incremental survival is in patients with left main coronary artery disease and severe triple-vessel disease with reduced ejection fraction, two populations that make up only a small proportion of a catheterization laboratory cohort. But quality-adjusted expected

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**Fig. 2.** An example of a benefit calculation: The maximal survival curve (A) is calculated based on an individual's age, sex, and comorbidity; a minimal survival curve (C) is calculated based on the patient's present cardiac state: symptoms, severity of ischemia, ejection fraction, and coronary anatomy; a therapeutic survival curve (B: e.g., bypass surgery) is calculated by interpolation between the two other curves based on the known efficacy of bypass surgery in prolonging survival and improving quality of life. Where each curve crosses the median survival line (50% survival; points a, b, and c) defines an expected median survival. The difference between the expected therapeutic survival and present expected survival (minimal median survival) is the therapeutic benefit. See text.
benefits are much larger, ranging from –0.1 to +6.1 years with a mean of 2.1 ± 1.4 years, because bypass surgery relieves pain in a large proportion of patients.

Figure 4 demonstrates the relation between individual benefit and societal cost. The abscissa of both graphs represents the crude and quality-adjusted benefits in years, and the ordinate is the return on investment, both as described above. We can see that for crude benefit (Fig. 4A), the vast majority of patients return negative dollars (mean $-32,499); that is, they cost the society more. This negative cost is related to the fact that bypass surgery, in the majority of cases, does not significantly improve survival. Those few patients with positive returns on investment are those who are very young, have left main disease, or have severe triple-vessel disease with depressed ejection fraction. But more important, we know that bypass surgery significantly reduces symptoms in the majority of patients, thus improving quality-adjusted survival. Fig. 4B demonstrates that the majority of patients do have positive returns on investment (mean $+18,694), because their symptoms are improved.

These two graphs depict the conflict that most societies have when addressing the cost of medical care. Should coronary bypass be performed on patients over the age of 80? Only by making the benefits and costs explicit will we advance the debate, such that these difficult decisions can be made. With the constraints of our present healthcare system, can we devise a system that provides the incentives to maximize individual benefit and maximize value to society?

An Alternative Proposal: Fee-for-Benefit

We have seen how the proposed solutions to our healthcare crisis have focused mostly on cost, whereas the primary goal of healthcare is the provision of benefit. To develop an appropriate incentive, the fees paid for a service (the value of that service to a payor) should be linked to the expected therapeutic benefit (the value of the service to the patient). In purely economic terms, the greater the value of a good or service, the more is paid for it. Combining purely medical and purely economic concepts can yield a powerful incentive for optimization of medical care.

Fig. 4. The relation between individual patient benefit (crude and quality-adjusted) and return on investment for coronary artery bypass graft (CABG) surgery.

Because bypass surgery is expected to improve crude survival very little (see Fig. 3), it also has a poor return on investment (mean $-32,499). But because bypass surgery improves symptoms significantly, the mean return on investment for quality-adjusted benefit improves significantly to $+18,694.
Under our present system of reimbursement, the payment for any procedure is invariant with respect to patient benefit. As depicted in Fig. 5A, a hospital is paid the same for a patient with single vessel coronary artery disease and minimal symptoms as for one with left main disease and severe symptoms; yet the benefit of bypass surgery to the latter patient is much greater. A method of reimbursement based on individual procedural benefit would provide an incentive to perform high-risk, high-benefit surgeries, and a disincentive to perform surgery on patients with low benefit and thus questionable need. By negotiation between payor and provider, this relationship could be structured according to the sigmoid curve analogous to that seen in Fig. 5B; the greater the estimated benefit of the procedure, the greater the reimbursement.

Let us apply these concepts to two patients being considered for bypass surgery. The first is a 55-year-old man with typical angina pectoris and left main coronary artery disease. Based on the model described above, he would be expected to receive an additional 6.3 quality-adjusted life years corresponding to a utility of +0.307 for bypass surgery. Compare those results to a 75-year-old asymptomatic man with double-vessel disease. The 75-year-old would be expected to gain only 0.1 quality-adjusted years for a utility of +0.005. Under fee for service, the hospital would receive the same payment for both patients (Fig. 5A), whereas under a fee-for-benefit system, the hospital would receive <$10 000 for the 75-year-old (patient 2; Fig. 5B) and ~$37 000 for the 55-year-old (patient 1; Fig. 5B). This incentive would encourage the use of bypass surgery in patients who would benefit and would encourage the use of more appropriate alternative therapies (medical, angioplasty) in those who would receive little or no benefit from surgery.

There are many disadvantages to this approach. First, it can be applied to expensive therapies only where there are sufficient data to generate the necessary models. Second, it would require a negotiation between payor and provider over the shape of the reimbursement curve. It would also require that the provider acquire, store, and share all necessary data for the computation of expected benefit. But the basis for this strategy is ethically and economically sound. The goal of medical care is the provision of benefit, and reimbursement will be based on providing maximal benefit to the individual patient—a sound decision-making foundation, both medically and economically.

Providers and the Future of Healthcare

The exact direction that American healthcare will take remains unclear. There will be more consolidation, competition, and the need for innovative ideas regarding healthcare delivery. We as healthcare professionals have the ethical obligation to keep the focus of healthcare on the individual patient, foreswearing cost reductions as a primary goal. But we are also citizens in a large, complex society with an obligation to optimize the relation between individual patient benefit and societal cost.

We can accomplish these ethical and practical goals by active participation in clinical databases: (a) to demonstrate the effectiveness of high technology therapy; (b) to develop the types of models described above; and (c) to minimize the cost of care, while assuring that there is no reduction in quality. To be heard, our voice must be loud regarding that delicate balance between societal costs and the welfare of individual patients.

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CLINICAL CHEMISTRY, Vol. 41, No. 5, 1995