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## Cost-benefit analysis of surgery: Some additional caveats and interpretations

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It must be a rare reader who has progressed this far in the book without questioning the application of cost-benefit analysis on a broad scale. This brief essay emphasizes some special issues relevant to medical decision-making and indicates how classical assumptions sometimes lead to nonoptimal behavior. Some of the problems have been discussed by Amy Taylor and Nava Pliskin in Chapter 1, the methodological prologue. The reduction to dollar figures of inherently non-quantifiable entities such as death, lost time from work or leisure, pain, and suffering forms the greatest barrier to the implementation of these methods. Clark Abt's Chapter 3 addresses such issues, as does Weinstein, Pliskin, and Stason's Chapter 21.

We will not dwell on them any further. Concentrating on the purely economic side, this chapter will explore the extent to which it is appropriate to use the prices actually paid for medical goods and services as measures of their true worth as inputs into the surgical process. A variety of conflicting forces may enter the picture. Some point to market prices undervaluing the true worth of medical inputs, while others are likely to lead to overvaluation.

It is best to start with a review of the reasoning which implies, in the context of ordinary resource allocation or economic planning, that such market prices are appropriate guides to policy. In this way, we will uncover some implicit assumptions that are subject to challenge in the present context.

At first blush, selling an input on a market where every potential buyer would pay the same price is surely the best way to allocate a fixed quantity of the resource. In this way we would ensure that it is received by those for whom it is

most valuable. There are, however, two related questions to be asked before we can justifiably rely on the price mechanism alone to allocate resources efficiently. The first is that the value of the item for an individual might not correspond to its value for society as a whole. Inoculation against contagious disease is a prime example. Second, we cannot be sure that the total quantity to be distributed is itself "optimal." Perhaps there can be too many vitamins as well as too few. A more detailed analysis of the situation is therefore necessary.

Before proceeding to address these matters, it is necessary to say what "optimal" means. An optimum may be taken to represent a situation in which no individual can be better off without hurting at least one other person. At an optimal allocation of resources, some individuals may, nevertheless, be much wealthier than others. We will have little to say regarding the problem of income distribution and equity. Is it true that because someone is otherwise disadvantaged, he should be entitled to superior medical care, or priority in receiving service, as society's way of evening things out? Most people would agree that there are better, less chancy, ways of administering redistributive policies, and therefore would accept the distribution of wealth as given for the purpose of allocating medical resources.

Our concern will be the attainment of an optimum in the above sense with respect to the allocation of medical resources. Since the economist's traditional prescription is for laissez-faire, it is valid to ask why we should have cost-benefit analysis at all. The reason is that many of the assumptions underlying this presumption are invalid in the medical context. Stopping at this point is not enough. Whether evaluation takes place by the "invisible hand" of the marketplace or directly using cost-benefit analysis, sooner or later prices will be used to estimate costs. We want to know if these prices accurately reflect true social costs, and if not, what is the direction of bias. The answer typically depends upon which of the economist's assumptions is being violated, and why.

The following characterize the traditional conditions under which the "optimality" of an economic equilibrium can be proven.

1. The economic world is static and perfectly certain. All choices to buy or sell can be made now, and will be executed without default.
2. Each individual, and every firm, treat prices as given and do not try, or expect, to influence them by his market action.
3. All firms maximize their profits and redistribute them directly to individuals for their own discretionary use in expenditure.
4. Individuals choose rationally from among the alternative consumption plans available to them. That is, given two observations on the individual's chosen plans when he was faced with two different lists of prices, it will never be the case that his choice in the first instance would also have been affordable in the second and that the second would have been within his means in the first. The rationality of his choice in one circumstance or the other would have then been contradicted. Moreover, no one would ever waste any resource by consuming less of it than the amount he purchased.

Of course, no one pretends that these assumptions are actually satisfied all the time. People and firms make mistakes, foresight is imperfect at best, and, indeed, the complete list of potentially relevant prices is not really ever known. Never-

theless, markets perform tolerably well if the broader ideas behind these assumptions are generally operative. What we want to discuss is the set of circumstances peculiar to the allocation of surgical resources which causes these conditions to be systematically violated, and thereby produces prices in the market that are way out of line with the valuations we would like to use in our cost-benefit analyses.

We will proceed as follows: We reconsider each of the assumptions, show how it is likely to be violated in the medical context, and discuss the nature of the error that would be produced by a cost-benefit analysis that valued medical inputs at the actual prices being paid for them.

It will be easiest if we organize the discussion along the lines of the four assumptions of standard economic theory presented above.

### STATIC ECONOMIC ENVIRONMENT

In the real world, all buying and selling is not executed at one primeval instant, before the rest of economic activity takes place. Potential investors or suppliers of new medical technology, for example, know the current prices for the goods and services they might plan to supply, but by the time their investments bear fruit, the conditions in the market could be very different. There is no room for this in the standard economic model sketched above. In that model, when an investment is made, the resulting revenues are known with certainty and the decisions can never be retrospectively incorrect.

Particularly in the medical context, imperfectly foreseen technical progress can cause serious misallocations of resources or misjudgments of potential cost and benefit if current prices were to be used. For example, if a sufficient supply of paramedical personnel were to be trained, the costs of postoperative care might be reduced substantially in many cases. But whether this will take place and how large the cost saving will be are unknowns.

In many elective surgical procedures, one of the costs to be considered if it is not undertaken is the potential that it may have to be done at a later date (see, for example, Neutra's paper on appendicitis, Chapter 18, and Neuhauser's on hernia, Chapter 14, in this volume). However, if cost-saving techniques may be introduced in the interim, the cost-benefit analysis based on current market prices will overestimate the relative value of performing the operation immediately. On the other hand, it is possible that medical progress will be made more rapidly in other surgical areas. This would tend to increase the value of hospital beds for uses other than the operation in question and would lead to an underestimate of the value of doing it immediately, before this unanticipated increase in the cost of hospital beds takes place.

### PRICE-TAKING BEHAVIOR

Another source of inefficiency and error is the possibility that suppliers of medical resources recognize the dependence of prices upon the quantity that they sell. This is particularly acute when the item is protected by patent which prevents other suppliers from competing with the original inventor. Society is then

faced with a genuinely insoluble problem. Without protection by patent, inventive activity would be stifled since the extra profits would quickly be eliminated by competition. But with patent protection, some degree of monopoly power is inevitable. This is a highly complex issue on both the economic and legal levels. We will merely indicate why monopoly power might result in misallocation.

Let us suppose that the manufacturer of some complex medical instrument, which is necessary in a particular operation, can sell 400 of them per year for \$1,000 each or 450 of them for \$800 each. Suppose further, having already discovered the necessary technology, the cost of manufacture is \$500 per unit. Assume that hospitals can either equip their operating rooms for this operation or not. At a price of \$1,000 it may be worthwhile only at larger metropolitan hospitals that are more likely to encounter such cases. There may be only 400 such hospitals, so that the situation in which 400 items are produced and sold is an economic equilibrium. It is better from the manufacturer's point of view than cutting the price to \$800 and producing 450 of them, because that would give a total profit of \$135,000 instead of the \$200,000 that could be made by restricting supply.

However, from the social point of view, it would clearly be better to induce the extra supply. The cost of the last 50 units is only \$500 each, while the benefits to the hospitals involved are all between \$800 and \$1,000. Therefore, although the cost-benefit analysis that would be performed by these 50 hospitals using the price of \$1,000 would be correct in indicating that they should not purchase it separately, it would lead to an incorrect surgical policy in the health-care system as a whole. This is another example of how market prices can be misleading guides to social values.

### PROFIT MAXIMIZATION

Perhaps even more serious than the two problems outlined above is the fact that many institutions in the medical sector have goals other than profit maximization in mind. It may seem paradoxical that more socially oriented objectives might lead to worse results than selfish profit maximization. Specifically, the prices that would emerge in a system with nonprofit maximizing behavior would no longer serve as correct guides in cost-benefit analysis. The following hypothetical example will serve to illustrate this point. Suppose that all hospitals increased the number of beds up to the point where profits were zero. That is, they go beyond the point of maximal profits to a larger scale of operations in the attempt to serve more patients. Even though each hospital takes the potential revenue from every extra bed as a constant (so that we avoid the problems mentioned above), the equilibrium price of each bed is lower than it would be if profit maximization were followed. This can be depicted as shown in Figure 5-1.

The upper diagram presents these calculations as they might be made by such a hospital. The downward slope of the curve labeled "price for bed depending on total available" is a result of the fact that progressively less urgent needs will be accommodated as the hospital expands. The curve for "cost of one more bed depending on the number available" depends upon factors such as crowding,

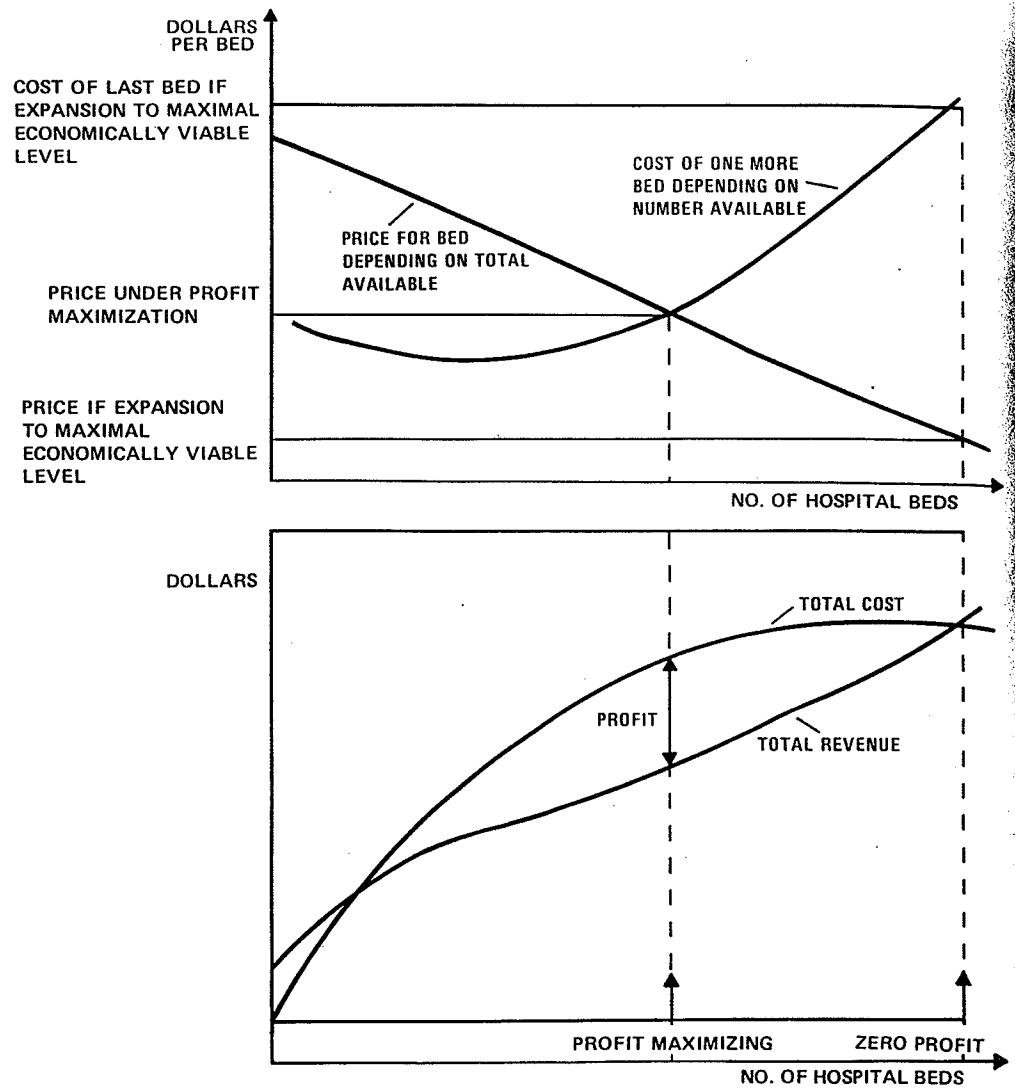


Figure 5-1. Determination of actual and profit-maximizing levels of hospital beds and related social cost calculations.

The upper figure plots the price and the social marginal cost per bed against the number of hospital beds. The curves cross at the number of beds maximizing profit.

The lower curves plot total cost against total revenue. The curves cross at the breakeven or zero profit point.

support services such as labs and outpatient clinics, etc. It will be decreasing when the hospital is smaller than its efficient scale, perhaps too small to justify having its own lab or specialized units of various types. The rising portion reflects crowding, increased administrative costs, and other costs which tend to increase more than proportionately with size.

In the lower graph the same data have been represented as the total cost and revenue corresponding to a given number of beds, rather than the cost and revenue of the last bed. The profit maximization point and size maximization point, subject to a no-losses constraint, are easily depicted.

Now consider in this milieu the problem of surgical versus medical treatment for some illness. The price of a hospital bed will be lower than its true social cost, and lower than it would be if hospitals were profit-maximizers. Therefore surgical treatment might be preferred on the basis of a cost-benefit analysis that used the equilibrium price of hospital beds as taken from market data, whereas a true social cost calculation would prefer the medical treatment.

## RATIONALITY

Although it is hard to think of someone purposely acting against his own self-interest, this may arise in some completely unintentional ways because of the nature of medical decision-making and the bearing of the ensuing costs. I will restrict myself to two instances in which the formalization of rationality as non-contradictory behavior, which we have taken in assumption 4, can give rise to misleading and highly biased results.

The first is especially acute in situations of serious, relatively rare illnesses. It is sometimes referred to as the problem of the neglect of small probabilities. Typically, individuals will be quite inaccurate in their assessments of probabilities less than  $1/50$ . When the incidence of a disease or other complication is orders of magnitude below this, they will tend either to neglect the possibility entirely or greatly overstate its frequency. Their demands generated by this, say for preventive medical services, will therefore accord with their prior beliefs but will be unrelated to the true social benefits to be derived. If a life-saving technique such as an intensive-care unit, would be economically viable only if used at a certain minimum intensity, personal expectations would be unreliable guides to the efficacy of acquiring it. Such information should be gathered directly, which is another point at which public policy guided by expert medical knowledge will outperform the market system.

Finally, we come to the issue of insurance. Medical insurance is so widespread, and problems related to it have been so well documented, that we need only make the briefest mention of it here.\* Medical insurance is surely not "irrational." However, it does induce a violation of the rationality hypothesis at a later stage in the decision-making process. Notice that the hypothesis of rationality implicitly assumes that the individual is personally paying for any care he receives out of his own income. When economists speak of insurance, they

\*The interested reader is referred to Arrow's "Uncertainty and the Welfare Economics of Medical Care," *American Economic Review*, 1963.

typically do not refer to the type of contract that reimburses the insured for his expenses. Rather, insurance in the standard economic model is a payment based on the medical condition alone, which can be allocated by the insured in any way he desires, independent of the medical costs he incurs. Insurance in the real world, however, has the feature that once the illness insured against is found present, the insurance company will cover medical costs (up to some maximum and perhaps with some deductibility provisions). This removes the incentive for the individual to act "rationally" with the insurance company's money. It also counteracts some of the incentive to take proper preventive care and to undergo screening procedures. These problems—known in the insurance literature as "moral hazards"—are not irrational in the ordinary sense, but they do violate the hypothesis of rationality as used in the proof of the optimality of market equilibrium. They create the potential for the individual to make apparently contradictory choices with the money he is to allocate among its alternative uses, the reason being that it is not *his* money and that the amount of it as his disposal depends on the choice he makes. In typical cases, once an individual knows that he is covered by insurance he does not economize on his medical costs. In this way the prices of some medical services are pushed up beyond their social value, since the only role left for prices is to allocate the existing supplies among the larger set of demanders. National Health Insurance Systems such as those in England or Canada must feel this phenomenon even more acutely. Cost-benefit analysis that uses such prices as estimates of social value of the procedures will err in this way.

### SUMMARY

In this brief chapter I have tried to outline some of the reasons why one should be cautious in estimating values and costs of medical inputs by the prices at which transactions are made. Biases can be in either direction and there are few general principles to guide us. It is important, therefore, to ascertain in each case the structure of the markets for medical services relevant to the treatment of the particular condition under study. The studies that follow in this volume have tried to cope with these difficulties and have shown that cost-benefit analysis can be an effective aid, when carefully applied. But the problems are difficult and the reader is cautioned that the answers presented can depend critically, as we have shown, on the economic hypotheses employed because they form an integral part of the analysis.

### Acknowledgment

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