Effects of Hospital Cost Containment on the Development and Use of Medical Technology

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NE OF THE DOMINANT CHARACTERISTICS of modern American medicine is the development and widespread diffusion of sophisticated technology. Originally considered an unequivocal blessing, the technological revolution in medicine has of late acquired something of a bad name. This change reflects a shift in the nature of current technology and its presumed contributions to the costs and benefits of medical care. In the 1940s and 1950s, biomedical science contributed the antibiotics that dramatically reduced the morbidity and mortality associated with a variety of infectious diseases. This true "high technology" of medicine was effective, safe, and inexpensive to administer (Thomas, 1974). Today, however, the public and many professionals view the medical technological revolution as expensive and complex, characterized by resource-intensive capital equipment of unestablished efficacy, which frequently requires hospitalization and serves to inflate the cost of care while delivering little demonstrable health benefit.

Increased awareness of the opportunity costs of resources devoted to expensive "halfway technology" is poignantly illustrated by Gaus and Cooper (1976):

[W]e spent 4 billion dollars for new technology [for Medicare patients in 1976] and we do not know if it did any good, much less how much

 \dots If we had continued providing hospital services to the aged, as they were in 1967, then we could have spent that 4 billion dollars last year [to] \dots have

- Brought *all* aged persons above the poverty line [with at least 3.3 million currently living below it]; or
- Provided the rent to raise 2 million elderly from substandard to standard housing units; or
- Brought all the elderly above the lowest accepted food budget and more; or
- Provided eyeglasses and hearing aids to all who needed them [estimated at 18 million needing or wearing glasses and over 3 million needing hearing aids], and more.

Which would have helped the most, [medical] technology or food?

The "technology problem" is simply a reflection of the fundamental dilemma of American health care: how to provide accessible, high quality care to all and at the same time restrain inflation in the cost of providing care. The profusion of expensive medical technology has been cited as a cause of rising costs and one of the effects of attempts to provide quality care. The question is how to search for, develop, produce, distribute, and utilize technology that will truly contribute to the higher quality and economic efficiency of health care, and how to simultaneously weed out technologies whose benefits are not commensurate with their costs.

The severity of the inflation problem is reflected in Congress' willingness to seriously entertain proposals for national hospital cost containment.¹ Concern has also been demonstrated recently by several government-sponsored inquiries into diverse technology

¹The Carter Administration's Hospital Cost Containment Act, as amended in the Subcommittee on Health and the Environment of the House Committee on Interstate and Foreign Commerce, is HR 9717. The Senate version of the bill is S 1391. The competing alternative, S 1470, introduced by Senator Talmadge and others, is limited to Medicare and Medicaid reimbursement. The major provisions of these bills, prior to amendment, are described in Committee on Interstate and Foreign Commerce, 1977.

Hospital Cost Containment and Medical Technology

issues: the deterioration of technology's research base; the safety and efficacy of technology; the role of technology in inflation; and so on (the President's Biomedical Research Panel, 1976; Office of Technology Assessment, 1978; National Academy of Sciences, forthcoming). In this paper we merge these policy interests by asking: How might hospital cost containment affect the development and use of medical technology?

Perspectives on the Technology Problem

The concerns with which different observers voice this seemingly neutral question indicate the diversity of perspectives on "the technology problem." The major perspectives are not inherently incompatible, but they do reflect a tension that pervades the cost containment debate. Proponents of medical technological development ask the question with trepidation, fearful that the economic discipline in cost containment will retard the development of useful medical technologies. These individuals believe that regulatory meddling by government coupled with the inherent public-good problems of research have erected barriers to the pursuit of promising biomedical research and development (R&D). Cost containment might exacerbate the situation, further weakening American leadership in biomedical science and restricting productivity growth in the practice of medicine.

Proponents of cost containment generally believe that the current system fosters excessive adoption and use of medical technology. They ask the same question in the hope that cost containment will direct the allocation of medical resources more efficiently, producing more cost-effective technology and reducing the waste they perceive to be associated with much existing technology. The dimensions of that waste include the following:

The current system fosters the production of too much technology, *i.e.*, technology whose social benefit is not worth its social cost.

New and existing technology is too widely distributed; new technology often diffuses too rapidly and indiscriminately.

Technology is used excessively and in many instances improperly.

The R&D and medical practice systems have led to the production of the wrong mix of cost-saving and cost-increasing technology, with the system heavily biased toward the latter. The "pro" and "anti" technology views are not necessarily incompatible, because they focus on different stages of the R&D-use spectrum. This difference suggests a subtle but important point that has eluded most discussion of the technology cost issue: while there is general agreement that technology contributes to the medical cost inflation problem (Warner, 1977), there is little consideration of the *mechanism* linking technology to inflation; yet for cost containment to be effective, policy must be tailored to the source of the problem. For example, if the problem results from an excessive stock of capital equipment, policy ought to focus on hospitals' acquisition of equipment, as do Certificate of Need (CON) and a ceiling on hospital capital expenditures. If the problem derives from excessive use of a reasonable stock of equipment, legislators should concentrate on reimbursement policies.

Alternatively, the inflation problem may result from the flow of new technology into the system, namely, the rate of increase in available new technology and the consequent pressures to adopt it. This might call for policy focusing on the medical technology R&D system, and not on hospital or physician behavior *per se*. Finally, it may be that "the tendency to overinvest in and overuse sophisticated services is just part of a larger tendency to overuse health services or to invest too many labor or nonlabor resources in the production of hospital services" (Wagner and Zubkoff, 1978). If this is the case, the contribution of technology to inflation should not be isolated as a "technology problem." Rather, cost containment policy should concentrate on general reimbursement and regulatory mechanisms, without an explicit technology focus. (See also Schroeder and Showstack, 1977.)

Medical technology comes in all sizes and shapes. Similarly, cost containment has many forms, varying from a dichotomous decision on whether to grant a hospital's request for a specific piece of equipment, to a general cap on hospital revenues. Each of the cost containment forms may have different effects on the development and use of medical technology; indeed, a single form may have very different effects on different types of technology. Thus for purposes of analysis it is necessary to define the meanings of both cost containment and medical technology. In this paper, cost containment will refer to a limit on hospitals' inpatient revenues, as proposed by the Carter Administration, with separate consideration of a ceiling on capital expenditures, a second significant component of many proposals. The operation of these limits and details on specific proposals are described elsewhere (see the bills referenced in footnote 1 and Committee on Interstate and Foreign Commerce, 1977). Medical technology will refer to non-labor inputs, with interest focused on sophisticated, high-priced capital equipment, *e.g.*, computerized axial tomography (CAT scanners), and other equipment and supplies having significant implications for hospital costs due to frequency of use, *e.g.*, automated electrocardiography. To an economist, technology means a defined configuration of all inputs, both human and nonhuman, used in a specific production process. The emphasis in this paper on "hardware" reflects the popular usage of the term, and concern about, "medical technology."

The remainder of this paper suggests some tentative answers to the issues raised by our question: How might hospital cost containment affect the development and use of medical technology? We begin by analyzing the environment in which medical technology develops, is adopted, and used. The purpose of this discussion is twofold: to provide a context within which one can understand how hospital cost containment might influence the development and use of technology; and to provide a perspective for assessing the desirability of alterations in the status quo. The following section suggests what some of those changes might be.

Factors Affecting the Development and Use of Medical Technology

Advancement of medical technology depends on a robust system of biomedical R&D and on demand for the products of R&D. In most industrial settings, these two factors are inextricably linked: the nature and amount of R&D depend principally, if not exclusively, on the productivity of firms' R&D departments (measured as contribution to profitability). In contrast, frequently in biomedicine much of R&D appears to function as an entity unto itself, dependent more on the mood of Congress and the public than on its innate productivity. In part, of course, this simply reflects the great difficulty in measuring the productivity of biomedical R&D, especially that of basic research. But it does raise an important point: some aspects of medical technology development and advancement are quite independent of the medical care delivery system and hence are unlikely to be affected by changes in the technology use patterns of hospitals that result from cost containment; other aspects do depend on changes in the delivery system and seem likely to be affected by cost containment. We will discuss these distinctions in the next section of this paper, after briefly examining herein the factors that influence both the development and use of medical technology.

Much of biomedical R&D, including almost all basic research, is the ward of the state. Through the National Institutes of Health and other agencies, the federal government dominates determination of how much and what type of research will be undertaken. Decisions about funding levels, categorical disease emphases, and the mix of fundamental and targeted research all reflect a combination of professional and political influences. Even many of the immediate beneficiaries of the government's largesse—medical schools and biomedical researchers—have little interest in the economic implications of the fruits of biomedical R&D. In short, market forces play only indirect roles in governmental R&D allocations, despite the fact that "Many . . . research funding decisions [which] appear to be million-dollar decisions at the time they are made . . . turn out to be billion-dollar decisions when the outcomes of the funded research reverberate through the health care system" (Gaus, 1975).

Involvement of the private sector in biomedical R&D varies according to the stage of research. Industry supports very little fundamental bioscience, concentrating rather on applied research and, especially, development. This is consistent with the theory of public goods, since the economic benefits of development work are both more certain and more appropriable than those deriving from basic research. Thus, private industry contributes relatively little to the creation of new basic bioscience knowledge but plays a major role in bioengineering and the development and production of hardware.

Both for-profit firms and non-profit researchers have incentives to work toward the solution of unsolved medical problems. There are few incentives to search for less expensive means of accomplishing an existing task, which is the goal of much of private industry's conventional research. The bias toward "new-solution" technology results from the professional prestige associated with developing and using a "new solution" and a reimbursement environment (discussed below) in which adoption and use decisions are effectively free to the decision makers. The consequence, many observers suggest, is that the bulk of the technological innovations that issue from biomedical R&D increase costs; relatively few save costs.

The biomedical R&D enterprise continually presents health care providers with a wide array of innovations. The medical professional environment encourages the adoption and use of innovations. Physicians, it has frequently been claimed, are driven by a "technological imperative" instilled during medical training where the image of high quality medicine is predicated on a scientific approach to problems, with modern technology constituting the instruments with which that approach is practiced. Furthermore, the existence of high-cost, hospital-based technology is considered a factor in the trend toward increasing physician specialization, which in turn reinforces the hospital's growing importance as a source of care and increases the demand of physicians for still more technology. Possession of modern, sophisticated technology confers prestige on physicians, and it often contributes to their economic well-being. As a result, hospital administrators want to acquire sophisticated equipment and facilities, both for their own prestige and to attract and hold high caliber physicians on their staffs. Finally, the public's growing faith in the power of science in general and of curative medicine in particular accelerates the demand for technologically advanced methods of care. In short, technological sophistication is viewed by many-patients, physicians, and administrators-as a surrogate for high-quality care.

The "social contract" binds physicians to provide the "best possible care." This acts as an additional pressure to adopt and use new technology. In medically desperate situations—*i.e.*, where the prognosis is poor and reasonable therapeutic alternatives few—physicians are often encouraged to use experimental innovations in nonexperimental settings. This may result in widespread diffusion of innovations well before their medical efficacy, toxicities, costs, and so on are understood (Warner, 1975), although early diffusion is not restricted to medical crisis situations (Altman and Eichenholz, 1976; Gaus, 1976).

Direct governmental involvement can promote the development and diffusion of technology, as does its support of research, but it can also restrict production and use, principally through regulatory policies. The overall effects of regulation on technology adoption and use are uncertain, although the available evidence is not encouraging: regulation intended to limit the spread of medical capital appears to have been reasonably ineffective (Needleman and Lewin, 1977). For example, where CON has succeeded in limiting growth in hospital bed supply, purchase of other equipment has increased, resulting in no overall savings in capital expenditures (Salkever and Bice, 1976). In contrast, the new medical device regulation procedures (U.S. Congress, 1976), which are intended only to assure the safety and efficacy of medical services, have raised the fear that "over-regulation" will stifle entrepreneurial initiative and thus reduce the discovery and production of new safe and efficacious devices. Certainly the regulatory effects of a ceiling on capital expenditures might be quite significant.

The economic environment of medical care provides some positive incentives and few disincentives to adopt the newest technology. Beginning with the subsidization of research and development, the government pumps considerable money into medical schools and elsewhere to encourage development of new knowledge and technical innovations.

But the most salient feature of the medical technology market is the mixture of the sellers' profit incentive and buyers' relatively unconstrained positions. The sellers' profit incentive has been cited as motivating the rapid and indiscriminate adoption of technology (Fuchs, 1973), but such adoption can occur only because technology buyers and users do not discriminate on the basis of all costs as well as benefits. This applies to each of the groups that buy or use medical technology: physicians, consumers, and hospitals.

As buyers and users of technology, cost-reimbursed physicians are indifferent to costs that are not borne by themselves or by insured patients. As suppliers of services in a fee-for-service setting, physicians often have a positive economic incentive to overutilize tests and other services that can generate personal profit.

Consumers find that increasing insurance coverage and affluence have significantly reduced the real direct (out-of-pocket) cost of much medical care, especially that provided in hospitals. Patients now pay less than one-eighth of the average hospital bill directly, compared with one-half in the early 1950s. In addition, increases in real income over the period mean that patients must now work fewer hours to pay the direct cost of a day of hospital care (Feldstein and Taylor, 1977). The lower real direct cost has increased the demand for care, particularly for the "style" and "high quality" of care (Feldstein, 1971, 1977). The hospital administrators' response has been "improvements," including the acquisition of the "latest" technology, which have driven costs up. Completing the circle is the consumers' response to the higher costs—namely, to buy more insurance (Russell, 1977):

Thus, as third party payment has increased over the years, the benefit required to justify a decision in the eyes of doctors and patients has declined. This has led to the increased use of resources in all sorts of ways — including the introduction of technologies that otherwise might not have been adopted at all and, more often, the more rapid and extensive diffusion of technologies that had already been adopted to some extent.

Cost or cost-plus reimbursement has two direct influences on hospitals qua technology purchasers. First, reimbursement of interest payments lowers the effective cost to hospitals below the true interest rate, encouraging overinvestment in marginal projects. Overinvestment is further encouraged by the relative ease with which hospitals can borrow, a result of the tax-exempt status of many bond issues and the safety associated with third party reimbursement. Thus, hospitals are not forced "to experience the real discipline of the capital market" (Silvers, 1974). This is particularly important if, as some observers argue, the availability of financing governs the rate of adoption of high-cost technology, with the technology's medical efficacy being of secondary importance (Rice and Wilson, 1975), as may be demand or costs (Ginsburg, 1972). Second, the reimbursement mechanism fails to distinguish resource-saving from quality-enhancing or service-expanding projects. Hence the economic system does not counter the non-economic forces that favor adoption of sophisticated and generally costly technology. Both of these consequences are reinforced by the fact that frequent upgrading of existing services and addition of new ones give providers greater leeway in the allocation of overhead, and most cost-based reimbursement schemes probably allow considerable latitude in this area (Silvers, 1974).

"In short, when those making the decisions pay none of the costs, resources are used as though they cost nothing" (Russell, 1976). All of the elements come together here to produce a situation in which the binding constraint may be the state of the art, *i.e.*, the technology itself, and not, as elsewhere, considerations of all costs and benefits.

Likely Effects of Hospital Cost Containment on the Development and Use of Medical Technology

Hospital cost containment is not a panacea in the battle against the rapidly rising costs of medical care. Even if it were thoroughly successful, hospital cost containment would only address the inflation problem in one component of the medical care sector. Medical inflationary pressures might continue unabated outside of hospitals. Indeed, there is considerable concern that hospital cost containment will transfer inflation problems-and technology-to non-hospital settings, conceivably exacerbating overall inflation and making containment of costs within hospitals a Pyrrhic victory. In addition, of course, is the real possibility that a program of hospital cost containment will not work. The ability of such a program to succeed in its principal objective—containing costs—is not the focus of this paper; neither are other, non-technology effects (e.g., effects on employment in hospitals). These concerns are left to other authors (e.g., Congressional Budget Office, 1977; Reinhardt, 1977; Silver, 1977; Zelten, 1977) but are mentioned here to keep the ensuing discussion in perspective.

The immediate target of hospital cost containment is decisionmaking on resource allocation within hospitals. Changes in the mix of resources within hospitals and in the frequency of their use are the first-order effects of cost containment. The effects on other health care delivery institutions and on the development and advancement of technology—in essence, on public and private sector R & D— are mainly derivative or second-order consequences. We shall examine separately both first- and second-order consequences for each of a general inpatient revenue limit and a ceiling on capital expenditures.

Limit on Total Inpatient Revenues

First-Order Effects: The most direct impacts of an inpatient revenue limit relate to the acquisition and use of technology within hospitals. The following first-order effects can be anticipated:

1. Decreased use of technology already in place. Staff physicians would be discouraged from ordering procedures perceived to have only marginal value. The recent trend toward more and more

Hospital Cost Containment and Medical Technology

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laboratory tests per illness (Scitovsky and McCall, 1976) can be expected to be reversed. Increasing input intensity—that is, inputs used per patient with a given diagnosis—has been cited as a major source of hospital cost inflation (Feldstein, 1971; Feldstein and Taylor, 1977; Redisch, 1974).

2. Substitution of existing lower-cost alternatives to tests or procedures of choice. The cost factor would join the convenience, versatility, or other attributes of procedures that currently dictate preferences.

3. Reduction in the flow of new cost-increasing technology into the practice of medicine, particularly in hospitals. This reduction would result from both supply and demand factors. Under pressure to contain costs, hospitals would reduce their orders (demand) for new cost-increasing technology. A second-order effect, expanded upon below, would be a reduced supply of cost-increasing innovations unless demand outside of hospitals grows sufficiently to compensate for the loss in hospital-based demand.

4. Increased interest in and consumption of new cost-saving technology. Obviously, this has implications for R&D, as discussed below.

5. Decreased diffusion of existing technology.

6. Increased hospital and area-wide cooperation and coordination. This is an obvious desirable outcome of a hospital cost containment program. Empirical studies provide evidence that many service areas currently have unnecessary excess technology and duplication of facilities (Abt, 1975; Roche and Stengle, 1973; U.S. DHEW, 1971).² Reimbursement mechanisms foster adoption of such excess capacity, and apparently regulatory efforts have not demonstrably inhibited it (Needleman and Lewin, 1977). Cost containment would put a significant price on duplication of facilities, and should therefore encourage hospital administrators to seek

²Excess capacity may be justified on the basis of option demand. That is, we are willing to pay a price (*i.e.*, the costs of unutilized capacity) in exchange for the certainty of the ready availability of the technology whenever it might be needed. While option demand is a legitimate basis for unused capacity, the amount of excess capacity often documented considerably exceeds that which option demand would recommend.

means of reducing duplication and excess capacity. An obvious means is the coordination of area-wide facilities planning, which is much more likely to be effective with the support, rather than opposition, of hospitals.³ In major cities, this might result in specialization in the services offered by hospitals.

Second-Order Effects on Other Health Care Delivery Institutions: The derivative effects of an inpatient revenue ceiling on other health care delivery institutions reflect incentives to shift resource-intensive care to these other settings:

1. The "dumping" of expensive cases on other institutions. Since financially catastrophic cases would reduce the hospital's resources for treating other patients, the hospital would have an incentive to send expensive cases to other institutions, including public (e.g., state) hospitals and nursing homes. While this might be within the letter of the law, it would certainly violate the spirit, since the cost would have been transferred, not contained. Whatever technology must be applied to expensive cases — and expensive cases are often technology-intensive — would probably move with the patients to these alternative institutions.

2. Shift in the use of cost-increasing technology from hospitals to private physicians' offices. As long as cost containment is limited to hospitals, there would be incentives for technology suppliers and physicians to locate technology in private practices. Both public and private organizations have called for extension of regulatory authority (especially for CON) to private non-hospital settings (Iglehart, 1977b; Institute of Medicine, 1977). Needless to say, such an extension would be politically difficult, but without it some cost problems might simply be transferred from hospitals to other delivery settings. Indeed, with physicians having a greater financial interest in the use of such technology in their own offices, additional unnecessary uses of technology might result. The danger of transfer

³Area-wide planning has met with limited success. The Comprehensive Health Planning Agencies, which preceded the new Health Systems Agencies (HSAs), were viewed as generally ineffective in this capacity. The National Health Planning and Resources Development Act of 1974 (PL 93-641) put some teeth into the HSAs created by the Act. However, active and cooperative involvement of hospitals and the medical profession in area-wide planning would certainly facilitate this process. Hospital cost containment would appear to encourage such constructive involvement.

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of technology is exacerbated by the growth of Medical Service Plans (MSPs), groups of private physicians who contract with hospitals to staff specific services. Such groups are not covered in most hospital cost containment proposals, yet they are in an ideal position to purchase and use technology normally employed only in hospitals. Thus, hospital cost containment raises the spectre of the following scenario. Cost containment makes technology usage in hospitals "expensive" to medical decision-makers; *i.e.*, it limits the resources available for other inputs. Consequently, it provides an incentive to remove such technology use from the hospital's class of costs that are subject to the revenue ceiling. Private groups (e.g., MSPs) then form, leasing or purchasing the technology in question, charging patients for its use, independent of their hospital bills, despite the fact that the technology is employed in the hospital in the care of inpatients. The cost of the technology is transferred through an accounting trick-it is not contained-and as observed above, use and hence cost actually increase with private groups now possessing a profit motive. This is not a certain consequence of an inpatient revenue ceiling, but neither is it a logical impossibility.

3. Shift in the use of technology from an inpatient to an outpatient basis. With the revenue limit applying only to inpatient care, there might be a wholesale shifting to outpatient care, according to opponents of this form of hospital cost containment. However, the question of the net effects of such shifting on both technology use and cost remains unresolved. Much hospitalization and inpatient use of technology result from an insurance system that favors these over ambulatory care. Thus, the cost containment incentive favoring outpatient care may simply balance the insurance system's inpatient bias.

Second-Order Effects on Development of New Technology: The effects of an inpatient revenue ceiling on the development of new technology derive from the effects on the use of technology by health care providers. The greater the distance between the stage of development and the application of technology, the less consequential should cost containment be. Thus, in general, basic research should be little affected, while some applied research and developmental work might respond significantly. The differential effects on private and public sector activity relate principally to the R&D

stages upon which these sectors focus their efforts and on the financial dependence of the sectors' R&D on the use of technology.

The most profound consequences are likely to be experienced by private firms engaged in applied R&D, where most private sector R&D activity is concentrated. The dependence of such firms on the successful marketing of their R&D products is clear. If a revenue cap diminishes the market for cost-increasing technology,⁴ one would expect to see:

1. Reduction in private sector R&D activity directed toward costincreasing technology; decrease in the production of cost-increasing technological innovations; reduction in the number of firms engaged in the development and supply of such medical technology. This is a simple and direct response to the change in market conditions.

2. Greater price competition among suppliers and lowered hospital costs. With the economic discipline imposed on hospitals, administrators and department heads would be forced to shop around. Hence cost containment would have a double-dose effect on hospital costs, inducing price competition among suppliers and encouraging frugality in the use of existing resources within hospitals.

3. More R&D and production of cost-saving technologies. Hospitals' incentive to constrain costs would create a significant new demand for cost-saving technology. Coupled with decreased demand for cost-increasing technology, this new demand would provide a powerful incentive for private firms to aggressively enter this new market. It is conceivable that hospitals' demand for cost-saving technology and the potentially large, relatively untapped reservoir of research ideas would combine to produce an even more robust medical technology market than currently exists. To be sure, the character of that market and its product would differ substantially from that which exists today, but the possibility remains that there would be active, imaginative R&D into a wealth of technological possibilities yet to be unearthed simply because the system has not previously offered professional or economic rewards for such

^{&#}x27;The "if" relates to the question of how much technology demand would be transferred to non-inpatient settings rather than simply "drying up."

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products. If this accurately characterizes the situation, applied R&D might prove extremely productive in an era of cost containment.⁵

4. Little effect on basic bioscience research. As noted above, the amount and nature of basic research are principally a function of federal funding. The incentive for researchers is to produce new knowledge, not to develop and sell a physical product. If anything, there has been a concern that fundamental biomedical research and medical practice are so dissociated that the fruits of research are not diffused sufficiently rapidly or widely into practice (Gordon and Fisher, 1975). If cost containment did have an undesirable effect on this most basic stage in the advancement of medical technology, research funding policies could be adjusted to compensate. Because there is likely to be a limited effect on basic research and a more significant effect on targeted R&D, one might anticipate a relative shift away from big capital-intensive technology toward knowledgeintensive "soft" technology. Much of the cost-increasing equipment embodied technology-the centerpiece of the current cost of technology debate—arises from the applied R&D work of the private sector. If this work declines due to a hospital cost containment program, the product of biomedical R&D will shift toward that which is least affected by the program, namely, the outcomes of basic science research.

A revenue limit program will not take place in what is otherwise a regulatory vacuum. Changes in the regulatory environment may have as much effect on the development of technology as do the explicit cost containment provisions. In addition to professional ethics, government policy and regulation are the only major hindrances to

^sThis theoretical conclusion is supported by the analysis of a major private sector supplier of hospitals. Becton Dickinson, a firm with nearly \$600 million in sales last year, believes that the struggle to hold down costs "can open up a relatively new area of product opportunity in the hospital for supplies primarily designed to reduce the cost of procedures. Historically, most new supply items have been sold on the basis of improvement in medical care The system ... has not been receptive to cost reduction as a sales tool.

[&]quot;Given a receptive, cost conscious environment, cost-reducing supplies represent a truly new class of products. Such items will be less expensive to develop and market and involve significantly less regulatory delay and risk than the medically more innovative products." (Blue Sheet, 1978)

the development, adoption, and use of technology.⁶ Cost containment could replace or eliminate the need for certain types of regulation that have had a repressive effect on the advancement of technology due to the maze of bureaucratic red tape they have constructed. Any diminution of such regulation would encourage exploration of new technological possibilities, even cost-increasing ones, thus partially offsetting the deterrent effects of cost containment *per se*.

Ceiling on Capital Expenditures

A ceiling on total capital expenditures would have many of the same effects as that on total revenues, but it would also have some quite distinct impacts resulting from concentration on a particular class of inputs, with exclusive focus on the capital costs of those inputs. The latter differentiates a dollar spent on acquisition of technology from one devoted to its use. Under a capital limit, a hospital faces real penalties for acquiring high-cost capital equipment, but virtually none for using equipment once it is in place.⁷

Were high-cost capital-intensive technology perceived to be simply another input responsive to the same incentives as other inputs, there would be no reason to have a ceiling on capital expenditures in addition to one on overall revenue if the revenue ceiling were applied to both equipment acquisition and all operating activities. The economic discipline inherent in the revenue limitation would be relied upon to produce a rational allocation of the limited

⁶Regulation can retard or prevent development, adoption, or use, either directly or indirectly. Examples of direct effects include: on development, restrictions on recombinant DNA research; on adoption, CON for high-cost technology; and on application, FDA approval of drug uses. Indirect effects are illustrated by the development penalties of added delays and other costs in the research-to-market process due to medical device certification of safety and efficacy. Policy decisions not to reimburse for use of a technology for specified purposes obviously will have strong deterrent effects.

⁷To the extent that physical depreciation of equipment is positively associated with use, increasing usage leads to an earlier need for replacement, and hence to capital expenditure. This would seem to be a very minor consideration relevant to frequency of use, particularly given that much medical equipment is scientifically obsolete well before it has physically deteriorated to the point where replacement is necessary.

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resources across all inputs. The fact that major legislative proposals include a separate capital expenditure ceiling suggests that policy makers do perceive a distinct "technology problem," and do believe that, under a general revenue limit alone, high-cost technology would continue to flow into the hospital sector at rates disproportionate to the true relative value of such technology. Although politically prominent, this view is far from universally accepted in academic circles. Indeed, a separate capital ceiling might be considered counterproductive, for reasons suggested below.

First-Order Effects: The direct results of a capital expenditure ceiling on the acquisition and use of technology within hospitals would include the following:

1. Decrease in the acquisition by hospitals of expensive capitalintensive technology. Both acquisition of new technology and diffusion of established high-cost technology would decrease. Furthermore, the ceiling would not distinguish between cost-increasing and cost-decreasing technology. Unlike the general revenue limit, which would encourage acquisition of the latter, the capital expenditure ceiling would discourage all forms of capital acquisition, irrespective of ultimate operating cost. Implicit in the incentive to avoid highcost capital technology is decreased use of such technology in the aggregate, with the possibility of more intensive use of acquired technology. Obviously, a capital expenditure ceiling would combat the purported unnecessary duplication and consequent underutilization of capital-intensive facilities. The danger is a reversal of the problem: a very restrictive ceiling might lessen the optimal availability of facilities and impose excessive burdens on existing technology, leading to reliance on second-best alternatives instead of capital-intensive technologies.

2. Search for diagnostic and therapeutic alternatives with lower component prices.

Second-Order Effects on Other Health Care Delivery Institutions: The derivative effects of a capital expenditure ceiling on other health care delivery institutions are similar to those associated with the overall limit. One would anticipate some shifting of capitalintensive technology and associated care to non-hospital settings, including to the offices of private medical group practices. Second-Order Effects on Development of New Technology: The effects of the capital ceiling on the development of medical technology are also similar to the effects of the revenue limit, although certain effects are exacerbated by the capital ceiling and at least one effect is quite distinct:

1. Decrease in technology-oriented applied R & D. This effect is exacerbated by the capital ceiling.

2. Decrease in the development of all high capital cost technology. This impact is distinctive because it will occur irrespective of the technology's implications for hospital operating costs. Unlike the general limit on inpatient revenue, the capital expenditure ceiling will work against the search for capital-intensive cost-saving technologies. This has obvious implications for the medical technology industry.

3. Little effect on basic bioscience research. Like the revenue limit, the capital ceiling should have little impact on fundamental research.

Conclusions

Hospital cost containment will restrict the flow of resources into medical care, assuming that "contained" costs are not transferred *in toto* to non-inpatient medical care. Containment may inhibit research into and the development of cost-increasing technology; a capital expenditure ceiling would also discourage R&D related to certain cost-decreasing technologies. Evaluation of the desirability of these consequences may ultimately rest on one's subjective opinion, but an informed judgment will include appreciation of the economic context in which such changes will take place. These are not changes from a position of social optimality. If they were, there would be no need to consider a policy of containing hospital costs.

The fundamental economic truism is that resources are scarce and have alternative uses. The true cost of an activity is the benefit that the resources consumed would have produced in their best alternative use(s). In a market economy, prices reflect these opportunity costs: to acquire a resource or commodity, one must be willing to pay at least what that good is worth to others. The assurance of the value of the good lies in the sacrifice the purchaser must make: by č

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willingly sacrificing the price of the good — and hence foregoing alternative purchases — the buyer is demonstrating that the benefit of the good is at least commensurate with its cost and exceeds the benefits that would have been derived from the alternative purchases.

In medical care, the absence of direct financial liability for the consumption of many services implies that neither patients nor providers need be concerned with the economic value of the medical resources consumed. Hence, the true social cost of utilizing the resources can exceed the benefit that induced their consumption. Providers' profit incentives may exacerbate the situation. The logical outcome is excess and possibly inappropriate use of resources. The problem is most acute where the vast majority of costs are assumed by third party payers, as in the case of hospital care.

The existence of widespread and deep insurance coverage reflects a variety of factors. In the private sector, both the depth of coverage—the small deductibles and low copayments—and the extensiveness of employer provision of coverage reflect in part the preferential tax treatment of medical insurance premiums (Ehrbar, 1977; Havighurst, 1977). In addition to performing the true insurance function—providing protection against unforeseen financial catastrophes—relatively complete coverage becomes a form of prepayment, significantly lowering the out-of-pocket cost of care and hence encouraging increased consumption. Increased demand leads to higher prices, which in turn increase the demand for insurance.

Public insurance programs are a positive reflection of the nation's social conscience in general and specifically of the attitude that money should not be a barrier to the receipt of necessary highquality medical care. The inflationary implications of Medicare and Medicaid are the price society has been paying for the equity these programs have delivered. Herein lies the problem: in both the private and public sectors, we have been attempting to implement the principle that health care is a right, by incrementally decreasing the out-ofpocket cost of care. In essence, we have been "freeing up" and "nationalizing" the demand side of the economic equation while struggling to preserve the free enterprise character of the supply side. Any student of elementary economics could predict the effects; any literate citizen can read about them daily.

Cost containment represents an attempt to preserve the distributional equity gains of the past decade while reintroducing an economic discipline into the provision of care, at least in hospitals. The objective is to counteract the consequences of the removal of financial barriers to care: inflation and the less understood problem that excess resources devoted to medical care deprive people of greater benefits from alternative uses of the resources. Conceptually, cost containment is a step in the right direction, attuning decision makers in the health care system to the cost implications of resource consumption. Furthermore, one group of hospital cost containment proposals—those which constrain overall revenues or expenditures but leave individual resource decisions to physicians and administrators—forces knowledgeable decision makers to confront alternatives directly: purchase of a CAT scanner would no longer simply require CON approval; now it would imply that a hospital could *not* purchase machines X, Y, and Z.

Many health care professionals argue that putting a cap on hospital revenues will unduly restrict the provision of services, possibly decreasing both the quality and quantity of care (Silver, 1977). If it is assumed that physicians and administrators will learn to make wise choices, damage can be minimized. Services of marginal effectiveness should be the ones reduced, and decision makers should learn to provide services more efficiently. Again, from the social perspective, resources not consumed in medical care will be used in other activities, possibly with more beneficial implications for health (e.g., pollution control). Indeed, if the previous characterization of the medical market is accurate-namely, that the relative absence of economic constraints has led to an overproduction of services, to excessive and inefficient use of resources-then an absolute *decrease* in resources devoted to medical care might actually be socially desirable. However, hospital cost containment calls only for relative belt-tightening, i.e., a decrease in the rate of growth of hospital expenditures.

Needless to say, it is a long way from the concept of cost containment to the implementation of an effective program. Regulation is pervasive in health (Iglehart, 1977a); based on past experience in this and other fields (Havighurst, 1977; Noll, 1975), one should not feel entirely sanguine about the prospects for success. Hospital cost containment is not synonymous with medical care cost containment. As noted above, a principal concern is that costs intended to be contained will simply be shifted from inpatient to outpatient status or from hospitals to other delivery settings. To the extent that this oc÷

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curs, the predicted effects on the development and use of technology would be diminished.

The discussion above should place in perspective the effects on technology development and use of two major cost containment proposals. A ceiling on capital expenditures appears to be a means of supplementing relatively ineffective regulatory apparatus (e.g., CON) with some policy muscle. A truly restrictive ceiling, such as that proposed by the Carter Administration, would have clear and strong implications for both the development and use of capitalintensive medical technology, particularly if combined with equipment- and service-specific national guidelines on appropriate maximum supplies, as defined in the Administration's bill (HR 9717, Sec 302). Put simply, the acquisition of such technology would be discouraged and hence so would be related research and development. Unfortunately, the ceiling fails to distinguish cost-saving from cost-increasing capital expenditure. Thus, to the extent that costsaving capital-intensive technologies might be developed, the proposal is partially self-defeating.

The general inpatient revenue limit might adequately serve the cost containment objective independent of the capital expenditure ceiling, assuming that the revenue limit was structured to relate to reimbursement for all costs and not simply operating costs. This is especially true if, as suggested earlier, excess investment in and use of technology are simply a reflection of the general problem of excess use of resources in medical care. Even if sophisticated technology is currently treated preferentially, the revenue limit's imposition of an effective budget constraint would force reevaluation of such preferential treatment.

Under a general inpatient revenue limit, the demand in hospitals for certain types of technology would slacken, and overall demand would cease to grow as rapidly as it has in recent years. Both of these factors could be viewed as deterrents to the development and adoption of technology. However, both can also be viewed as bringing the demand for cost-increasing technology, and hence for related research, more into line with the reality of the opportunity costs associated with them. Significantly, under a revenue limit, the new economic environment for hospital-based care would produce incentives for technology researchers and developers to channel their creativity into the search for and development of cost-saving technology. Such technology could expand the capability of the health care industry to deliver care with a given amount of resources. The relative absence of research effort in this area suggests the possibility that it might have a high and rapid pay-off. A shift in the mix of technology from cost-increasing toward cost-saving would represent a significant change in the delivery of medical care, and it might augur a new golden age of medical technology.

Much of the impact of cost containment on the improvement of health through new technology depends on the research origins of real breakthroughs. If future medical progress lies in the development of sophisticated capital equipment, with the private sector playing a leading role in the design and production of such equipment, hospital cost containment could significantly slow the advancement of medical science. If, by contrast, the true high technology of medicine is simple, inexpensive, and derived from basic research, cost containment seems unlikely to jeopardize medical scientific progress.

Hospital cost containment represents an attempt, albeit imperfect, to reduce or compensate for the discrepancy between the private decision-making costs and the social costs of medical care. Any serious and effective cost containment policy will have a substantial impact on the quantity and use of resources devoted to hospital-based care. The likely effects on medical technology are numerous and significant, although as a price to pay for controlling the ever-inflating costs of care, they do not necessarily appear to be intolerable. Some, in fact, should prove to be desirable.

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