The 'economics' of medical technology

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Abstract **The word 'economics' is used in this paper in its widest sense, referring to issues that 'influence the management, regulation and government of an enterprise'. In addition to the obvious monetary issues in health-care technology, social, ethical, legal and cultural issues are also discussed. The eventual, generally high cost of health care is definitely influenced to a greater or lesser extent by these factors. It is suggested that proper evaluation during the planning stage could lead to the development and introduction of technologies into health care in a more cost-effective way.**

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One of the greatest technological achievements of mankind was the marriage of the horse and cart for transport purposes. This marvellous combination of energy source and low-friction vehicle made it possible for man to open up the interior of continents for travel and commerce. The example of the wheeled horse-cart with a good driver highlights the importance of choosing the right combination of technology and techniques to allow available resources to be usefully directed.

In the last 100 years or so there has been an abiding hope that the increasing application of technology to problem areas could likewise conquer disease. Is this hope being realised or is there something amiss? There are dark rumblings about the side-effects and dangers of technology; an increasingly anti-science culture proposes a 'back to the earth' philosophy. The concept of 'health-care technology' is provoking more and more ambivalence. If we do not address these concerns as a matter of urgency, there is a real danger that the whole health-care cart will come crashing down, patients and all.

The word 'economics' is used in this paper in its widest sense, viz. 'the management, regulation and government of a household'. As such it does not refer simply to monetary considerations, but in the context of health care, to the much broader societal implications.

Health is probably the most valuable of all human attributes, yet we often take it for granted and place it at risk. Paradoxically, once we have lost it we are prepared to do anything at any price to regain it. Costs seem to

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take a back seat when we are dealing with curative health care.

Although the bottom line in health care remains financial considerations, the individual items must be carefully considered. Economists and medical practitioners alone cannot provide solutions to the economic problems in health care. These problems are multifaceted and need to be examined by properly equipped teams, which need the input of a range of people, viz. managerial, ethical, legal and sociological experts, apart from those of the above professions.

The present

Health-care technology is developing at an alarming rate. This phenomenon has been a cause for serious concern to health-care administrators for a number of years.[1] It is widely accepted that technology can offer many benefits and has therefore greatly enhanced our ability to prevent, diagnose and treat disease. However, unlike other technologies, health-care technology has brought with it a disproportionate escalation of costs — both monetary and non-monetary. The monetary cost includes not only the cost of equipment but associated overheads of a magnitude which generally overshadows the former. These include highly trained staff and expensive maintenance and repair.

When one talks about the 'economics of medical technology one has to consider the non-monetary problems which manifest themselves as questionable effectiveness and appropriateness, unequal distribution of services caused by over-specialisation and centralisation, dehumanising tendencies, and social, legal and ethical problems'.[2]

The unequal distribution of health care

During the 18th and 19th centuries medical science progressed relatively slowly, but the 1900s have seen rapid acceleration, particularly during the last 50 years. In the early days disease was diagnosed by the doctor after looking at the patient and listening to his complaints. No physical contact occurred and some doctors even performed diagnosis by mail! Later it became acceptable practice to use hands for palpation and only in the last century did diagnostic instruments, such as the stethoscope, start to be used. Only in the last 50 years have medical devices become inordinately complex and at the same time expensive.[3]

This complexity of technology made doctors tend to specialise and the expense saw them and their equipment become concentrated in hospitals. Technology-rich, expensively staffed hospitals developed in big cities, leaving the rural areas without adequate health-care services. This phenomenon occurred not only in South Africa but also in such highly developed countries as the USA. The effects of maldistribution of medical resources are probably more acute in developing nations, but in countries like South Africa, in which the First and Third Worlds exist side by side, the situation is exacerbated. With the rapid migration of people to the outskirts of cities the situation is brought 'closer to home'.

Peri-urban health needs comprise more than just curative medical treatment, and extend to adequate housing, diet, sanitation, stress-free environment, security and good working conditions. Only when these factors are adequately addressed can one start to talk meaningfully about improved health care. Until then one can only hope to alleviate the situation somewhat. But as things stand today even alleviation is very difficult. There is a shortage of doctors in both rural and peri-urban areas and the educational/cultural/convenience-loaded environment of the cities does little to encourage doctors to work in rural areas. We believe that only by judicious use of technology can we hope to solve this situation. Simple, easy-to operate, user-friendly technologies could be provided for the community nurse — the most important person in most primary care settings — to help her overcome some of the difficulties she experiences in providing basic health care, and to improve her effectiveness.

Another aspect of unequal distribution of health care is highlighted by the imbalance between diagnostic, curative and life-prolonging services on the one hand and prevention, promotion and rehabilitation services on the other. About 90% of total health-care funding is spent on the first group; what is left over accrues almost by default to the second. Classic medical expertise is concentrated and training occurs in high-technology academic hospital settings with the result that medical doctors receive only rudimentary training in other contexts. We can thus safely say that *disease* is receiving more attention than *health* and ask whether we are really justified in calling the process 'health care' under these circumstances.

There are two possible ways to solve this problem. The first, which is unlikely to succeed, is for the medical profession itself to redirect its priorities to primary care, prevention and rehabilitation, and away from the present emphasis on clinical medicine. A second solution could come from employing appropriate technologies together with those people who are suitably trained to utilise these technologies. It must be remembered that many of the problems in South Africa are unique local problems that cannot be solved by imported technologies, most of which are designed for use in a different context. Appropriate solutions must come from those who are sufficiently interested and have acquired insight into the problems through first-hand experience.

Effects of the newer technologies

The centralisation of health care and associated technology in tertiary care institutions has certainly contributed considerably to the advances in diagnosis and therapy in these institutions. However, more and more is being written about the pressures and effects of technology, which could adversely influence the entire health-care process.[4]

On the patient, family and friends

Any new devices and associated procedures have an impact on the patient and the whole family. Physical improvement in the patient can be accompanied by psychological decline with family consequences. For example, chronic home dialysis could disrupt and cause considerable financial difficulties while restricting the patient to the vicinity of his home town. The provision of an artificial heart costing over R300 000 might provide a questionable increase in quality of life and place tremendous strain and apprehension on the family.

Although, on the face of it, computer-aided record collection might be cheaper, it might depersonalise the doctor-patient relationship and raise problems with regard to confidentiality of clinical information.

On society as a whole

The prolongation of life of those with genetic diseases by technological means will certainly change the genetic pool of society and can lead to demographic redistribution of the health status of an entire population. This, in turn, can change social institutions or put inordinate strain on them.

On legal and political systems

The increasing deployment of new technologies raises ethical and legal questions. Makers of devices have to face liability actions; those using them are increasingly subjected to malpractice suits. These additional costs, in turn, influence legislative pressures on the political machinery required to effect changes. Political responses include efforts to redirect available health-care resources to the various sectors of the population as technology modifies the demographics of disease.

On the economic system

Technology can have both positive and negative effects on the economic system. Increased productivity can result when disease is prevented or when a person is properly rehabilitated. It can also put extra burdens on society if life-saving technologies increase the ratio and number of people on welfare due to disability and/or age.

On the medical care system

Technology can demand new specialists and cause others to become redundant: for instance the availability of digital imaging systems, especially magnetic resonance imaging and computed tomography, has to a large extent made radio-isotope scanning obsolete, as well as the expert staff needed to conduct it. The changes can affect the educational requirements of all those involved in the delivery of health care. For example, with the new information-processing technologies, de-emphasis of encyclopaedic knowledge on the part of the medical practitioner might free him to adopt a more analytical approach.

These are but a few examples of ways in which health care technology can adversely or favourably affect our lives and the lives of those around us.

The pressures of technology on the medical profession

Financial pressure

There are strong fiscal incentives for including high-technology methodologies in diagnosis and treatment. Doctors can charge a higher fee for a shorter examination using sophisticated equipment than for a thorough but non-technological examination. To obtain sophisticated equipment is a good investment, with favourable tax incentives and good return on capital, while there are no rewards for not using technology. Medical insurance usually pays for claims involving high-technology investigations without questioning the need for it. Doctors are thus encouraged and rewarded for replacing quality clinical time with high technology. In the USA, doctors often order many unnecessary special investigations to help thwart malpractice claims.

Peer pressure

Medical doctors are trained in tertiary health-care centres, where they get used to and became dependent on the newest technologies. Equipment which produces numbers or graphs on oscilloscopes and charts gives a semblance of scientific rigour and accuracy and leads to the so-called 'gadget syndrome', which reflects trendiness, devotion to a certain technology, and even professional competition and jealousy. Unfortunately, in medical schools there is insufficient training in the working principles, advantages, limitations and dangers of using these technologies, including economic comparison between alternatives. A trainee doctor might do a test for fear of being reprimanded for not doing so. Few doctors are reprimanded for doing too many tests. Insufficient knowledge of the cost/benefit ratio compounds the situation and precludes discussion and debate.

Patient demands and public awareness

When sick, we as patients quite reasonably want the best treatment possible. We associate the best with the most recently instituted, under the dubious assumption that technology undergoes continuous improvement. Unfortunately, the popular press is to a great extent to blame for trumpeting spectacular advances in technology without giving sufficient coverage to the state of development, side-effects and limitations, including costs. It is the duty of developers and users to point these out to the media. Unfortunately, the newsworthiness of the negative side-effects can never compete with the sensationalist possibilities of a new cancer cure story.

Moral and ethical pressures

Innovative technologies also introduce new moral and ethical issues and dilemmas. Technology is playing an important role in the definition and determination of death. The routine use of life-support technologies poses questions concerning when to terminate treatment with the 'heroics' of life-at-all-costs becoming the norm in the USA. Unquestioning application of these technologies in a milieu of constrained financial resources raises the question about who should be treated and on what basis this should be decided. Other vexing legal and moral issues which remain far from resolved concern clinical experimentation, organ donation/storage/transport/transplantation and various artificial fertilisation/implantation techniques.

The law has yet to come to grips with the clinical and moral dilemmas raised by these procedures, and provides little guidance or protection to progressive practitioners.

Time pressure

It seems that many of these 'advances' emerge too fast for comfort. Technologies become obsolete before they have matured and established themselves and there is not enough time critically to evaluate and respond to the consequences of technological interventions. This 'shortage of time' can lead to loss of control over patient and disease and thus to the dehumanising of patient care. One might ask: 'Why are we in such a hurry to introduce the newest technologies?' We have been without them for millions of years. The couple of years needed to evaluate a technology thoroughly might be a worthwhile investment to ensure that the right questions are asked with regard to its overall efficacy.

Legal liability

The complex mechanical and electrical nature of most technologies brings to the fore the safety aspects, which involve both patients and staff. The possibility of diagnostic errors arising despite correctly functioning equipment further complicates the situation. Legal cover against possible erroneous diagnosis or inappropriate treatment adds a tremendous financial burden to medical doctors and equipment manufacturers. Certainly in the USA insurance premiums are crippling and, to avoid malpractice suits, 'defensive medicine' demands excessive diagnostic and therapeutic procedures. A trend towards this 'unhealthy' state of affairs is clearly evident in South Africa.

Complexity

Medical knowledge is growing logarithmically, with ever more sophisticated technologies continuously emerging.

Meanwhile, the practising medical doctor is hard put to stay abreast of the latest advances. Complexity also manifests itself in the increasing amount of diagnostic information a doctor must routinely digest in order to make rational clinical decisions. There is a fear that medical doctors are now in danger of becoming managers of information rather than curers and comforters of the sick.

The cost of health care

The runaway cost of health-care technology has been causing concern in many quarters over the last 5 years. In the conventional industrial setting new technologies are either cost-reducing or benefit-increasing or both. By contrast health-care costs generally increase monotonically with greater effectiveness and/or quality.[2] The reasons for this difference in outcome include the following.

Initial capital investment. This is high in many instances, but the spread of cost over many years causes amortised equipment cost per diagnosis or treatment to be low.

The equipment component of a 20-bed intensive care unit (ICU) (including ventilators, monitors, radiographic equipment and even 'high-tech' beds) costs in the region of R1 million. Calculated on a cost per patient basis, this is only about 2 - 3% of the total average cost of daily hospitalisation in an ICU. Similarly, computerised tomography and autoanalyser equipment cost R1,5 million and R500 000 respectively, and individual tests appear relatively inexpensive. This creates a false impression of true costs.

'Invisible' overheads. These comprise the largest portion of the equipment-related cost. They include salaries, training programmes, building, maintenance, consumables, safety monitoring and administration. For example, the capital equipment costs for clinical laboratories in the USA represented only one-fiftieth of the total national bill for laboratory investigations.

It is especially important to guard against 'creeping developments', which are sometimes initiated by well-intentioned charities that donate equipment to hospitals, which then have to pick up the major part of the bill, i.e. the running costs. 'Donations' of equipment by companies may not prove as altruistic as they seem when the training, maintenance and spare parts bills start arriving!

Need for costly follow-up care. The mere availability of technology generates the temptation to use it in every case, even in those where the prognosis is poor. Heroic non-discriminatory use of cardiopulmonary resuscitation equipment has resulted in ever-larger ICUs filled with chronically debilitated patients who will never return to their homes. This problem has reached epidemic proportions in the USA.

Need for ongoing use. Dialysis, for example, once instituted, is most commonly maintained indefinitely if not followed by renal transplantation. For example, in 1984 in the USA renal dialysis cost $12 000/person/year; the resultant cost to the country was about $1 000 million annually.

Indiscriminate use. This always results in an increase in the cost of health care since it results in more equipment being needed than would otherwise be the case. The amount of money spent on health care cannot increase without limits. If the costs are allowed to expand in one area, e.g. due to unjustified, excessive usage, they will necessarily have to be reduced in others.

In the USA the introduction of prospective payment schemes for diagnostic-related groups was designed to encourage cost-effective deployment of limited resources. Under this scheme, Medicare insurance pays hospitals only for the diagnosis of and therapy for a disease, and not for the particular way this is achieved. Since its inception a few years ago, this system has already started providing encouraging results. Hospitals are giving more thorough consideration to the broader ramifications of new technologies and shying away from those which increase cost without clear benefit.

Who should take responsibility?

It is clear that technology in health care is a source of many problems, ranging from unequal resource distribution, through unwanted effects and unfair pressures on those involved, to financial considerations. There is a tendency to blame the medical profession for all the ills of the health-care system. This is of course to a large extent unwarranted. A large portion of the responsibility can be attributed to the technological transformation of health care that has not been properly planned and analysed. We believe that, with proper planning, many of these problems could have been eliminated or minimised. Even the developers and sellers of these technologies, with some insightful circumspection, should have been able to foresee some of the problems and could have provided leads to health-care planners about how to deal with them at a relatively early stage.

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