

High Technology Medicine: How Defined and How Regarded

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THE WORD "TECHNICAL" SHARES WITH "ACADEMIC" a tendency to attract secondary pejorative adjectives. And nowhere more so than in the academic world. Compare technical high schools with grammar schools, technical colleges with universities, technicians with scientists. Not for nothing does the Dean of Arts sit two places higher at the University Senate table than I do, as Dean of Medicine; but I am two places higher than the Dean of Engineering. If art looks down on science, then science looks down on technology. In the mandarin mumbo-jumbo of the University Grants Committee technologists are grudgingly accepted as "academic-related." Yet for the dictionary, technology is the science of industrial arts—from the Greek *technicos*, meaning art. Art is defined as human skill or workmanship, and that implies the use of tools. Indeed we tend to define the progress of civilization by the increasing sophistication of the tools that are used, as well as by the products of their use. Of course it is the use to which modern medical technology is put that provokes most discussion and that will take up most of my review. But first I am concerned with defining technology at the mechanical level and describing the different forms it takes. I make the simple proposition that technology means the use of tools.

Tools extend our powers of observation and of manipulation. With tools we can sense or do things that we could not without them; or we can achieve an objective more readily. A tool need not be complex to have far-reaching effects, not only on practice but on concepts. Before the invention of the stethoscope there was considerable debate about how to ascertain that death had occurred; a late eighteenth century article asserted that putrefaction was the only certain evidence. Laennec's tubes focussed attention on the heart beat as the signal of life; 150 years later another technology (the mechanical ventilator) displaced that concept.

My concern is with *high* technology. But when is a technology so regarded? This must be arbitrary because some of today's high technology may become tomorrow's low technology, as some of today's research becomes tomorrow's routine. For my purpose I propose an operational definition—that it is complex and expensive, with the consequence that it is restricted in availability—usually to a limited number of places where it is under the control of specialist staff. It follows from this that demand for its use exceeds supply, so that some form of explicit rationing is required. It is possible to analyse high technology according to the type of machine or instrument used—radiological, endoscopic, anaesthetic, and so on. But the debate is less about the mechanics than it is about the secondary influence that increasing use of high technology may have on the practice of medicine—both in general and for particular patients. That requires consideration of where high technology fits into the agenda of the medical task.

The Medical Task

At the risk of over-simplification I suggest that the main components of that task, at least for hospital doctors, consist of the sequence: diagnosis, prognosis, decision, and management. Notice that I place prognosis immediately after diagnosis, not as an epilogue or afterthought as so often happens in medical textbooks. In the days when doctors could do little to influence the outcome of the illness, their reputation rested largely on the veracity of their predictions. We are today so busy with what we do about illness that we are apt to overlook the importance of prognosis. Seldom does the discharge letter from hospital

to the family doctor include a specific statement about prognosis. It could hardly do so when written by junior staff, who do not have the necessary knowledge; but their seniors are often no more ready to offer an estimate of what the future holds for this particular patient. Yet prognosis is the central component of the medical task. Diagnosis, which comprises not only labelling but an assessment of severity, should lead to a prediction of the probability of various outcomes, with or without alternative interventions. If decisions about management are to be rationally based they should depend on comparing these different probabilities—which ought to encompass the relative risks and the likelihood of benefit associated with alternatives, not forgetting the natural history of the condition without medical intervention.

I have not only promoted prognosis to what I regard as its proper place in the sequence of medical practice, but I have interposed decision-making as an explicit step. The word "treatment" I have displaced in favour of "management." There will be those who argue that prognosis is implicit in diagnosis and that decision-making is implicit in management. However, in order to analyse the potential contribution of high technology to the medical task, as well as its secondary influences, it is useful to identify these separate activities and to itemize the main types of action involved in each of these steps.

DIAGNOSIS depends on eliciting a history and examining the patient, sometimes supplemented by investigations; and then on processing all this information.

PROGNOSIS depends on comparing the information about this individual patient with what is known about similar patients who were managed in various ways.

DECISIONS have to be made about what to do for the patient as well as about what to tell the patient and his family.

MANAGEMENT is more complex, and is best analysed by considering separately ends and means—objectives and methods.

The objectives of management vary greatly, and those initially embarked on may have to be altered because of new developments. The most consistently beneficial form of management is undoubtedly *reassurance* of the patient that he has a benign, self-limiting condition that calls for no medical intervention. But this brings benefit only when this assertion is well founded.

Even with all modern therapeutic advances *cure* is a possible objective

in only a minority of patients diagnosed as having a condition that will not resolve on its own. Even in such cases cure can seldom be assured, and intervention usually involves some risk of complications. Most patients who now reach hospital have progressive disease the ultimate outcome of which cannot be influenced. There is a wide variety of such patients—from those likely to die in the next few months to those facing many years of physical or mental disablement that may be continuous or intermittent. It is an oversimplification to style the needs of these patients as *care*, and then to contrast this with cure—especially as this carries the nuance that if we can cure we need not be too concerned to care. Those “incurable” patients who are terminally ill need comfort, sympathetic and honest counselling, nursing and social support, and sometimes symptomatic measures such as drugs to relieve pain. For others who have less advanced disease more active but strictly palliative intervention may be appropriate, such as deep x-ray therapy or limited surgery, but with no expectation that life will be prolonged. In the management of conditions that do not threaten life (e.g. congenital abnormalities, arthritis, psychosis) *palliation* may be highly effective, but it cannot rightly be termed cure.

In an attempt to correct the false dichotomy between curing and caring in hospital medicine I proposed some years ago that a third category of activity be recognized—for which I suggested the term *rescue*. Such activity (Jennett 1976) relates to life-threatening situations—though the threat need not be immediate nor the intervention an emergency. Rescue procedures are often successful in postponing death and they sometimes result in cure. More often they extend the duration of survival of disabled patients; sometimes their quality of life is much worse after rescue than it was before the crisis that called for rescue. Consequently doubts can arise, even in the minds of caring relatives, as to whether the rescue has been worthwhile—even though in strictly medical terms it may have been judged to have been “successful.” Rescue procedures include intensive care, renal dialysis and transplantation, much open heart surgery and neonatal surgery, and a good deal of treatment for cancer. Rescue usually involves high technology and it is not surprising that they share many characteristics—high cost and limited availability of specialized equipment and staff. However, rescue is only one use to which certain types of therapeutic high technology can be put—most can also be used for cure or for palliation.

Technology and the Medical Task

A distinction must therefore be made between high technology per se and how it is used. Much of the criticism of technology is fuelled by the inappropriate application of tools that have considerable potential benefit if only they were properly deployed. How best to ensure more appropriate use of high technology in the future is a theme dealt with elsewhere (Jennett 1984). Here my concern is to identify in broad terms different aspects of the medical task to which technology can contribute, before describing the main types of high technology that loom large in medicine today. Most of the tools of medical technology can be regarded as fulfilling one of five technological tasks. These are visualizing parts of the body, measuring physiological function, substituting lost function, contributing to surgical procedures, and processing information.

Visualization

Roentgen's discovery (in 1895) that x-rays could enable doctors to see the bones was one of the milestones of medicine. The next 70 years saw the development of contrast radiology to enable non-opaque bodily parts to be shown by x-rays. Many of these procedures were uncomfortable at best (barium meals and enemas), whilst some carried appreciable risks (angiography of the brain or heart). The development of the new imaging techniques of isotope scanning, ultrasound, CT scanning and magnetic resonance imaging (MRI) have not only enabled doctors to see much more than ever before, they have also made the acquisition of that information much less uncomfortable and hazardous to the patient. As a consequence investigations can now be more readily embarked on and repeated, resulting in an increased yield of knowledge particularly about dynamic aspects of various conditions. In the case of CT scanning and MRI, and to a lesser extent isotope scanning, they have also introduced a mathematical element into imaging which makes its interpretation less of an art form. It is less dependent on the experience and visual imagination of the radiologist because the degree and extent of an abnormality can now often be expressed in terms of a calculated deviation from normal.

Endoscopy has come a long way from the original cystoscope (in 1877), and fiberoptics have now made it possible not only to see much more but it has enabled doctors to dispense with more unpleasant means of acquiring that information.

The operating microscope was first used for ear surgery in 1921, but only in the 1960s did it become a tool for surgeons in many disciplines—ophthalmology, otorhinolaryngology, neurosurgery, and peripheral nerve surgery. You may believe that it belongs under surgery in my classification—but I have it under visualizing technology so that I can remind you that both imaging and endoscopy can be used for interventions as well as for investigation. These new technological tools have not only made many hazardous investigations obsolete, but they have dispensed with the need for open surgery in the treatment of several conditions.

Measurement of Physiological Functions

It was in 1901 that Harvey Cushing returned from Italy with the technique for measuring blood pressure. He soon reported the application of this to the monitoring of the blood pressure during anaesthesia using the so-called ether charts. No longer were doctors dependent on whether the pulse was hard or soft, bounding or thready. The continuous measurement and display of heart rate, electrocardiogram, respiration rate and pattern, and of blood pressure are now commonplace in intensive care units, and the foetal heart is often electronically monitored. I did not include monitoring as one of the major medical tasks, regarding it as a subset of investigation. However, monitoring may contribute not only to diagnosis but also to prognosis and to management, in that changes in vital parameters can indicate the progress of a condition, response to therapy, development of complications and the need for further action. Monitoring is prevention, with a small “p” and on a short time-scale, preventing complications rather than diseases—but contributing significantly to avoidable mortality and morbidity. Monitoring of this kind tends to be associated with the patient being wired up to machines and thereby restricted in movement. But the development of telemetric devices is already well advanced (e.g. SAMI, the socially acceptable monitoring instrument).

Substitution of Lost Function

Early examples of this approach to therapy were wooden legs and spectacles. Powered limb prostheses, contact lenses, and hearing aids are in that tradition, as are various electronic communication aids for the disabled. More readily recognizable as high technology are dialysis machines, pacemakers, and ventilators, the latter having been around

for longer than you might think. A hand-operated model of 1876 was proposed for installation at one mile intervals along the River Seine for reviving the nearly drowned; this plan was never put into action because of the public expense—*plus ça change, plus c'est la même chose*.

Surgery

This was perhaps the first medical technology—the first assault on the human body with tools designed to heal rather than to harm. Because it has become commonplace it is now seldom considered a part of modern technology. Indeed most of the instruments used are little different from those of a hundred years ago. Knives, saws, clamps, and sewing needles are still the main armamentarium of the surgeon and although some of these are now powered they are still knives and saws; even high technology knives in the form of lasers represent only a modest advance. Other external means of destroying pathological tissue still centre on radiotherapy in its various forms—another type of high technology that has long been with us. The value of some modern technologies, such as extracorporeal circulation equipment, the operating microscope and endoscopes, is to make possible more complex but traditional techniques of cutting and stitching.

Collecting and Collating Information

Computers are now commonplace in hospitals. Perhaps because they are also seen in the supermarket, the garage, and the bank they seldom excite comment as an aspect of modern medical technology—except for concern about the confidentiality of personal information. Yet it is the technological capacity of computers to store and to collate information about symptoms and signs, investigations, therapeutic processes, and outcomes gathered from large numbers of patients that provides the most effective means of measuring the benefits of high technology. This is because diagnosis and prognosis that are based on such systematically collected and collated data are more accurate than those based on clinical experience and intuition. Decision-making can then be more rationally based, because the probabilities of various outcomes associated with alternative means of management can be compared. Computers also make it possible to assess the value of new technologies more rapidly and efficiently than would otherwise be

possible. Partly this is because of the computational power available; but it derives also from the discipline that the use of computers imposes. To make clinical observations compatible with the computer demands stringent definitions that can be expressed in digital form. These can prove beneficial to medical practice far beyond those hospital units that are involved in formal research. Moreover the adoption of such constraints makes multicentre trials possible, thus accelerating the accumulation of adequate numbers for valid conclusions to be drawn, for example about the efficacy of a new technology. With an increasing number of students already computer-wise when leaving school, and with low-cost computer systems becoming rapidly more available, no one can doubt that the practice of medicine will become increasingly computer oriented, if not computer dependent.

This classification of medical technology by function may be useful for analytical purposes but in practice the tools of technology take their place alongside traditional procedures. Nonetheless there are certain medical activities that involve so much technology that they are immediately recognizable as high technology packages—e.g. intensive care, renal dialysis and transplantation, and open heart surgery. Some specialties, such as obstetrics and neurosurgery, have certain high technology components but retain much traditional activity. Yet other specialties, such as radiology and laboratory medicine, are almost wholly technological. In patient-contact technologies reference is often made to the contrast between invasive and noninvasive techniques. Views will differ as to what constitutes an invasive technique but one objective of technological development is to achieve safer and less invasive methods, a goal already achieved in many areas. When it comes to attitudes to technology a distinction might also be drawn between visible and invisible uses of technology. In the x-ray department and the obstetric unit the patient sees, hears, or feels the machines; in intensive care units the relatives sit by the bed and watch the ventilators. But no one sees the technology of the operating theatre, of the biochemistry laboratory, or of the computer that is producing diagnostic and prognostic probabilities.

Attitudes to Technology

For centuries medicine was largely an extension of the church, dispensing comfort and charity rather than cure. The language of the monasteries

lingers—we work in hospitals and infirmaries and many of us still betray our age by talking about nursing sisters. An early Picasso, depicting a bearded physician sitting beside his patient's bed, was cruelly captioned by one of my teachers "Devoted but Dumbfounded." Its actual title is "Science and Charity." That could act as a text for us today, faced with the need to tame and humanize technology. But when this was painted in 1896 the problem was the opposite—doctors were long on charity and short on science.

The first half of this century saw doctors able to offer more and more by way of investigations, drugs, and surgery. But the individual specialist remained largely a solitary entrepreneur who formed a direct relationship with his patient and who delivered health care according to his personal inclination, inspiration, intuition, or prejudice. For his work in the voluntary hospital the specialist was not paid, a system that emphasized that for the masses health care was still a charity. For the minority it was fee for service; but although the private patient might talk more with his doctor than did the charity patient, the individual doctor's word was still largely law. Like the church from which it had emerged the medical profession depended much on a combination of authority and mysticism or magic; also on the unquestioning faith of those to whom it ministered. That was no bad thing at a time when few medical interventions had any direct therapeutic benefit and the placebo effect was all important. Placebo, first used as a medical term in 1811, is defined in the Oxford English Dictionary as "medicine given more to please than to benefit." And it too has ecclesiastical origins, being the opening words of the first antiphon of, appropriately enough, the Vespers for the Dead—"Placebo Domino. . . ."

Changes in the practice and organization of medicine in the last quarter century have fundamentally changed the role of the hospital doctor—and particularly of those whose specialty involves them in using high technology medicine. He can neither deliver complex services of this kind without the assistance of a team of other specially trained staff, nor can he dispense expensive services on his own authority. This is because the supply of such services cannot meet demand, so that some form of explicit or implicit rationing is inevitable. The availability of such technology is limited both because of cost and because, even if money were no object, there would not be enough skilled staff to satisfy demand. Such limitations are not a peculiarity

of Britain or of other countries with various forms of national health service. Even in the most affluent of western countries there is no possibility of individual practitioners providing, nor of patients as private persons paying for, unlimited intensive care, renal dialysis, or open heart surgery. Because of the more visible nature of cash transactions in North American medicine, however, discussions of high technology medicine there tend to be dominated by considerations of cost; moreover these discussions are apt to be more precise and practical and less philosophical than they are in Britain.

The emergence of high technology medicine and the growing cost of hospital care in many specialties has therefore changed the role of the hospital consultant.¹ He is no longer a solitary provider making a personal social contract with the patient. Rather he has become a member of a large team that includes other doctors, technicians, and administrators—in addition to his traditional team-mate the nurse. He has become a manager, and often also a technologist, to add to his traditional role of healer and scholar—by the latter I mean one who learns and who teaches (Jennett 1974).

These changes in medical practice have been occurring *pari passu* with the information explosion that is associated with the emergence of television as almost an additional estate of the realm. The public today has unprecedented knowledge, not only about medicine but also about the workings of government and of politics. This has resulted in a move away from paternalism so that experts are now more likely to be suspected than respected. Medicine has not been immune to these societal changes which have altered the way that people regard illness and its treatment. The cartoonist may still depict the doctor forcing unpleasant medicine down the throat of his patient in order to portray authority (e.g. the Chancellor in his budget) forcing a line of action on an unwilling public “for its own good.” But medicine is no longer like that, for the doctor has lost a lot of his authority and mystique. People increasingly expect some say in what is good for them even in the field of medicine—both corporately at the level of policy-making, and as individuals confronted with their own illnesses.

Before considering how best to exploit and control medical technology

¹ *Hospital consultant*—all medical specialists, exclusive of house staff, practicing in hospital.—Ed.

in the future it is important to note some attitudes to technology that have already become commonplace. Many are based on false perceptions, on expecting too much or too little from technology, on blaming it or extolling it for changes that are in fact due to other factors. Even if some of these misapprehensions are corrected others are bound to persist and new ones will doubtless emerge. Unless due account is taken of how technology is viewed and what responses it evokes, plans for the better deployment of technology in the future may well be frustrated. When it comes to considering attitudes to technology a much simpler classification is needed than the analytical one already proposed. I suspect that most techniques are seen as being either diagnostic or therapeutic. Moreover diagnosis is seen in much more contrasting blacks and whites than is often the case in practice. A diagnostic machine will be seen as "excluding" sinister possibilities such as serious heart or brain disease or malignancy—making reassurance or relieve the simple but vital sequel. But when diagnostic technology reveals disease there is often too ready an assumption that this will logically lead to effective treatment. Campaigns for the early detection of disease, in particular of cancer, have sometimes resulted in doctors becoming victims of their own propaganda. Unhappily the evidence that early diagnosis results in improved outcome is still limited to relatively few situations. No one would advocate actively delaying diagnosis, but before yielding to the temptation to designate diagnostic technology as a weapon in "the fight against cancer" doctors should reflect on the other side of the coin. The early diagnosis of untreatable disease may do no more than prolong the period of worry for the patient and the family. As a resident I worked for a physician who did medical examinations on executives for insurance purposes. He so often discovered symptomless high blood pressure, then a condition for which there was no simple effective treatment, that he would never let anyone take his own blood pressure. It is said that when, in the early days of CT scanning, the consultant staff of a prestigious neurological institute offered themselves as normal controls, the variations in ventricular size that were disclosed were too disturbing to allow the practice to continue. There is a serious message here for diagnostic technology. Because it becomes possible to acquire more information about bodily processes, that data does not necessarily lead to benefit; it may not therefore be justified, even if it is harmless as a technical procedure.

Attitudes to therapeutic technology likewise stem from an over-

simplistic approach—that is, after all, the distinction between attitudes and analysis. In place of the easy assumption that diagnosis will lead to treatment is the equally facile expectation that therapy will lead to cure. Seldom is there much attention to the proportion of patients for whom a given therapy is relevant, let alone the subset of that group for whom it might be successful. As we shall see, much of the debate about therapeutic technology is about its failures. These result largely from its use in patients who either do not benefit at all, or who derive only temporary improvement, or whose rescue leaves them more severely disabled than they were.

How various interested parties see the balance between burden and benefit of high technology medicine depends not inconsiderably on the media and in particular on television, and in Britain also on radio. I propose therefore to survey briefly some of the influences that broadcasting can have on the attitudes of both patients and professionals. I propose then to consider the attitudes of patients and of society, which might be subtitled a study in ambivalence. Then to deal with the attitudes of those concerned with developing and selling high technology (industry), and of those financing and therefore deploying it (health authorities). This might be subtitled a study in conflicting vested interests. Lastly there are the attitudes of the doctors and nurses who use it—and whose hour-to-hour and day-to-day decisions are the crucial element in determining how much is used, what is used and when it is used. Not only are they the persons whom the patient and his family actually see dispensing high technology, but their decision-making at the point of consumption is the most influential. Doctors and nurses share some of the ambivalence of society and some of the vested interests of authority.

Influence of the Media

It was a quarter of a century ago that a former Rock Carling Fellow, Charles Fletcher, incurred the wrath of the British Medical Association (BMA) by having aided and abetted the BBC to produce the series “Your life in their hands.” The protesting and posturing in the columns of the *British Medical Journal* (BMJ) and the lay press went on for weeks, and there were questions in the House of Commons. People seemed all in favour of knowing more about what doctors did though many were reported in the *BMJ* to be fainting at the sight of blood, even in black and white. Some doctors were full of praise

but many expressed doubts, even outrage. The BMA passed reactionary resolutions, and stiff editorials appeared in the *BMJ* under the sarcastic title "Disease education by the BBC." However, four years later Sir William Haley, editor of the *Times*, in an address to doctors entitled "Problems of medical publicity" came out strongly in favour of letting the public know more about the facts of medicine. Indeed he emphasized that there should be more about the facts of medicine rather than about the organization of medicine, which he believed to be taking up too much space in newspapers. The *BMJ* matched its publication of his address with an editorial full of reservations, and chided Sir William for his approval of the medical reporting standards of "that other great Anglo-Saxon newspaper, the *New York Times*." Commenting that the American public was more technologically minded than the British, the *BMJ* quoted an American Professor of Public Health as having claimed that the United States had become the most over-medicated, over-operated, over-inoculated, anxiety-ridden country in the world, with its media preoccupied with health.

I relate all this to remind you what a long way we have come since then—as doctors, as patients and as a public. We now take it for granted that TV will show us how business is conducted by many professionals whose activities were previously shrouded in mystery. The TV camera walks us along the cloisters of enclosed religious orders, sits us beside an airline pilot, or on the rostrum of the conductor at rehearsal. But more often than any of these the camera goes into hospital. There can seldom be an evening without at least one major medical programme—either current affairs, documentary, or drama. These three genres are quite different, managed by separate departments in the broadcasting services and each with its own different objectives and standards. Each has its own kind of influence on attitudes to medicine and its technology.

Current affairs, that is to say news and comment, is a response machine geared to react quickly to events, apt to look for sensation, human interest, and conflict. Doctors get drawn into instant comment about news stories, about which they may know little more than the second-hand account given to them in the studio before the green light goes on. Also within current affairs is the investigative feature, journalistically speaking. The point of departure of such a programme is the assumption that something untoward is going on. The aim is to disclose, reveal, and unmask rather than to inform. Confrontation is the name of the game, and to heighten tension the presenter will,

like a good legal counsel, keep his key evidence, his star witness, until the point in the programme when the chosen victim is likely to be most discomfited. The major angle for the copy is conflict, and actual differences of opinion between experts may appear larger than life. These are the programmes least liked by doctors and that are apt to be most misleading to the public. Although they account for only a minority of the medical output they are liable to loom large for a few days or weeks after they are shown, and the effects of some of them linger longer. The BBC "Panorama" programme on brain death in 1980 was an archetype of this genre, provoking even more furore among doctors and the public than did the 1958 debut of "Your life in their hands."

Documentaries come in four main forms. One is concerned with information. This may be at the popular magazine level of "Tomorrow's World": or it may deal more exhaustively with a single topic as in "Horizon."² The programme-makers here are usually scientifically qualified, they take medical advice, and they are usually well oriented in their subject matter. In the longer programmes on a single topic they will nonetheless tend to seek out opposing, or at least differing, viewpoints—seldom difficult to discover in medicine and science. Sometimes the temptation to accentuate one aspect of a problem produces distortion—but my experience is that for each watching doctor who complains of that there are many who are full of praise.

Another type of documentary deals with the experience of patients and their families—having an operation or investigation, coping with disability, having a baby, or facing terminal illness. Doctors and nurses can learn a lot from such programmes as they may also from the explicitly informative documentaries. Yet another style is the *cinema vérité*, the camera as the fly on the wall, showing rather than telling how it is for an hour in the life of a general practitioner in a casualty department, or a hospice. Lastly, in the documentary mode, are the talking heads programmes on controversial issues—such as recent ethical series on doctors' dilemmas and on natural childbirth versus intervention obstetrics.

Drama about doctors may possibly be the most important of all in shaping the way that people come to regard illness, doctors and

² "Horizon"—a BBC television science series, some of which is reprogrammed in the United States by PBS as "Nova."—Ed.

hospitals in the context of real life. As I said in a radio talk in 1981, plays or serials built around doctors and their lives show that they are as much prone to bias, prejudice, and personality traits as everyone else; and that factors in their personal lives can affect their professional activities. Drama also reinforces what is obvious from documentaries, that there are almost always alternative ways of dealing with various medical situations, and that doctors often differ about which is best. Fortunately, drama producers go to much more trouble than journalists to ensure the authenticity and accuracy of what they show. A great deal of reliable technical information is informally imparted by these programmes. It is then perhaps fortunate that drama programmes are probably the most influential in terms of affecting general attitudes to modern medicine; a recent paper in the *New England Journal of Medicine* reached the same conclusion for North America.

When it comes to medical technology in documentaries it is inevitable that the focus is usually on the ingenuity of the new tool, on what it is supposed or expected to do. Seldom is there time or inclination to temper optimism with realism, or to qualify claims for breakthroughs with caveats about limitations. Consequently expectations are sometimes falsely raised by such presentations of technology, although I believe that presenters are becoming more responsible in this regard, taking care to warn viewers not to hope for too much too soon.

Television also increasingly gives a platform for patients, families, and pressure groups concerned about various aspects of medicine. These tend to focus on the disabled, the mentally ill, handicapped babies, and the care of the dying, and provide a balance to the more technologically oriented programmes. There has been no shortage of air time for those wishing to protest about too much technology, particularly in the context of childbirth, whilst alternative and fringe medicine have had a fair innings.

Radio is still very much a force to be reckoned with in Britain—not least because of the number of captive listeners in cars. There is everything from straight science on the Third Programme, through magazines like *Medicine Now*, to those aimed at specific groups of patients and their families, such as “Does he take sugar?” for the disabled. General magazines such as *Woman’s Hour* rarely get through a week without one or more medical items, and there are one-off³

³ *One-off*—unique; custom-made; once only.—Ed.

documentaries on controversial issues. Twice in recent years the Reith Lectures⁴ have been on aspects of medicine—the highly successful series on how the brain works by Colin Blakemore (physiologist), and the challenge to modern medicine by Ian Kennedy (academic lawyer) which reminded doctors how readily they can be misunderstood by onlookers. We have come a long way since Dr. Hill of the BMA included the BBC on his daily rounds and created the Radio Doctor.

My purpose here is not to draw up a balance sheet on broadcast medicine but to make sure that due account is taken of the wide range of information and opinion to which our patients and the public are now exposed. It is in that context that we now practice medicine, recognizing that many decisions about individual patients and about the allocation of priorities cannot be made by doctors alone. The Royal Commission on the National Health Service urged greater involvement of the public in debates about priorities, and in May 1981 I broadcast a series of talks entitled “Doctors, patients and responsibility” in which I recommended that doctors should seek to promote such debates. High on the list of controversial issues must be the appropriate deployment of technology, particularly that which is limited in supply or of dubious value. Television must now be recognized as a natural forum for such debate, although not the only one.

How well medicine has come to terms with the media is evidenced by the regular “Medicine and the Media” column in more than one journal; by conferences on this topic and by articles and taught courses on how to appear on television. This shows a realistic appreciation of the power of the media which in turn reflects the power of information. Not for nothing do revolutions usually now begin by capturing the broadcasting station of the nation. Not for nothing is the skyline of Dublin a tracery of tall television aerials trained to pick up the uncensored output from Britain—which the Catholic church readily acknowledges as the main reason for its slackening grip on the people of Ireland. Not for nothing did David Hume, in his essay on the liberty of the press, state that this “ought to be indulged almost in every Government except the ecclesiastical, to which it would indeed be fatal.” In drawing attention to that quotation in his 1962 Winchester address to the BMA William Haley commented that even the most

⁴ *Reith Lectures*—a prestigious and influential annual series of six lectures delivered on the BBC and subsequently published.—Ed.

ardent champions of freedom of the press claimed that this should not be unlimited. Hume, he added, stopped short—cynically and sardonically, perhaps—of religion. I have already made more than one allusion to the close parallels in the past between the medical profession and the traditional church.

Attitudes of Patients and Their Families

Most patients, faced with suspected or obvious serious disease, seem to expect technology to come to their aid. Told by the doctor that a lump, a cough, or a headache is of no importance, many of them will seek the further reassurance of some laboratory test. They may do this by asking to be referred to hospital, where they will certainly expect some investigation. The test is the currency of the outpatient transaction in hospital, as the prescription so often is in the doctor's surgery. Simple blood tests and ordinary x-rays are now old hat, and some patients may accept reassurance that there is nothing seriously wrong only if a more elaborate machine has been seen to be used—the gamma camera, ultrasound, or CT scanner. Relating this experience afterwards the patient may boast that he "had to have" a scan—evidence that his complaints had been taken seriously, even though it was good news in the end because nothing was found.

When the patient is acutely ill technological intervention is usually welcomed and taken in its stride. The monitors in intensive care indicate that bodily functions are under surveillance and they do not much limit an ill patient from doing what little he wishes to do. However, in the labour ward and delivery room women have objected, questioning the need for routine monitoring when they are involved in a physiological rather than a pathological process. Moreover they specifically object to the restriction on movement that some such monitoring involves. This is a situation that will recur again and again in this review, where the controversy is not so much whether a given technology is good or bad but rather whether it is being used too often—applied routinely rather than selectively.

A more general complaint levelled against technological monitoring is that it may seem to distance the patient from his doctors and nurses, that it reduces the comfort of contact, the time for talk. Staff may indeed be tempted to glance at the machine displays and forget to say anything to the patient, who is denied even the technical touching

involved in the taking of the pulse. Intensive care units may even have central consoles where nurses scan banks of television screens showing the parameters of many patients, sometime even their faces. If microphones are provided for the patients in their rooms to talk to the nurses at their consoles the sci-fi scenario is complete, with even eye contact eliminated. That is technology untamed—but it is the fault of insensitive planning and application by men, not an inevitable consequence of using mindless machines.

Talking is no triviality. It is what distinguishes man, providing the universal means of communication of mind with mind. With the coming of writing, when the oral tradition of telling stories or imparting information became no longer the only mode of communication, there were doubtless those who expressed doubts and regrets. There certainly were when printing made writing no longer a personal manual task and the teller and the told could be distanced still further. Come television and the oral tradition returned—but then there was a wringing of hands at the baleful effect that this would have on reading and writing. Perhaps our reactions to technology in medicine were predictable and should occasion no surprise.

Talking is, however, the most important single thread running through the relationship between doctor and patient. But talk is labour intensive; talk takes time, and time costs money. When patients choose to pay for private care they are usually buying more of the doctor's time than they would otherwise get; they are paying for more talk, not for more technology. Properly used, technology should make way for more talk. Is not the telephone one of the most important instruments of modern medicine, saving the time of travel? Telephone diagnosis may be suspect but for a patient or relative to be able to talk to the doctor miles away, perhaps across snowy hills in the countryside, is a triumph for technology. Think too of the Samaritan service,⁵ offering a life-line to those who feel sucked by the tide towards suicide, before dismissing the telephone as a mechanical intruder between the patient and help.

Back in hospital high technology should relieve the doctor and nurse of time-consuming chores of longhand notes and charts, of filling forms and taking repeated observations by hand and eye. That should

⁵ *Samaritan service*—a suicide prevention service with telephone hotline staffed by trained volunteers.—Ed.

mean more time for talking to patients, for reassurance, for explanations to anticipate concern about the next close encounter of a technological kind. If this does not occur it is because the machine-minders have got it wrong, not that the machine should not be there. These minders need to remember that they are primarily people-minders and should be trained to divide their attention appropriately between their different charges.

To ask whether patients and their families are disposed to trust their doctors more than their machines is to uncover another layer of ambivalence. Often they seem to want some laboratory test before accepting reassurance—though they have no concept of the accuracy or reliability of that test. Told by the receptionist that the test is negative many patients will go away to celebrate. In the very different context of the intensive care unit, already surrounded by technology, relatives will often more readily accept a decision that nothing more can be done if they know that it is a human decision by doctors. But in the 1980 TV brain death debate much was made of using the electro-encephalogram as a means of reassuring relatives, almost a speak-your-death machine. Some doctors, including some Americans, openly revealed their ambivalence by admitting that they did not need the technology of EEG to reach their decision but that it was useful in convincing relatives; some doctors claimed that it helped them to reassure the nurses too.

With computers the reaction is otherwise. When these are used as a basis for decision-making adverse comment is sometimes made that computers are “deciding” about life and death. That their collations and calculations are far superior to any that the doctor can do in his head does not seem easy yet for people to accept. Perhaps it is the recollection of the botched up bank statement or the erroneous electricity bill in that unmistakable computer type that worries them. The simple explanation in the medical context is to emphasize that the computer is providing information, just like a report from the laboratory, and that it is the doctor at the bedside who decides what to do. That is a good explanation only if it is true.

In all of these instances we are witnessing ambivalence which as students of the behaviour of threatened, frightened human beings should cause doctors no surprise. What should concern us is how doctors and nurses behave in these circumstances. Do they take the time and trouble to talk to the patient and his family, using technology

only when it is clearly necessary and then explaining its use and value? Or do they aid and abet the supposed "demand" for machine-made comfort, reassurance, decision-making? That is a matter to discuss in relation to the attitudes of professional staff, who have their own ambience of ambivalence—because they too are people with problems.

Attitudes in Society

The reaction against authoritarianism in Western societies is associated with a move towards greater rights for the individual. In the context of illness this includes the right of the patient to participate in decisions about what is done to him, the right to know the truth about his condition, and the pros and cons of different ways of dealing with it. This carries the implication that he has the right to refuse any treatment advised. And it is technology that is most often refused—the intrusive monitoring of the labour ward, the life-prolonging technology that extends the period of suffering from chronic, recurrent, or terminal illness. Rights to participate in decisions often turn on choices between technologies—between surgery and radiotherapy, between drugs or surgery, between dialysis and transplantation. Implicit in these rights is the right to choose the objective of management—to be involved in deciding whether length of survival or quality of life is to take precedence. Traditionally doctors' measures of success have been a low immediate mortality combined with a high percentage of survivors at some agreed later date. These are now often challenged because a patient may choose a lower chance of longterm survival, even a higher risk of immediate mortality, in order to avoid the high probability of prolonged disability. What is actually done depends largely on the personalities of the patient and of the doctor, and on their relationship.

It has to be recognized that the objectives of doctors and of their patients do not always coincide, although they often do. This matter of patients' rights deserves attention here under the discussion of societal attitudes because they are more often pressed by organized groups such as the Patients' Association and MIND (National Association for Mental Health) than by individual patients. Inevitably in the United States it is lawyers rather than voluntary organizations that have become involved in this confrontation with the medical profession. The so-called "living will" and "right to die" legislation in California

is largely devoted to restraining the use of technology to prolong life in defined circumstances. Yet further evidence that these matters are now acknowledged as a matter for discussion outside the context of medicine is their emergence in the theatre. In the highly acclaimed West-End play "Whose Life Is It Anyway?" the central character was a sculptor paralysed in all four limbs after an accident who tried to refuse further treatment, and pled to be let die. Journals of medical ethics have emerged to which most contributors are not doctors but philosophers, theologians, economists, and lawyers. The Royal Commission on the National Health Service had very few doctors and not a single one from the technologically oriented specialties. Clearly then this issue of technology in medicine has become a matter for concern by society as a whole, which is of course wholly comprised of patients, past, present, and future.

Apart from its concern that technology may not always be used in the best interests of the individual patient, as seen from his own viewpoint, society is suspicious that the escalating cost of health care is largely related to the expansion of expensive technology. The high cost and dubious benefit of high technology medicine, together with its application to the relatively limited field of acutely ill patients, are seen in stark contrast to the low technology needs of the large numbers of the chronically sick and the elderly. Consequently we have the Royal Commission declaring, on behalf of society, "The emphasis on acute and high technology medicine is being challenged, and more thought is being given to the chronic sector." This view has been echoed in several Government reports since then, for example in *The Way Ahead* and *Priorities for the 80s*.

The concern of society that the balance of the allocation of health care resources should be adjusted away from high technology medicine has been voiced by several other commentators. The Archbishop of Canterbury in his 1976 Edwin Steven's Lecture at the Royal Society of Medicine warned doctors that they should take more thought before pressing their life-extending technology on individual patients or on society. Ivan Illich is of course well known for his broadly based attack on modern medicine in which high technology falls among the rubble, bringing most of the rest of medicine down with it. Ian Kennedy's tract for our times, threateningly entitled *The Unmasking of Medicine*, has to be taken more seriously. Not only is it nearer home and more directly relevant, but its case was more reasonably argued

and it was given the prestigious platform of the four Reith Lectures in 1980. Again a major criticism was that too much expensive technology was being used without due account of the resulting benefit; that it often does more harm than good; and that money, time, and effort might often be better spent on other activities. These critics from outside medicine borrow most of their copy about the alternatives from critics within medicine itself—and there is no shortage of these. Nor do those who offer alternatives to orthodox medicine lose the opportunity to offer their nostrums in the context of current criticisms of the limitations of technology that are voiced both from without and from within medicine.

There is, however, another public voice. This expresses indignation that certain technologies are not more widely and readily available than they are. Most often this plea is heard about technologies that are generally acknowledged to be beneficial, such as renal dialysis and transplantation, or joint replacement surgery. These views are commonly articulated by pressure groups related to certain diseases, or by MPs or other representatives of the public within a local context. Comparisons may be made between the provision of such effective technology in different parts of Britain or in different countries. Complaints of inadequate provision are often concerted efforts orchestrated in collaboration with doctors in the appropriate specialty. One way in which such energies are sometimes channelled is into raising funds or attracting gifts for the acquisition of high technology equipment. In the earlier part of this century a philanthropist would endow a bed in a hospital and see his name perpetuated on the wall above it. Now it is more likely that he will seek to purchase an item of technology, from a modest monitoring tool at £300 to a massive machine at £300,000 or more. No good expecting a reasoned argument about the benefits expected from such technology when the purpose is to persuade everyone that it is essential for the welfare of the people. One result of contributions to such seemingly good causes is that major items of equipment may be sited in wholly inappropriate places in regard to need or availability of related services. Moreover, revenue costs may be diverted to the support of such technology against the tide of more sober appraisal of local needs. Whatever the reasons and whatever the consequences, such activity cannot be ignored; it is evidence of the public voting for technology in a very practical way.

There are other influences in public life that are difficult to define

but that should not be disregarded. One is the morale of living in a country where citizens can be assured that, if suddenly struck down with serious illness that is remediable by technology, there is a reasonable chance of receiving appropriate care. The other is national prestige. Doctors who travel widely will be familiar with dust gathering on the covers of high technology Western equipment in Eastern block and Third World countries, where there is insufficient knowledge or technical back-up to use such equipment properly. It is difficult to find any reason other than prestige for having bought such goods, when there are obviously many more pressing needs. But prestige is important for different reasons in Britain, where we have a tradition of distinguished contributions to medicine. Organizationally this ranges from the foundation of the Royal College of Physicians in 1518 to the National Health Service in 1948; and technically from vaccination through antiseptics, anaesthesia, penicillin, the double helix, and the CT scanner. Unless there is a reasonable level of provision of effective technology in a country with such a medical history and tradition there is bound to be serious disquiet sooner or later, not only in the medical profession but in society at large.

Doctors' Attitudes to Technology

The variety of views held and expressed by doctors about technology reflect their specialty, their personality and also their experience as patients' advocates and as professionals in competition with their colleagues. To analyse these variations and their origins is to uncover some of the most fundamental conflicts within the profession. These include what proportion of resources should be allocated to high technology types of medicine; which patients should have certain technological procedures; how to assess the efficacy and general worthwhileness of various techniques; how to respond to conflicting comments from patients, from the public and from fellow professionals that on the one hand they should use high technology medicine more often and more widely, and on the other hand that they should not allow it to dominate their practice too much.

Doctors are the target for such criticism because it is rightly assumed that their decisions at the point of consumption largely determine what part high technology plays in modern medicine. They decide what procedures are to be used for which patients and when—and

they are seen to do so. But they are able to exercise this choice only within the resources provided and it is not obvious, even to the doctors involved, to what extent the advice proffered by the profession to various levels of health authority does in fact influence the allocation of these resources. For many doctors conspicuous private consumption (e.g. a Rolls Royce) has been replaced as a status symbol by conspicuous public consumption. To be seen to be developing and expanding high technology procedures signals success in the competition for scarce resources—as between specialties, between hospitals, and between individuals. No wonder that Sir Douglas Black (1981), in his trenchantly titled lecture “Apples of Discord,” should have identified high technology as one of the major divisive influences in medicine today.

If technology is one dominant characteristic of contemporary medicine, another is specialization. To some extent it is the emergence of complex technologies that has made specialization inevitable. The greater reliance on technology of some specialties than of others accounts for some of the differences of opinion among doctors about the rightful place of technology in medical practice. There are now more than forty recognized medical specialties in Britain; these fall into three large groups that reflect broadly contrasting attitudes to technology. The first group are doctors who deal directly with patients, taking full responsibility for decisions about their care (the so-called sharp-end or hands-on specialties). Then there are those who contribute importantly to clinical care by their technical skill, who may have some direct patient contact but who are not themselves clinical decision-makers (the so-called service specialties of laboratory medicine and radiology). Lastly there are those who are concerned with the health of communities rather than with individual patients, but whose influence on what services patients receive can be crucial (community medicine specialists).

The concern of the community medicine specialist,⁶ in his administrative role at health authority or hospital level, appears to his clinical colleagues who have to deliver health care to be largely concerned with the cost of high technology medicine. He has to try to maintain a balance between the provision of resources for the more and the less

⁶ *Community medicine specialist*—a formal position within the NHS since 1974, with responsibility for identifying needs among population groups, and the planning and monitoring of appropriate services at district and regional levels.—Ed.

technological of the front-line clinical specialties—in particular between the acute hospital services and the chronic sector, which deals largely with the elderly, the mentally ill, and the handicapped. If community medicine specialists in the field are regarded by many high technology clinicians as their natural enemies this is perhaps because with contracting finance it is the community medicine physicians who often have to bear the bad news that more expenditure is not possible on this or that technology. Moreover community physicians who head academic departments or who hold key national positions are suspected as the main architects of government reports that recommend more equitable distribution of resources geographically; and a change of emphasis to more spending on chronic than on acute care, more on preventing than on treating disease. In taking what many would see as a stand against technology community medicine specialists would claim to be calling for a broad view of the health needs of the community as a whole. McKeown's (1979) Rock Carling Lecture was a notable contribution from this section of the profession that drew the expected critical response from those who felt maligned by it.

The service specialties are in practical terms almost wholly technological and indeed radiology has been the scene for several of the most visible and costly expansions of high technology in medicine. Concerned about these costs radiologists and clinical biochemists have begun to show interest in monitoring the scale and nature of the services that they provide, and in devising systems for quality control. If the service specialties have responded more willingly to overtures about audit than have clinical specialties, it has to be conceded that this task is much more feasible for them. Their transactions are readily reckonable—numbers of one kind of test or another, the amount of chemicals and films used, and a product (a radiograph or a numerical test value) that can be objectively assessed. Unfortunately one of the most obvious activities of these specialties in their attempt to control tests has been to urge a reduction in what they see as the over-use and inappropriate use of their facilities by clinicians. The latter, front-line doctors as they like to style themselves, find themselves in double jeopardy. On the one hand they are accused of being laggards in adopting audit for their own activities; and on the other of undermining the efforts of the service specialists who are seen as trying to respond responsibly to the call to contain costs in their own domain by careful bookkeeping.

Within the clinical specialties there is a wide range in the degree of personal involvement with technology—from those who are declared practitioners of high technology (e.g. cardiac surgeons, renal physicians, intensivists), to those who may from time to time require it for their patients but who do not themselves dispense it (e.g. geriatricians and general practitioners). It is therefore a common stance for these low technology doctors, often seemingly in conspiracy with community medicine specialists, to decry the disproportionate resources consumed by their high technology colleagues. Very often, however, the demand for high technology procedures has been initiated by non-technological doctors such as general practitioners and geriatricians. With an ageing population elderly patients now figure prominently not only in the wards of high technology specialties but on the waiting lists for investigative and therapeutic procedures. Major surgery for the elderly is now commonplace and reports are published of its value. The debate on restricted deployment of renal dialysis in Britain is largely focussed on the use of an upper age limit for selection that is much lower than in most countries. It is therefore a false antithesis to consider doctors who raise doubts about the use of high technology as being against it altogether. Like so many other critics their plea is for more thoughtful use, or at least it is when their pleading is thoughtful and not an outburst based on frustration at their own seemingly inadequate resources in comparison with those of their high technology colleagues.

When arguments do spring from such feelings there are apt to be accusations that high technology specialists are indulging their own interests and their fascination with technology, rather than responding to the needs of their patients or of the community as a whole. But high technology doctors would not be in the specialties of their choice were they not attracted by this approach to medicine; it might seem unfair to criticise them for practising their hard-won skills, provided they are putting these to good use. However, they too can be thoughtless in what they say and what they do and some of their attitudes and actions inevitably invite adverse criticism. There can be no excuse for advancing as a reason for investing in expensive radiological equipment that it will contribute to the job satisfaction of the local radiologist (although there might be in North America where hospitals may use technological facilities as a means of attracting staff from rival institutions).

More subtle is the suspicion that the development and application

of new technological methods are aspects of academic medicine and ipso facto associated with the prestige of a certain department and its staff. Centres of excellence may be regarded as synonymous with centres of expense, and enterprising individuals pejoratively labelled as entrepreneurs. The anti-academic lobby within the medical profession is a force to be reckoned with. Like the inter-specialty rivalries it is basically a challenge issued by the have-nots that those who have are squandering their inheritance. Again it is not specifically anti-technology, but often the focus of criticism is the supposedly unwarranted use of technological tools in clinical practice. These critics do not always distinguish between research and routine in selecting their targets. Nor to be fair is that distinction always recognized as clearly as it should be by those involved in the development of high technology in academic departments.

Whilst some of today's research becomes tomorrow's routine other techniques may be used as a research tool for a limited period, in order to discover the effect of some particular intervention. For example, intracranial pressure monitoring was used in a limited series of patients to discover the effect of anaesthetic agents on intracranial pressure, as a result of which there was a radical change in anaesthetic practice in neurosurgical operating theatres. Those of us responsible for that research never recommended that intracranial pressure monitoring should become a routine procedure during surgery. Similarly when new technologies are being assessed there may be need for many more observations and measurements than are required once they become established in normal practice. Considering the frequent criticism that technologies are adopted too readily into practice before they have been properly assessed, it seems unfair to accuse academic departments charged with such assessments of having over-complex practices compared with their colleagues dealing with the routine management of patients in a community hospital. One recommendation for improving the rational use of technology would be for no method to be made generally available until it had been assessed in academic units that had the resources to examine it critically. That would no doubt be interpreted by the anti-academic lobby as yet further evidence that to him who hath, more shall be given.

Research attracts another type of criticism that although not specifically aimed at technology is often seen in this light. There is concern about the ethics of research investigations in patients—dramatized several years ago by an emotive reference to human guinea pigs. It may seem

that either the technocrat is accused of using his tools uncritically before their efficacy has been established, or he is taken to task for using patients as unwilling guinea pigs for testing his tools. This subset of the anti-academic argument can excite public interest, and that in turn may make it more difficult to accede to demands for rigorous trials of new technologies—demands such as those so articulately argued by Archie Cochrane (1972) in a previous Rock Carling Lecture. These counter currents within the profession account in part for why formal assessment of technology has not long since been adopted without argument. The truth is that there is argument—it is not simply a question of *laissez-faire*.

An argument sometimes advanced in defence of the use of particular high technology methods is that not to employ them in certain situations might be considered unethical or even negligent. Such a case rests on the assumption, seldom substantiated, that the benefits of these particular technologies are so self-evident that their use should be regarded as current good practice. Fortunately we in the U.K. are still a long way from having to practice medicine in an atmosphere of legal harassment of the kind that leads doctors in the U.S. to put their patients to unwarranted risks and unnecessary expense in the pursuit of defensive medicine. Nonetheless this is one more factor to add to the several already identified as contributing to the confused reaction to technology of the medical profession.

When doctors dealing with conditions that still cannot be cured or controlled fire yet another salvo at their high technology colleagues there seems sometimes to be a hint of the smell of sour grapes mixed with the whiff of grape-shot. Rather than being against technology their hope is that technology might one day transform their own tasks as it has done those of colleagues in other specialties. The elaborate regimes of the tuberculosis physicians, of malarialogists, and of psychiatrists 20 years ago were not *anti-technology*; they were *ante-technology*. Once effective technologies were developed these labor-intensive and costly placebos were abandoned and the benefits of technology welcomed.

Medical critics of high technology frequently plead for resources to be diverted to preventive medicine. However, in developed countries regulations about environmental hygiene and about safety at work, together with immunization programmes, have already wrought most of the benefits likely to accrue from such traditional public health measures. Future efforts of this kind must surely be subject to the

law of diminishing returns. Prevention therefore now focuses on changing lifestyles and on educating the public to be aware of the early signs of serious disease. But most of the criticisms that have been levelled against high technology medicine apply also to many preventive measures. Not only is there serious doubt about which aspect of diet is really important (is it sugar, or fat, or fibre?), but there are voices protesting that the dangers of moderate obesity have been overstated. Those calling for more efforts at prevention and health education seldom produce rigorous studies to indicate the effectiveness of what they are recommending; yet it is often the same people who demand such trials for technological procedures. A leading cardiologist has suggested that attempts at mass control of coronary risk factors are unproductive and that attention should be directed at people identified as being at particularly high risk. This is applying to prevention the doctrine of triage that is repeatedly recommended for the technologies of investigation and therapy.

Even where clear causative relationships have been established, as with smoking, the effectiveness of measures to limit the hazard have been modest. It could be said that to discover the dangers of smoking but not how to stop people smoking is "half-way" prevention, to turn the phrase coined to denigrate medical technology. There should be more estimates of what realistic goals are likely to be achieved if preventive measures were to be effective. One calculation is that if cancer of all kinds were prevented the longevity of 40-year-old white males in the United States would be increased by only two years. By that standard it would not be difficult to demonstrate that so-called "half-way" therapeutic technologies have added many more quality years than have preventive measures, even if they do not restore normal expectancy of life.

It could be said that some aspects of prevention are waiting for a technological breakthrough, that they are ante-technology. If means were found through technology to stop people smoking or drinking, would not the priests of prevention and the health educators grasp them with enthusiasm? And would they then be any more moderate, any wiser, any kinder in applying them than are today's diagnostic and therapeutic doctors in promoting their wares? And what about the effects of preventive measures on the quality of life of those who bear the brunt of prevention? Those who have experienced the rigours of a salt-free diet as an experiment tell how they counted the days till they could enjoy a meal again. Even exercise is not without its

unwanted side-effects, from the morbidities of joggers to marathon mortality and death on the squash court. Those who continue to smoke knowing the risks, or who resist the pressures to jog, are in effect saying that the prevention seems to them worse than the risk of disease. And what about the Californian women recently shown on British television having prophylactic mastectomies to prevent the possibility of breast cancer? Is that not prevention taken to excess every bit as much as the overuse of technological tests and therapies?

One critic of technological excesses in medicine puts some of the blame for the demand for screening and diagnostic check-ups on the health education lobby. He considers that it has a lot to answer for in the obsession of the American public with matters of health, which he believes amounts to mass hypochondriasis. Not only are people there forever watching their diet, indulging in regimes of exercise that are more elaborate than the homespun keep fit classes of a generation ago, but they are alerted to the fact that any trivial symptom may be the harbinger of serious disease. By generating these fears they create demands for repeated investigations to set their minds at rest—whether cervical smears, mammography, or regular physical check-ups. It is unfair to blame only those doctors who deliver technologies that have been shown not to be cost-effective; they are simply responding to a public demand, created by the preventive doctors—who ironically are often the leaders of the anti-technology lobby.

Another sequel of too much health education is to raise peoples' expectations, that a good life means a long life. In turn that brings back the old-fashioned feeling that illness is a visitation from the gods, a retribution. Struck down by a heart attack or a stroke the victim (or his spouse) feels guilty at not having taken more preventive measures. And it brings a feeling of unfairness to the family of the food fad or health freak who nonetheless falls victim to the disease he invested so much trouble in trying to prevent. In the words of George Burns, the American comedian, at the age of 82, "If I'd known I was going to live so long, I'd have taken better care of myself."

Envoi

Technology is now as much a part of medicine as it is of life. Some technologies are full of promise—they can remove the threat of death,

reduce disability and dependence, and offer the possibility of years of life of quality. Most technologies also have some potential for harming the individuals exposed to them. All technologies consume resources—more of which are often needed for the minders than for the machines. Comparison of costs without balancing the benefits is meaningless—but the meaning it seems to have can be misleading. What seems expensive may be well worth the resources it requires; the accumulated costs of many minor but useless expenditures may be a greater waste. But there is seldom a clear dichotomy between the useful and the useless. More often it is a matter of relative worth, weighing the benefits, risks, and costs for individual patients, and taking account of how many in the community stand to benefit and what opportunities of bringing benefit to other patients would be forgone.

There are no good and bad technologies—their potential for benefit and burden depends upon a balance between many factors. Not enough is known about these—we need more knowledge, more data. These include technical matters of biology, physics, and engineering, and of empirical observation of what happens in practice when a technology is used in a variety of situations. But there is need also to know more about less tangible aspects of applying technology in medicine—of the social as well as the physiological benefits and burdens, both to individuals and to society. Assessing these is difficult, ascribing values to them even more of a problem. If reducing ignorance of the first kind is a matter for doctors, technologists, and others at the bedside and in the laboratory, many others have to contribute to the social appraisal of technologies and the ordering of priorities about allocating resources.

It is then back to the bedside for the application of these two types of knowledge in day-to-day practice. Better informed about the technological potential and limitations of his tools, and about society's views on their appropriate use, the doctor has then to decide in partnership with the patient what to do. Both parties are becoming more explicit in stating their respective positions than in the past, but decisions will still rightly depend on the personalities and value judgments of each in respect for the autonomy of both. It will take time for both patients and professionals to learn how to handle this changing relationship. For some hospital specialists it will not be easy to climb out of the comfortable rut of dealing with each patient by instinct or intuition, persisting with past practices, resisting review,

and handling patients paternalistically if not with authoritarian overtones. Whilst they may regard the agenda for change as threatening there are others who already recognize in this new approach to the clinical task a challenge that promises to make their daily work in hospital more interesting and, because more effective for patients as a whole, more rewarding. It is with these forward-looking doctors that the new approach to technology will begin—indeed has already begun. Its spread will be gradual but it is to be hoped that it will not be too long before the number of doctors convinced of the need for change reaches a critical mass (to wait for a majority might be forever). When that time comes we can expect to witness not only a more orderly adoption of new technologies but a change in the use of existing ones—some used more often and others less frequently, whilst the obsolescent are discarded. Any programme of management for technology as a whole must assume a pragmatic approach, avoiding the influence of purists and academics who are unwilling to take or to recommend action until or unless all the data they want is available. It is fundamental to medicine that decisions have to be made under conditions of uncertainty. This is not to imply that they need be made irrationally or intuitively. They should simply be the best decisions that are possible in the circumstances. As Samuel Butler wrote “Life is the art of drawing sufficient conclusions from insufficient premises.”

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