TECHNOLOGY ASSESSMENT IN MEDICINE: AN AUSTRALIAN PROPOSAL

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A large part of the increasing cost of health care services is often attributed to the introduction of new technology. While a review of the literature reveals that the evidence to support this view is ambiguous, it does indicate that the unregulated market fails to discriminate well between effective and ineffective health care technology. In some cases it has permitted the proliferation of medically harmful technology. At present Australia does not have a regulatory mechanism for ensuring the efficient use of new technology. The present paper suggests how such a mechanism could be established and the incentives that would be necessary to encourage the proliferation of only effective and efficient medical technology.

Keywords: medical technology, regulation, cost control, cost benefit analysis, cost effectiveness analysis, federal-state relations

INTRODUCTION

It is almost a cliché that a country cannot afford to pay for all of the health related technology that is being developed and marketed. The cliche is quite possibly wrong; at best it is untestable. With 7.5 per cent of the GDP devoted to health care, it would be possible to double the supply of existing facilities and then to double them again. This would probably satiate all but the most dedicated hypochondriacs. The constraint facing society is not what is technically possible, but what is economically rational. People do not choose to devote an excessive proportion of their limited resources to one activity. By demanding lower taxes and upper limits to their health insurance premiums, the population is collectively demanding other goods and services in preference to an ever increasing supply of medical care.The constraint upon new technology is further tightened by the need to choose either more new services or more existing services — and in most countries there are proven means for alleviating unfilled needs. In Australia, the lamentable state of Aboriginal health is amenable to treatment. Mentally and physically handicapped children, especially in the more remote parts of Australia, do not receive sufficient care.[1] There are numerous ways in which the suffering of the disabled and chronically ill elderly could be alleviated. It is because of these competing

objectives that the economist's dictum of 'scarce resources but unlimited wants' is applicable to the market for new health care technology.

In recognition of this dilemma, Mr Hunt, the Australian Minister for Health in 1977, established the Committee on Applications and Costs of Modern Technology in Medical Practice. Its terms of reference were to consider the control of technology in public hospitals. No reference was made to the private sector. In the final report, the committee considered the possible regulation of medical fees but advised against action pending further investigation. It was suggested that a national panel be established to act as a repository of technological information and to advise on new technology, and it was recommended that each state develop its own guidelines for rationalising technology.[2] While the latter recommendation was implemented, there was no subsequent attempt to develop a systematic and co-ordinated approach to the control of new technology, and there has been no subsequent formal enquiry into the subject.

Four years after the committee's report, the National Health Technology Advisory Panel (NHTAP) was established to "identify and examine existing and emerging medical technology, to determine methods and priorities for assessment, and to make recommendations to the Minister with respect to assessment and funding of new technology". The resources available to the panel are, however, woefully inadequate for this task.[3] In mid-1984, a full-time secretariat of two was appointed for the first time. Since its inception the panel has met on only eight occasions and produced two reports. While these have been of a high standard, the body cannot adequately monitor the progress of new technologies which are estimated to be arriving at a rate of several hundred per annum and to be diffusing rapidly. In his review of technology assessment in Australia, Hailey concludes that:

> The methods used in this country in reaching decisions on health technology have followed a less logical course than that outlined by the US Office of Technology Assessment (OTA). While advisory/policymaking groups are active in State and Commonwealth Health Authorities, decisions have tended to be made in reaction to pressures from professional bodies and the media and developments overseas and sometimes in accordance with Parkinson's Law.[4]

The purpose of the present paper is to review in greater detail the magnitude of the 'problem' caused by new technology and the reason why the problem has arisen. In the second part there is a review of the contribution of applied economics to the solution. Finally, there is a

proposal for a more integrated approach to the assessment of medical technology and a discussion of some of the principles that could be applied in achieving a coherent policy.

THE PROBLEM

The Macro Perspective: Costs

It is methodologically difficult to disentangle the effects of technology from other cost inducing variables and, to date, there has not been a thoroughly satisfactory analysis of the overall impact of technology in the health care sector. The two most well-known studies obtained opposite results. Fuchs concludes that technology has increased the costs of US health care,[5] while Mushkin and Landefeld claim to have shown that the opposite is true.[6] Both analyses use a 'residual' approach. Rising health care expenditures are explained in terms of a set of readily identified variables — population growth, income, health insurance and the availability of doctors and hospital beds. The unexplained residual is then assumed to be a result of technological change. Unfortunately such studies are very sensitive to the data used and to the specification of the model. Measurement errors and the omission or inclusion of particular variables have significant effects upon the residuals. Since much of the data is collinear and the residuals are very small, the results are, at best, unstable and unreliable. Further, given the specification of the analysis, it is not clear how the results should be interpreted. Since the variables used are those that are generally included in a demand, not in a cost, equation, the residual may simply reflect the effect of technology upon demand.

Alternative, and less ambitious, methods have attempted to identify the contribution of technological change to the cost of particular illnesses and to the increase in hospital expenditures. After one of the most comprehensive of these studies, Scitovsky concludes that "with minor exceptions cost raising changes in treatments outweighed cost saving changes in both periods studied . . . so that the net effects of changes in treatment were generally cost raising".[7] This was largely a result of the more intensive use of known procedures. Thus, for example, it was found that "the number of laboratory tests per case of uncomplicated appendicitis rose from 4.7 tests per case in 1951 . . . to 9.3 tests in 1971 [and] tests per case of perforated appendicitis increased from 5.3 tests in 1951 . . . to 31 in 1971".[8]

This latter observation illustrates an important and recurring theme in the recent literature, namely, that the principal cause of rising costs has been the increased use of undramatic, small scale and often well-established technologies. Banta notes that 10 to 15 per cent of the US hospital expenditures of $US85 billion in 1983 was on intensive care,

itself a complex of technologies.[9] Diagnostic x-rays and laboratory tests cost $US7.6 billion and $US15-20 billion respectively. Diagnostic tests alone accounted for 40 per cent of the recent increase in hospital costs. Similarly, Banta argues that "widely publicised capital intensive technologies contribute a smaller percentage than diagnostic tests. CT scanners ($875 million), coronary bypass surgery ($1.5 billion) and electronic foetal monitoring ($411 million) do not make a ripple in the figures".[10] Scitovsky concludes that "the changes going on in the treatment of common conditions which probably require less spectacular medical intervention . . . . probably account for the largest share of our expenditures on medical care.[11] Maloney and Rogers also argue that small, not large, scale technology has been a major contributory factor to rising costs.[12]

In aggregate analyses of hospital costs, technology has generally been equated with intensity of treatment. The approach is justified by defining technology very broadly as any change in the method of organisation of treatment. However, as a consequence, such analyses cannot identify the specific technologies responsible for changes and, more seriously, they cannot disentangle the effects of changing knowledge or new equipment from the effects of changing practice norms caused, for example, by the increased availability of the given type of equipment or from an increasingly defensive practice caused by an increasing threat of litigation. There is a consensus, however, that technology (broadly defined in this way) has increased hospital costs, but there is no agreement on the magnitude of the increase. Warner's estimate is that 34 per cent of rising hospital costs is attributable to major equipment and its operating costs.[13] More recently, Banta has concluded that between 33 and 75 per cent of the increase is explained by technology, broadly defined.[14]

The Macro Perspective: Benefits

For a number of years there was extreme scepticism concerning the benefits of new technology.[15] This was partly because of the demonstration that the major improvements in health outcome occurred before the introduction of effective therapy,[16] and through repeated demonstrations of the inefficacious and often harmful effects of many technologies. Partly it was a result of the failure of life expectancy to increase in the immediate post-war period. At the macro level, it is difficult to demonstrate the other benefits of technological advance. For the past two decades life expectancy has begun to rise again, primarily as a result of a decline in coronary heart disease and the rate of infant mortality. Three possible causal factors are the increasing availability of the same type of health care services,

technological advances, and a change in lifestyle. The first of these possibilities is not supported by the evidence.[17]

There appears to be little doubt that a major part of the decline in infant mortality has been a result of developments in neonatal technology. There have now been a number of studies of the reasons for declining coronary heart disease. Stern and Goldman and Cook conclude that 40 per cent of the decline is attributable to specific medical interventions,[18] whereas Kannel suggests that up to one third of the decline could be explained by the use of anti-hypertensive drugs.[19] The results are surprisingly consistent with Mushkin's estimates.[20] In this analysis, health outcome was explained by per capita income, unemployment, industrial accidents, the availability of nurses and medical practitioners and by bio-medical research, measured as the number of PhDs in bio-medical science. Mushkin found that for the two periods 1900-1975 and 1930-1975 this index explained 30 to 40 per cent and 20 to 30 per cent respectively of the decline in aggregate mortality. Thirty nine per cent of the decline in morbidity, as measured by sick days amongst members of the armed forces, could similarly be explained by bio-medical research.

The Micro Perspective

The macro evidence surveyed above should not be, in itself, a cause for concern. The observation of increasing expenditures caused by medical technology and a possibly modest return, as measured by health outcome, is not inconsistent with an efficiently operating market in which the production of health is increasingly costly, but in which increments to health are valued very highly. The more legitimate basis for concern is evidence that the benefit to cost ratio of expenditures on medical technology is significantly less than it could be, either as a result of the adoption of ineffective technology or because of excessive expenditures on efficacious procedures. Indeed, as long as the benefits are positive, the macro evidence is almost entirely irrelevant as a basis for evaluating either the market or the need for intervention. Cost enhancing technology may be a reflection of legitimate demands. The demonstration that technology has reduced costs is compatible with massive inefficiency.

There is almost unanimous agreement that inappropriate medical technologies have been introduced and efficacious procedures over used. The problem is not simply that procedures are adopted when costs exceed benefits. Rather, procedures are generally adopted before the benefits are known.[21] Subsequent testing, if it occurs, has commonly shown procedures to be ineffectual and, on some occasions, potentially dangerous.[22] Thus, for example, by 1978 the CT scanner, electronic foetal monitoring and mammography were all in

wide use despite inadequate information on their efficacy and efficiency. It is generally agreed that the significant percentage of false positive results from electronic foetal monitoring was responsible for the epidemic of caesarian operations in the late 1970s and early 1980s, a procedure which involves a non-trivial risk. Banta's survey concludes that the use of this procedure may have resulted in more harm than good.[23] By 1984, magnetic resonance imaging equipment was being produced by at least 23 companies and 145 machines had been installed worldwide. This occurred despite the fact that in 1984 its applications "must be considered potential rather than demonstrated".[24]

The proximate reason for this situation is that there is far greater enthusiasm and funding for basic research than for the evaluation of the products of this research. Few technologies have been implemented after testing by random control trials; even fewer have been subject to cost effectiveness analysis. The more fundamental reason is that the market for medical technology has failed in the sense that there is little incentive for the production of the information required for an accurate assessment.[25]

At each decision point in the medical market the incentives operating in both the USA and in Australia have encouraged the uncritical use of new technology. Neither the individual nor the individual's agent in major decision making — the doctor — has the capacity to evaluate complex technology. In medical care, 'more' is usually equated with 'better', especially when the treatment is new — an equation which is reinforced by the present technological orientation of the population. Cost is not important to the patient as there is extensive insurance cover for the majority of procedures. Similarly, doctors have no interest in costs, and by training and socialisation have a predisposition to use the most recent technology. Medical journals contain innumerable reports of apparently successful, but methodologically unsound, trials of new procedures which could enthuse the casual and methodologically uncritical reader. In addition to this encouragement, media coverage of many innovations heightens public expectations and consumer demands while the manufacturers of medical technologies vigorously promote their products. Hospitals might be expected to place greater emphasis on cost effectiveness, but in the USA for many years, hospitals have competed with one another in the provision of facilities in order to attract doctors and, with them, their patients.[26] In the USA, both the hospital and the doctor are further encouraged to employ available procedures irrespective of their possible effectiveness in order to minimise the probability of a successful malpractice suit.

Finally, and most importantly, there are powerful financial interests within the health care system promoting utilisation of new

technologies. In 1979, there was an estimated worldwide R and D expenditure on health related technologies of between $US11-$US15 billion.[27] The financial viability of the private sector component of this research depends upon the sale of the new technologies. Once sold, there is a further financial incentive for the doctor or hospital to maximise the use of services. With fee-for-service payment, 'utilisation' normally means 'income'. There is clear evidence from a number of studies that the use of new technology is related to the remuneration for its use.

The result of this complex of incentives and lack of restraints is a fairly typical life cycle for new technology that is described by Russell, Williams and most fully by McKinlay.[29] Following the introduction of a new technology, there is a series of 'promising reports' in medical journals. Despite the absence of adequate testing, these gradually lead to 'professional adoption' and so to 'public acceptance'. With time, the technology achieves the status of a 'standard procedure'. At this stage it may, for the first time, be subjected to a random control trial, but only after overcoming significant obstacles to this erected by the financial and professional interests that have come to be associated with the procedure. After the technology has been shown to be ineffective, there is the stage of 'professional denunciation' of the trial. The final stage of 'erosion and discreditation' of the procedure occurs only gradually and may take more than a decade.[30] The purpose of public policy should be to circumvent this immensely wasteful and medically harmful process, and to establish incentives or procedures that result in a more discriminating use of health technology.

THE SOLUTION: COST BENEFIT ANALYSIS

The solution to the 'problem' of medical technology includes two separate stages. First, it must be decided which technologies should be adopted. Second, incentives or controls must be devised to ensure that the chosen technologies are distributed and utilised efficiently. Economic analysis is of assistance with both of these tasks.

Cost benefit analysis was evolved specifically for the evaluation of projects for which market supply and demand could not be used. While its origins may be traced back to 1902, it was not seriously applied to the health care sector until the 1960s, when it was employed to determine the relative merits of dialysis and transplants in the debate over the treatment of end stage renal disease. Since this time there has been significant evolution in the economic theory and three separate titles are commonly used to distinguish variants of this methodology, namely cost benefit analysis (CBA), cost effectiveness analysis (CEA) and cost utility analysis. Essentially, all three involve

little more than a systematic attempt to measure true costs and outputs in a way that permits comparison and decision-making.

The distinguishing feature of cost benefit analysis is that both costs and benefits are measured in dollars. Consequently, it is possible to judge the desirability of a single project in isolation from competitive uses of the resources; if the benefits exceed costs, then the project should proceed; otherwise it should not. When CBA was applied in the health care sector, a major debate occurred over the measurement of the value of life in dollar terms. Neither of the two approaches which have been suggested are thoroughly satisfactory.[31] As a consequence, cost effectiveness analysis has often been preferred. With this, benefits are not expressed as dollars, but in terms of some measure of outcome — often the number of years of life saved or days of morbidity prevented. Occasionally, an intermediate measure is employed such as the number of cases of a disease detected by a diagnostic test. A cost effectiveness ratio is derived which indicates, for example, the dollar cost of each year of life attributable to a procedure. Since the units for measuring costs and effectiveness differ, CEA can be used only for contrasting and ranking projects. In the case where two procedures result in identical outcomes, the criterion for project selection becomes cost minimisation.

Cost effectiveness analysis also has a major practical weakness. Typically, technologies do not result in strictly comparable outcomes, even when they are applied to the same illness. One procedure may result in a longer life but greater pain; another may cause a particular set of side effects. Initially, both CBA and CEA referred to these quality of life factors as 'intangibles', to be noted but not quantified. With the development of cost utility analysis in the last ten years, techniques have been evolved which permit the quantification of these intangibles and the calculation and comparison of costs per quality adjusted life year (QALY). With CUA the typical health states resulting from alternative technologies are described and then judged. In some studies this has been done by physicians and in others by patients, policy makers or by a random cross-section of the public. Time spent in different health states is assigned a cardinal score of weight on a zero-one scale. This may be done in several ways. In the most direct approach, a 'time trade-off' technique is used. Respondents are asked how long they would be willing to spend in one state relative to another. In what is often claimed to be the theoretically more appealing 'standard gamble' approach, respondents are asked to select between two alternatives. The first is N years of life with a chronic illness (which is carefully described). The alternative is a gamble. There is a probability, P, of full health for N years and a probability of (1-P) of death. P is varied until the respondent is indifferent between the alternatives, thereby revealing

that the preference weight which is attached to a year of the chronic illness relative to full health is P. There has been considerable research into the consistency of responses to these questions, into the stability of the response (as descriptions are presented differently) and into how responses vary with time preference.[32] Once weights have been determined, the number of QALYs may be calculated by multiplying years in each health state by the appropriate weight. The cost of a QALY associated with different projects may then be compared and projects ranked.

There is at least one legitimate shortcoming with cost effectiveness analysis as a basis for policy. The implied objective of CEA is the maximisation of aggregate health benefits (however defined) for a given cost. Distributional aspects are ignored. However, it is possible that a project would be preferred if it resulted in a more egalitarian distribution of benefits, or in a redistribution of benefits to a previously neglected group.

A large number of practical difficulties have been raised to support the assertion that CEA cannot be used as the cornerstone of a technology policy.[33] These include the claims that a prerequisite to a successful CEA is a random control trial of a technology and that such trials are time consuming and costly, that the methodology of CEA is still underdeveloped, that few have been carried out to date and seldom with new technologies and that, like random control trials, they are costly and slow. Further, it is argued that the number of new technologies developed each year and the rate at which they change results in an insurmountable logistics problem. Most seriously, it is argued that the delay in introduction of new techniques caused by evaluation will deprive the population of medical benefits; that is, regulation will be a health hazard.

These objections are not persuasive. The cost of evaluation research is high, but not when it is compared with either the cost of basic biomedical research or with the costs resulting from the diffusion of ineffective or harmful technologies. The direct cost of evaluation is not itself a sensible criterion for judging CEA. Rather, the net cost or benefit of the evaluation should be considered after allowing for the savings that would result from eliminating unwanted procedures.

It is true that information available with respect to both costs and outcomes of many technologies will inevitably remain incomplete. This indicates that there should be a sensitivity analysis using the best available estimates of the upper and lower limits of the likely values. If there is insufficient data for even this task to be conducted sensibly, then it is not appropriate to permit the distribution and subsidisation of the procedure.

In 1978 the US Office of Technology Assessment established that each year, hundreds, and perhaps thousands, of new technologies

enter the medical system. Many of these are now routinely evaluated by the US Food and Drug Administration and its equivalent agencies in other countries. It may still, however, be feasible to evaluate only a fraction of the remainder. Despite this, a rational policy would expand the evaluative role until the additional cost of the regulatory activity equalled the expected marginal benefits from the regulation. That is, technologies would be selected for evaluation using explicit criteria, including their potential costs. A prerequisite to fulfilling this requirement is a broad knowledge of the new technologies that are entering the market and a preliminary estimate of their probable financial impact.

Evaluation in conjunction with effective regulation does imply a delay in the introduction of new procedures. It is, therefore, true that some patients will not receive benefits, but it is equally true that others will be protected from ineffectual therapy. If these have substituted for older more proven treatments, this latter group of patients will unambiguously gain from the regulation. If the new, ineffective technolgoy is used simply as an adjunct to the older treatment, there will be an increase in resource use. In the present environment, where health budgets are effectively limited, this implies less health care for other patients. Either way, the unregulated introduction of ineffective procedures will result in poorer health care for someone else. Without evaluation, these costs will last until the life cycle of the technology, described earlier, is completed. This is likely to exceed the delay caused by the evaluation.

Finally, it is also true that the techniques of CEA are relatively new. In particular, the wide ranging application of the QALY in the Australian context would involve extensive research and validation of the weights to be used. While this approach to decision making is new, decision making is not. The unique element in CEA and CUA is that each step in the analysis, each assumption used, and the weights given to each element of the decision matrix are explicit. A different decision strategy cannot avoid these steps or assumptions; it can only obscure them. When data are unreliable, this may be an effective defensive strategy against the criticisms of vested interests, but it does not promote consistency or the maximisation of expected health benefits.

The final defence of CEA is that there does not appear to be a sensible alternative. The imperfection of regulatory methods does not imply the desirability of a market solution. Regulation entails evaluation in which costs and benefits must be compared. The techniques of economic analysis discussed here simply indicate how this may be done properly.

A PROPOSAL FOR ASSESSMENT OF MEDICAL TECHNOLOGY IN AUSTRALIA

To control successfully the diffusion of beneficial technologies, six general principles should be observed.

1. Comprehensive Planning

It is not possible to control the diffusion of technology by regulating only one part of the health system. As in the USA, where this occurred, the result would be shifting of technology into the unregulated sector. In particular, the failure to regulate the private sector would distort and finally undermine control. The unregulated introduction of technology would result in potentially large medical incomes and increased professional interest for the best practitioners, thereby either depriving the public sector of these doctors or forcing medical payments to increase. A possibly false public perception of superior quality, in combination with strong physician incentives to direct patients into the more profitable private sector, could lead to either a progressive erosion of the public sector or to the competitive adoption of unwarranted technologies.

2. Balancing Costs and Benefits by Doctors

The structure of the health care system should encourage, as far as possible, the utilisation of new technologies only when benefits are believed to match costs. In practice this can be achieved in two ways. First, when technologies require capital equipment, this may be physically limited so that the capacity exactly matches the estimated number of cost-effective services needed. Second, when capital equipment cannot be controlled, the level of remuneration should contain no financial incentive to carry out the procedure — the reward should leave the physician financially 'neutral'. With both options decision makers should be as fully informed as possible by recent evidence on the efficacy of technology. In the absence of financial incentives, the professional behaviour of practitioners could be expected to result in the efficient use of technology. In the first case, equipment would require rationing. Use would be restricted to those who received the greatest benefit. In the second case, control would be less effective. Doctors would have a professional incentive to use any efficacious procedure, not simply those where benefits exceeded costs. This problem could potentially be overcome by the inclusion in the Medicare benefit schedule of a description of the procedures that were eligible for an insurance rebate. The diffusion of technology may also be checked by imposing budget caps either on hospitals or on geographic regions. While this may be a potentially useful backup to 'catch' those procedures that avoid control, it is an indiscriminate

technique. It is less likely to result in the optimal use of particular procedures.

3. Co-ordinated but Decentralised Decision Structure

There are probably economies of scale in both technology and economic assessment. For this reason it is desirable to have a national centre for the assessment of health technology (NCAHT). However, while planning should be coherent, it is not necessary that all decisions should be made nationally. To achieve the greatest flexibility with respect to local needs, decision making should be made at the most decentralised level subject to the technical constraints imposed by the technologies.

4. Balancing Costs and Benefits by Governments

If decisions are to be made by different levels of government — federal, state or local health region — it is desirable that the decision making body that receives credit for the technology should also bear the costs. It is not sensible, for example, for the state government to make decisions and receive credit for equipment that is financed by the federal government. Under these circumstances, the states will understandably behave in a politically rational and economically undesirable way. Further, it is desirable that the full cost of decisions be borne by the decision making body. Cost sharing reduces the incentive to act and enforce politically difficult measures.

5. Coherent Regulation

There should be the minimum possibility of controls being circumvented or disputed in a way that results in the distortions encountered in the USA following the certificate of need (CON) regulations, designed to restrict supply physically to a level that was demonstrably necessary. This implies that discretion should be used sparingly and subject to the conditions discussed above. There is extensive evidence that when criteria are lax, *ad hoc* and subject to negotiation, arbitration or legal challenge, the resources and motivation of the regulated far exceed that of the regulators, and regulation commonly fails.

6. Proactive Decision Making

Guidelines should be determined for particular technologies before, not after, they have entered the country. They should determine what is desirable, not attempt to control what has already happened. After technologies have been established, there will be financially powerful groups with a vested interest in preventing regulation. It will be

difficult to conduct random control trials since it will be claimed that for 'ethical reasons' patients cannot be denied treatment.

A National Centre for Assessing Health Technology

Evaluation and policy guidelines should be initiated and co-ordinated by a national centre for the assessment of health technology (NCAHT). Such a body should have three central functions.

1. Knowledge and Dissemination. A prerequisite to the proactive dissemination of guidelines is a knowledge of the technologies that are likely to enter the market and the most recent evidence on their likely costs and benefits. A detailed technical library should therefore be maintained, supplemented where possible, by correspondence with relevant research organisations. This section of NCAHT could be responsible for periodic (annual) reviews of recent developments in the technologies investigated by the centre and for the dissemination of this information to the appropriate bodies — government agencies, hospitals or private practitioners.
2. Basic Research. There should be three levels of basic research in this section of the centre. The first would be a preliminary 'back of the envelope' assessment of the probable magnitude of the costs and benefits of new technologies. This first stage would be used to rank technologies in order of priority for subsequent investigation. In addition to costs and benefits, a further criterion for selection should be the extent to which a new technology could be over utilised. If it was capable of being applied to only a limited range of well-defined symptoms (as in the case of lithotripsy), there would be less concern than where procedures could be applied to virtually anyone with particular trivial symptoms (as with magnetic resonance imaging of the brain). The second level of research would be cost effectiveness analysis, commencing with an assessment of clinical efficacy. This could employ either overseas results — collected by the library section — or, in its absence, new Australian research. It would be desirable for the centre to support its own project team for small scale evaluation and to have the capacity to commission outside studies. For large scale projects it would be necessary to forward recommendations to the minister, as in the recent case of magnetic resonance imaging. The third type of research would be methodological: to determine, for example, the applicability of the QALY in the Australian context, to determine weights for different states of health and whether it was feasible to obtain a robust 'all purpose' set which could be used in a variety of cost effectiveness analyses.

3. Policy Advice. A fourth type of research would be conducted by NCAHT. The results of the cost effectiveness analyses would be translated into national requirements. The outcome of this process could be of two forms. First, there could be a recommendation with respect to the ratio of units of equipment per 100,000 population, after adjusting for age and sex or after adjusting for other relevant variables. Secondly, there could be a recommendation with respect to a particular rebate to be paid for a procedure, calculated in the way described later. Each type of technology considered should be categorised by the policy branch of NCAHT according to the level of government at which the control would be exercised. This, in turn, would be determined by the type of technology. There are four likely levels:

   a. national:

      Where the unit of capital is so large or the condition is so unusual that a single national centre is desirable. This might apply, for example, in the case of liver transplantation, bone marrow transplants, or if different national centres were designed to specialise in particular cancers. Where the specialisation was too great or the condition was too rare, NCAHT could recommend overseas treatment as a more cost effective alternative than a national centre.

   b. state:

      It may be necessary to co-ordinate certain large scale technologies statewide. Candidates for this category would be perinatal, coronary and intensive care units, burn centres and magnetic resonance imaging equipment.

   c. local:

      When the optimal number of units is sufficiently large, it may be desirable to decentralise decision making to the health regions within a state. Candidates for this might include the CT scanner, chemotherapy, dialysis and day surgery.

   d. office or health centre:

      Capital equipment is often too small for direct controls to be feasible, or in some cases, specific equipment may not be required. This category includes electronic foetal monitoring equipment, dry chemistry pathology, and surgical techniques.

While NCAHT would not regulate directly, for it to be effective there should be formal channels between it and the branches of government that would implement policies. Consequently, representatives of each of the four levels above should be included in

NCAHT or, conversely, members of NCAHT should be represented at these other levels. Control of level d technologies entails the regulation of insurance rates. Consequently, there should be a formal link between NCAHT and the Health Insurance Commission.

The first three categories in the control hierarchy would imply direct regulation of the number of physical units to be implemented. Additional units which might enter the private sector should either be denied reimbursement from private and public insurance or, preferably proscribed through licensing laws. Once capital has been established, it is possible to mount a political campaign to obtain benefits. Control at the national level is relatively straight forward as the principles for successful regulation listed earlier are all fulfilled. The commonwealth government, through the Department of Health, would bear the cost of the units and receive the political credit.

State governments control public hospitals and additionally have the constitutional power to pass the laws necessary to regulate private hospitals and the private sector generally. Consequently, without the co-operation of the states there is little possibility of controlling the diffusion of technology. As noted earlier, however, there are strong political reasons why the state should not co-operate. There are real political costs in regulating a powerful profession. But there is no burden to the state treasury when private equipment is installed and the recurrent costs of the equipment's use are financed by the federal government via the Health Insurance Commission. Worse still, there is a positive inducement to allow this to happen. If the private sector expands, there will be fewer demands on the public hospital system. There is an incentive to control costs within public hospitals, but the incentive with respect to high technology equipment is diluted by the fact that the right of private practice by salaried staff using this equipment results in a profit to the hospital and to the state. A fraction of the fee is retained by the hospital and state payments to the salaried staff can be reduced and an equivalent fee for service payment substituted.

It is possible to alter these incentives by adopting a proposal for the reform of fees made by Richardson.[34] Following NCAHT advice, the Commonwealth should decide upon the appropriate level of provision of capital. The general purpose grant from the Commonwealth should then be increased by an amount which would compensate the state for both the capital and the operating cost of the equipment, where the operating cost is calculated as the number of services that are predicted to arise from the state's population times the rebate which is paid for the service from the Health Insurance Commission. The actual fees (not rebates) charged for procedures which use this equipment should be summed by the Health Insurance Commission and deducted from the general purpose grant. States should be free to

licence as many units of the technology as they wish in either the public or the private sector. The effect of this proposal would be to increase both efficiency and equity. Efficiency would be enhanced since states would be forced to compare the marginal costs and benefits of their decisions. They would have, for the first time, a strong incentive to enact adequate legislation for the control of the private sector. With respect to equity, if states adopted the national guidelines suggested by NCAHT, the net cost would be zero. If they failed to control the proliferation if ineffective technologies, they would bear the cost. This is more equitable than the present system where the states that fail to enact controls are cross-subsidised by the taxpayers in the states that achieve effective regulation. The proposal permits states to deviate from the recommended guidelines. This does not appear to be an undesirable feature.

If the evidence provided by the knowledge dissemination section of NCAHT unequivocably indicated the desirability of a given level of provision, it is unlikely that a state would deviate from the recommendation significantly. If the results of evaluative research on a technology were unclear, a degree of variability in a state's performance would be justified by legitimate differences in the interpretation of the evidence. Flexibility with respect to local demands is efficient; uniformity *per se* is not.

States could determine whether decision making should be devolved, in part, to regional health authorities. If this were done, then the same principles could apply between the state and region as described above for the Commonwealth and the state. That is, regions could determine the desired level of high technology from within the third tier of the heirarchy. NCAHT would provide information on costs and benefits and the regions would bear the cost of additional capacity in the form of a reduced health service elsewhere.

When the control of capital is not possible, the principle should be adopted that there should be no financial inducement to use a procedure: strictly medical criteria should apply. This incentive will be achieved only if the fee received for a procedure is strictly equal to the marginal cost of the procedure. Incentives could be inappropriate if, for example, an allowance was included for the cost of capital equipment. This would result in the marginal reward exceeding the marginal cost. There would be an incentive for overuse — to recoup the capital cost repeatedly! If equipment is sufficiently inexpensive and the procedure sufficiently common that every doctor in a particular specialty is likely to purchase the equipment, the capital cost should be considered as part of the cost structure of the entire practice and a recommendation made for it to be built into the cost component of the medical fees structure. In effect, the capital cost would then be spread over all of the services carried out and the

procedures from the new technology would be reimbursed at cost.[35] When the direct operating cost of a technology was close to zero it could be appropriate to have no separate item for the procedure and reimbursement would be in accordance with the length of the consultation.

A similar logic results in the conclusion that the marginal cost of a procedure should be calculated as the marginal operating cost of the machinery plus the foregone earnings of the doctor during the time taken to carry out the procedure. That is, the professional component of the fee should not exceed the time taken for the procedure times the average rate of remuneration for that type of specialist per unit of time. An increased fee to 'compensate' for an 'increased work value' would result in both inefficiency and inequity. The time and training required to master the new technique is the cost of obtaining the human capital necessary to carry out the procedure. As with the cost of physical capital, this can not be recouped through the particular items or else the reward per procedure would exceed cost, thereby generating an inapproporiate incentive. Rather, the compensation should be built into the entire fee schedule. This is already done annually when the 'net income component' of the fee schedule is increased. There is an explicit recognition in this process that doctors should benefit from the general productivity growth of the community. It would be quite inequitable if doctors, alone, were compensated twice for productivity gains: once when the productivity increased in the general community and the second time when their own productivity was increased. This does not occur elsewhere.[36]

The requirements discussed above for achieving control at the fourth office or health centre level imply that the rate selected as equalling marginal cost should be a maximum fee. It would not be possible to permit doctors to charge in excess of the scheduled fee. Such an increase would provide the incentive to expand services that this proposal seeks to avoid.[37] There is a precedent in the recommendations of the recent Pennington committee for constraining diagnostic fees to a particular level. This principle needs to be expanded.

The Private Sector

With the proposals outlined here, the private sector would become part of an integrated network. For the reasons given earlier, part regulation of the health care system would, at best, cause serious distortions and would probably fail in the long run. While there is no reason, in principle, why new technologies should not be installed in private facilities, it increases the difficulty of overall control. It was noted by Banta and Russell that the reason for Australia's comparative success in controlling technology to date is that it has

been concentrated in public hospitals and subject to global budget controls.[38]

A particular dilemma arises if the private sector is to be part of an overall state network. In the proposal above, the capacity of capital equipment was to be restricted to the optimal level and, after the provision of information, it was assumed that doctors would ration patients in accordance with medical need. In public hospitals financial considerations are almost irrelevant and the assumption is reasonable. With the private sector sharing some part of the equipment, the total capacity might remain the same, but a second motivation could be introduced. Generally, the fee paid to the private sector includes a component to compensate for the capital cost of equipment. As noted earlier, this results in the fee exceeding the operating cost: the procedure is profitable. Consequently, the owner of the equipment has an incentive to maximise the number of private patients using the equipment at the expense of the more needy patients of other private doctors who will be forced to use public facilities. This would result in excess demand for public sector equipment and the use of private sector capacity for profitable but cost-ineffective procedures. The monopoly power granted to private practitioners could also result in significant patient charges which would reinforce this process.

The two possible solutions to this problem were discussed earlier in the context of office or health centre controls. First, it might be possible to describe the procedures for which a medical rebate is eligible (for example, MRI scans of the brain and central nervous system, but not of other parts of the body). In this way, owners of equipment would be forced to share capacity with others in exchange for a service fee. Secondly, where this was not possible, the only feasible solution appears to be the constraint of fees to the marginal cost of operating the technology. Since the capital cost could not be recovered, it would be necessary for the practitioner to receive a government grant. With either solution the private equipment would have to be considered as a semi-public utility. It would be an integral part of a state or local network of health services. It would not simply be the property of a private entrepreneur.

Finally, the private sector has often been regarded as a watch dog on the public sector — a safety valve in case regulators mistakenly define their role as being the minimisation of expenditure, irrespective of benefits. Clearly this task cannot be carried out by the free uncontrolled diffusion of unevaluated technologies. It would, therefore, appear to be desirable for channels of communication to be formalised between interested private practitioners and the NCAHT — first, to ensure the maximum flow of information to the regulatory body; secondly, to correct errors of analysis; and thirdly, to appeal

against recommendations. A final right of appeal to the minister should be regarded as normal.

CONCLUSION

Evaluation and regulation of new technology have the potential to improve significantly the health status of the population. Most obviously, evaluation will minimise the probability of the adoption of harmful procedures. Further, to the extent that new and ineffective techniques may substitute for older, more effective, methods of treatment, regulation will protect the quality of care. There is a more indirect beneficial effect of regulation. When overall health costs are rising and there is a general, but not very specific, perception that the returns on new technologies are rather low, there will be strong fiscal pressures to adopt indiscriminate control mechanisms, such as fixed budgets. In the absence of careful evaluation, the procedures to be eliminated in order to achieve the arbitrary budget limits will reflect the relative political powers of the specialty groups involved, rather than the actual benefits of the particular procedures. The many significant benefits from new and effective medical technologies may be jeopardised by the failure to separate them from ineffective procedures.

The proposals that have been outlined here are not designed to reduce expenditure *per se*. Rather, their purpose is to maximise the probability that when expenditure occurs it will be on efficacious procedures, and to ensure that, subject to the achievement of regional flexibility, health benefits per unit of expenditure are maximised. The control system suggested is compatible with any level of aggregate expenditure that society is prepared to devote to effective health care. Further, the logic of the principles discussed is not specific to the evaluation of conventional medical technologies. It might be applied equally well to the health care services offered by chiropractors, acupuncturists, naturapaths, and by those practising other forms of alternative medicine.

There are two major obstacles to the institutionalisation of evaluation and regulation. The first is the perception that such activities would be excessively expensive. Hicks points out that a commitment of one per cent of total health expenditures would more than suffice for the task and that even this is a significantly lower proportion of revenue than is normally spent on research and development.[39] The one per cent estimate is almost certainly excessive. However, the more relevant issue is whether the expected benefits of regulation exceed the expected cost. While the indirect costs of regulation are hard to estimate, there is little doubt about the magnitude of the potential benefits. Even the most hasty arithmetic

figuring indicates that they are great. For example, the successful prevention of twenty MRI machines from entering the market could alone save the country $100 million. Compared with such savings, the administrative costs of a regulatory program are trivial.

The more serious obstacle is the possible lack of political will to obtain these benefits. The lamentable history of the NCAHT in the USA is striking verification of a basic tenet of the anti-regulatory lobby, namely, the inability of governments to act in the public interest when the benefits are dispersed and hard to identify and there is concentrated, well-organised opposition from vested interests.[40] Unfortunately, there does not appear to be an acceptable alternative to reliance on a stumbling and often self-interested government. The alternative is to permit the unrestrained expansion of unproven technologies in a market environment where demand is potentially unlimited, where use — not effectiveness — generates profit, and in which the profession may legitimately and profitably equate use with quality. This option does not make good sense.

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35. It is arguable that the proposal outlined here would result in excessive fees. Doctors with excess capacity (resulting from an oversupply of practitioners) would have a financial incentive to carry out procedures and obtain an average rate of return when they would otherwise obtain nothing.
36. Over a period of time wages are linked to an increase in average productivity, not simply through industrial tribunals, but by the need for businesses to pay competitive wages. When productivity is less than average, wages must still, ultimately, rise, thereby forcing up prices and causing a contraction of the (inefficient) industry. When productivity exceeds the average, wages do not rise excessively unless trade union pressure causes an undesirable distortion in the market. Rather, relative prices fall, the industry expands, and the benefits of the productivity growth are shared throughout the community. In the present case, the increased productivity of doctors would result in increased consumer benefits per dollar of health expenditure. It is not equitable for doctors to be exempted from contributing their share to increasing community benefits in the way described.
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