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AN APPROACH TO THE SOCIAL CONTROL OF HOSPITAL TECHNOLOGIES

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1. INTRODUCTION

Technology is of fundamental importance in health and hospital care. Without it the health system has nothing to offer sick and distressed people except supportive care. To consider health policy or hospital planning without explicit consideration of technology, as is quite often done, is to miss the entire point of the health care system.

It is commonly thought that technology consists in machines and equipment of various kinds, but, in fact, it has a broader meaning. It includes the knowledge underlying the artifacts and involves organizational, economic, cultural, ethical, legal, and political elements[1,2]. One can think of the "hardware" of technology and the "software" of technology. For this reason, health care technology is defined as the drugs, devices, and medical and surgical procedures used in health care, and the organizational and supportive systems within which such care is provided[3]. For the purposes of this paper, the discussion will be limited to clinical technology.

Thus, "technology" may mean very large complex machines with huge capital investments or it may mean procedures carried out by health care personnel with very small instruments, or even with their hands alone, as in physiotherapy. The health care system has a traditional technological base going back centuries, and this is still the technological basis of most of what is done in health care. The medical history (anamnesis) and the physical examination are together a diagnostic technology. Technology can also obviously be quite new and innovative and based on knowledge developed only very recently.

The forces encouraging or discouraging technological innovation are extremely complex[4,5] and cannot be dealt with in this paper. It is important, however, to acknowledge the many different forces involved in innovation, researcher curiosity and creativity, the demands of patients, the wishes of clinicians, visible health needs, industry promotion, and policy attempts by politicians and policy makers to the adoption and use of technology. While this paper may take a position promoting the more rational choice and use of technology, these processes are not - and never will be - totally rational. Many decisions, for example, are made for reasons of financial gain or prestige. Many decisions are made on the basis of custom, tradition, and belief. In pleading for more rational processes, the goal is to make rational considerations a more important part of decision-making, not the only determinant.

2. PROBLEMS ASSOCIATED WITH HEALTH CARE TECHNOLOGY

Problems with health care technology have become increasingly apparent in recent years. As far as developing countries are concerned, many problems can be found in the processes known as "technology transfer", which will be discussed in section 6. In industrial countries it has been recognized that many technologies in widespread use are ineffective. Most new health care technologies are incorporated into health care with only limited evidence of effectiveness. Stoddart and Feeny [6] have provided the following

summary of the behaviour patterns of physicians, hospital management, and ministries of health, whose decisions determine how technology will be used.

1. Technologies are often accepted for general use without evaluation.

2. Technologies are often accepted for use before evaluations are completed, making it extremely difficult to act upon subsequent results which suggest the technology is not of benefit.

3. Technologies are often over-supplied relative to reasonable estimates of population health needs.

4. Technologies that have been evaluated, and accepted for use on the basis of the evaluation, are often utilized for conditions beyond those covered by the evaluation.

5. Technologies that have been evaluated, accepted for use, and used within the broad conditions for which they have been evaluated are often utilized in the aggregate at frequencies beyond those known to be efficacious and necessary.

6. Even for technologies which avoid the above characteristics, there are situations in which existing utilization of some technologies is cost ineffective in that an equally effective but lower-cost technology exists but is not utilized.

These problems are obviously related to the financial costs of technology - an increasingly visible problem since all countries are now faced with limited resources for health care. It has been estimated that technology, using a broad definition, accounts for as much as 50% of the increased cost of hospital care[4].

While the most visible health care expenditures are for medical equipment and pharmaceuticals, the cost of personnel and technical support is actually larger, even with very expensive equipment-based services, indicating that the "software" of technology (that is, what health care providers do) deserves more attention. For example, a computed tomography scanner in the USA was found to cost from $177 000 to $337 000 a year to operate[7]. The amortized annual cost of the equipment was $76 000 to $117 000, while nonphysician staff cost $36,000 to $75 000 and physician staff cost another $60 000 to $130 000. An Nd:YAG laser in the Netherlands was found to cost $53 000 to $61 000 a year to operate. The amortized capital cost was $23 000 to 30 000, while personnel costs, <u>excluding</u> physician costs, were $25 000[8].

High costs are usually associated with high technology services such as computed tomography and magnetic resonance scanners, neonatal intensive care units, and coronary artery bypass grafting. While such high technology is undoubtedly expensive, it was found to account for only 14% of total health care costs in the Netherlands[9]. The overall expense of equipment is also significant but should be seen as supportive of professional procedures. In industrial countries, about 3-8% of health expenditure goes on the purchase of equipment, and another 7-20% goes on pharmaceuticals[10]. Radiology and imag-

ing account for 3-5%, and laboratory and pathology typically account for around 3%[11]. However, these proportions may be quite different in the developing countries. For example, it is known that 30% and even more of national health budgets in developing countries goes on pharmaceuticals[12]. It should also be noted that recurrent costs may be substantial, as in the case of X-ray films, chemicals for auto-analyzers, and disposable equipment.

Technology also raises many social and ethical issues. An important one is equity. Industrial countries have striven to develop systems that provide comparable benefits to all their citizens. However, there is obviously little equity between rich and poor countries. And in poor countries equity is a serious problem, with the rich obtaining care comparable to that available in the industrialized countries, and the having little or no access to care at all.

Technology has been associated with some of the problems of health systems[13,14]. New technology leads to specialization and superspecialization. X-rays led to the specialty of radiology. The ophthalmoscope led to the specialty of ophthalmology. Specialists tend to practise in hospitals, in their own departments. They may pay little attention to the patient as a person and may fail to take a holistic view of the patient's illness. Thus, as medical care becomes more technical, it may also become more fragmented and impersonal. The need for training increases. More resources go to address specialized problems, and fewer are available for such activities as prevention and primary care. Technology has also been associated with centralization of the health system into large hospitals.

3. DEALING WITH TECHNOLOGICAL PROBLEMS

Owing, in part, to these problems with technology, public administrators have begun to examine its role in the health care system. A variety of policies can affect technology, including budget and payment policies, direct regulation, policies on physicians' practices (number, type, and location) policies governing the role of certain physicians such as general practitioners, policies on prevention, and the development of alternative services such as out-of-hospital surgery. Europe in particular is an active arena for experimentation in policy development[15].

Concern with these problems has stimulated fresh developments in the still-new field of health care technology assessment[4]. Assessing technology means simply trying to understand its important consequences. In a narrow sense, technology assessment may be a technical evaluation of a device or an evaluation of a surgical procedure for its effects on outcome. In a broader sense, however, technology assessment is a form of policy research that examines the short- and long-term consequences of individual health care technologies and families of technologies and thereby is a source of information needed by policy-makers in developing policy and formulating legislation and regulations, by industry in

developing products, by health professionals in treating and serving patients, and by consumers in making personal health care decisions.

Technology assessment deals with different dimensions of the effects of technology, depending on the specific needs for information. The different dimensions can be divided into three.

1) Efficacy and safety. (What are the benefits and risks of the technology?).

2) Financial costs. (How much does the technology cost?).

3) Social, cultural, and ethical aspects. (Are there special societal implications of the technology?).

As more and more countries have developed mechanisms and institutions for assessing technology, international networks and data banks have also begun to develop. There is now quite a lot of information available for guiding administrators in the adoption and use of health care technology. The possible use of this information is an underlying theme of this paper.

4. HOSPITALS AND TECHNOLOGY

It is obvious that technology is important for all parts of the health care system and for all personnel, but in this paper, consideration will be limited mainly to hospitals, with a focus on the larger hospitals.

Hospitals are an essential part of any health care system [16,17,18,19], especially politics and policies at national or regional levels and resource constraints. Moreover, as people learn that technological solutions are available for their health problems, they obviously seek access to such services, often inappropriately.

Within this dynamic situation, technology is something of an independent force, particularly in developing countries. Equipment and pharmaceuticals are produced by industry, which is mainly influenced by the potential profits. Medical and surgical procedures are developed mainly in large teaching hospitals in the industrial countries, from which they spread. Thus, developing countries have little or no chance to affect technology development. They are offered an array of choices, and choice may be the only power they have.

The impact of a specific technology depends on the type of hospital in which it is used, and its social control must be tailored to that hospital[20]. Hospitals vary from very large teaching hospitals to small institutions that are little more than clinics. They also

vary in type. They may be public hospitals, owned and operated by a government department; they may be private hospitals, with a major orientation to collecting enough money from patients to survive and prosper; they may be charity hospitals, with a strong commitment to the health of the population they serve but with their own priorities; they may be military or industrial in nature, with a prime responsibility for keeping a certain group of people at a high functional level.

In developing countries direct policy tools may prove to have a limited ability to affect hospitals other than those belonging to the public sector[17].

Finally, the type of technology used will depend on the size and type of hospital. A very small peripheral hospital in a developing country will usually have only rather basic technology, while larger hospitals will be able to offer more complex technology as well. Capital-intensive technology tends to concentrate in very large teaching hospitals.

Thus each hospital has its own problems with technology, and any approach to the control of technology requires explicit consideration of the type of hospital and the type of technology to be controlled.

5. PRESENT SITUATION IN HEALTH CARE TECHNOLOGY

Historically speaking, the health care system has been able to offer little in the way of effective technology. It was not designed to provide effective technology to sick people. What it did was to provide care to people with problems. Gradually, effective technology did begin to emerge, but even today many of the practices in widespread use are known to be ineffective and many more are regarded as dubious.

The history of medical science and health care technology may be divided into three periods: (1) an early period of slow accumulation of medical knowledge through empirical observation, which began even before the ancient Greeks and ended with the beginning of modern scientific thought as described by Descartes in 1637; (2) a period of relatively rapid expansion of knowledge, primarily during the nineteenth and early twentieth centuries; and (3) the modern era of the biological revolution, the development of machine-based technology, and the appearance of extended longevity, with a corresponding increase in rates of chronic disease.

Despite this long history, effective therapies were rare until recently. Beeson[21] compared treatments recommended in a 1927 textbook of medicine to those recommended in 1975. He considered that 60% of the remedies in 1927 were harmful, dubious, or merely symptomatic; only 3% provided fully effective treatment or prevention. In the interval, effective regimens increased sevenfold and dubious ones decreased by two-thirds. The Box (Sweden and Back Pain) illustrates the number of ineffective treatments available, using the example of back pain.

Sweden and Back Pain

Sweden has a national body for assessing health care technology, the Swedish Council for Health Care Technology Assessment (SBU). SBU was set up in 1987 with the goal of changing health care policy and practice in constructive directions. After a three-year trial period, SBU was confirmed as a permanent national body by the Swedish Parliament in 1992.

One of the first assessments done by SBU concerned the problem of back pain, including its economic consequences. Back pain is the most common reason for sick leave and early retirement in Sweden, and thus has enormous economic consequences. In addition, back pain is a common reason for medical visits and for medical diagnosis and treatment.

The literature was reviewed to determine the efficacy of commonly-used diagnostic and treatment methods.

The study found that a variety of diagnostic methods were used in back pain in Sweden. Some of these diagnostic methods were found to have low reliability.

The Swedish health services offer a large number of methods to treat back pain. Most of those in use in Sweden were found to be either ineffective or unproven. An important finding was that early movement and rehabilitation promote recovery. On the whole, however, it was concluded that most people who experience back pain cannot be offered specific medical treatment aimed at the real cause of their symptoms because of the lack of knowledge about the real causes and most appropriate treatment of back pain.

Therefore, the report recommended a cautious approach to diagnosis and attempted treatment of the condition, as well as new research on efficacy of proposed technologies. It recommended that if clinical findings do not indicate the likelihood of one of the rather rare clear-cut causes of back pain that could be treated, no other initial examinations should be done. The report found that definitive examinations, such as x-ray examinations, are not appropriate during the first weeks of pain. In summary, patients with back pain should have a careful clinical examination. In the absence of indications of clear-cut pathology they should be sent home without further examinations with the advice to move the back as much as possible, and with the advice to return in a few weeks if the pain persists. (Most cases of back pain resolve completely without definitive treatment within a few weeks.)

This report was extensively publicized and led to a renewed discussion of the disorder throughout Sweden. The conclusions were very credible because SBU's expert group included the best-known experts in back pain in Sweden, including prominent physicians and surgeons. The impact of this report is presently being assessed.

The assessment of technology has a correspondingly long history, but assessment was made by personal experience and anecdote. With developments in the twentieth century, more scientific methods became available. The most important advance was to recognize the importance of the control group. Without a control group it is generally difficult or impos-

sible to attribute any health change to the intervention. It might be said that the formulating of the randomized controlled clinical trial in the mid-1930s by the British statistician Bradford Hill inaugurated the modern era of assessment of medical practices and technology.

The period since the Second World War has seen the most rapid development of health care technology in history. Since 1950 there has been an explosion of medical knowledge. The discovery of the structure of DNA set off a true biological reaction. Available laboratory tests have expanded dramatically. New imaging devices such as computed tomography scanning, introduced in 1972, and more recently, magnetic resonance imaging and positron-emission tomography have radically changed the process of diagnosis. New operative technologies have made such procedures as open-heart surgery relatively safe, and surgery combined with other disciplines such as immunology has led to an era of organ transplants. Overall, the period is most characterized by an extremely dramatic development of machines; previous human actions such as monitoring vital functions, mixing substances together to observe chemical reactions, and measuring myopia (short-sightedness) have been embodied in electronic and mechanical devices that have replaced people. At the same time, advances in electronics and biomaterials have made such technologies as cardiac pacemakers possible.

Despite this rapidity of change, the next 40 years will probably see even more rapid change[22,23]. While advances may be seen in many areas, only a few will be highlighted.

One very important advance is health care telematics, the combination of informatics (computers) with transmission lines such as telephone lines and fibre optics to allow the rapid manipulation and movement of information. Computers are already widely used in both administrative and clinical functions. In the Netherlands, for example, more than 50% of general practitioners now use computers in their practices. With time, this development will lead to an increasing integration of the health care system. Clinical information will be available wherever it is needed. Scientific information, such as what treatments are appropriate in certain circumstances, will be more widespread and easier to access. Clinical guidelines and standards will be increasingly developed and used as the basis of practice. The direct monitoring of practices will be possible, and quality will be assured by such monitoring and the direct feedback of the data acquired[24].

Another extremely important set of new technologies stem from the biological revolution and biotechnology[22]. The tools of biotechnology have already begun to revolutionize parts of the health care system. New important drugs and vaccines are beginning to appear. The function of blood banks will be greatly changed. The contribution of genetic factors to disease is beginning to be understood, and tools to prevent and treat genetic diseases are developing. Perhaps the most important implication of biotechnology is that it is leading to tremendous increases in knowledge of human biology. For example, the immune system is beginning to be understood, and one can already see the results of this understanding in the improved outcomes from organ transplants.

In between the molecular and system technologies is a large number of technical advances. The use of endoscopes and catheters, in association with treatment technologies

such as small instruments, lasers, and heater probes may be taken as an example[25]. These treatment tools can be incorporated into an endoscope (including a laparoscope) or a catheter or passed through it to many parts of the body previously only accessible by invasive surgery. This technology can be applied in many specialties of medicine and surgery, and in some cases is already reasonably well evaluated. In the future, this advance, in association with other technological developments, seems certain to effect a radical change in the treatment of a number of conditions, including cancers, blood vessel diseases (e.g. coronary artery disease), and bleeding problems.

Other important technical advances include the fact that many machines are much smaller, as well as more reliable. For example, clinical laboratory testing can now be done by dry tests or by desk-top methods.

The technological changes have many implications. They may affect or influence the health status of the population in significant ways. They will surely require different types training for health care professionals, as well as retraining for those already practising.

Perhaps the most significant change involves the nature of the hospital and its relation to the health care system. Decentralization will become possible in many cases[26]. Decentralization has obvious desirable aspects in making services more accessible and in giving people the feeling that they can influence the nature of those services. However, some highly specialized activities such as heart, liver, and kidney transplants should be concentrated in a few places to control costs and assure adequate standards of quality. At the same time, a number of technological developments permit the decentralization of care.

In industrial countries interest is growing in early discharge from hospital and associated home care[27]. For example, the early discharge of people after surgery can be beneficial and cost-effective. Improved support in the home could allow the earlier discharge of people after acute illnesses. At the same time (and probably <u>because</u> of early discharge) their is an increasing prevalence of medical problems in home care that require skilled nursing, such as tube feeding, pain control, and oxygen use.

Diagnosis seems certain to move progressively to less centralized sites. Diagnostic services in the clinic and the home, using kits and dry chemistries, will almost certainly increase. Providers can do more and more tests in the home, and certain tests can even be carried out by the patient.

Some technological treatments are already being given in the home. In addition, the treatment of chronic disease often requires self-care by the patient. It is not feasible to have a trained health care professional in continuous attendance on every person with a chronic disease. Increasingly, people with certain chronic diseases are monitoring their own clinical status and adjusting their therapy accordingly, as is the case with diabetes. Monitoring can also be carried out by different providers: relatively simple monitoring by members of the family, more complicated monitoring by nurses, and the most complicated monitoring by physicians.

Finally, technology offers the possibility of improving functional support for people with a variety of disabilities, making institutionalization unnecessary. The reasons for institutionalization are usually functional, such as inability to move around, dress, reach for things, or prepare meals[28]. There are technological solutions to such problems[27].

Cost pressures are already leading to a degree of decentralization of care, as people are discharged earlier from hospital or not admitted at all. Such pressures have helped to highlight the possibilities inherent in technology.

The changes implied, however, will not come easily[18]. The present structures of medical practice and of hospitals are familiar and comfortable. New types of people will be required, which implies new personnel structures. New types of organization will be needed. New professions such as clinical physicists and clinical engineers have become necessary in modern health care institutions. The old hierarchical system of physician control will no longer work. Collaborative and group decision-making must be evolved. Those giving health care need more and more knowledge about the skills and knowledge of other professions.

Furthermore, the present specialty structure of medical practice may become increasingly dysfunctional. Diagnosis and therapy are coming closer together and the traditional split between such specialties as internal medicine and surgery may need to be changed. Tensions have already developed between specialists over who will control the endoscope or the laser or similar advanced devices.

Active planning to overcome resistance to change will be increasingly necessary. On the one hand there will be those who are ready to rush to accept any new technology; on the other will be those who wish to maintain services as they are. Neither position is satisfactory. New, beneficial, and cost-effective technology must be adopted as quickly as possible. But all technology must be assessed before such as judgment can be made.

6. HEALTH CARE TECHNOLOGY IN DEVELOPING COUNTRIES

Developing countries do not develop their own technology. One important reason that is that their investment in health-related research is low. A study in 1979 found that one-third of the world's research and development budget was invested by the USA and about one-third by Western Europe and Japan combined[29]). Six countries - the former Federal Republic of Germany, France, Japan, the United Kingdom, the USA, and the former USSR - employed nearly 70% of the world's research and development manpower and spent nearly 85% of research and development funds.

Furthermore, development of pharmaceuticals and medical equipment is now dominated by giant multinational firms based mostly in the United States, Japan, and Western Europe. For example, 70% of the world's pharmaceuticals are produced in the industrial capitalistic countries[30].

The process of transferring technology from the place in which it originated to the place where it is applied is referred to as technology transfer. Technology transfer takes place between governments, academic and private institutions, and producers. In the case of health care technology, the point of application is the health care system. The health care technology may be a procedure in which knowledge and skill are the critical elements. It may, on the other hand, be a machine or a drug, but the important point to remember is that technology always includes a "software" element; a machine is of limited value if personnel are not trained in its use.

Effective technology transfer has been described by Teece, in an article by de Bettignies [31], as "a process of transferring from one production entity to another the know-how required to successfully utilize a particular technology".

When technology is transferred from developed to developing countries, special problems are raised[32]. Perhaps the most important point is that less developed countries are technology dependent. Their capability for developing technology is limited and their local industry weak[33]. Furthermore, and in part because of these facts, they lack the expertise and information sources to identify needed technologies. The technological infrastructure is often lacking, so the importing country must develop the capability to absorb and productively utilize foreign technology[34]. Finally, developing countries obviously have serious problems because they are poor.

Despite these difficulties, technology transfer from industrial countries to less developed countries is critically important. Technology - applied knowledge - is the path to a healthier population, whether the technology is a vaccine, a diagnostic tool, or a surgical procedure. This is a time of rapid technological change, and health care technology is becoming both more effective and more cost-effective. Less developed countries may be left even further behind if concerted efforts are not made to assure technological change in their health services.

Because the health care resources of less developed countries are seriously limited, they must make hard choices. Any country that is importing technology needs to ask a series of questions. What technology is available and what technology is in course of development? How can the technology be acquired and what it will cost? What effect will the technology have on health and on the health care system itself? What training, supportive systems, and so forth are necessary for the efficient implementation of the technology? And, will the technology be socially and culturally acceptable?

The answers to these questions - and other related questions - are available through the work performed in the field of technology assessment. Indeed, technology assessment was developed precisely to answer policy questions such as these[4].

The World Bank[35] has proposed that decisions should be based on the predicted disability-free life years in relation to the proposed investment. That is to say, decisions should be based on a form of technology assessment. The Bank has correctly observed that

debates about the structure of health care or the mix of services are at bottom "debates concerning the proper mixture of interventions." The proper mixture to achieve value for money in health care can be determined only by formal study of the benefits and costs of technologies.

Obviously, technology assessment must be adapted to the situation of the developing country. Because of the differences between the situations of developed and developing countries, technology assessment should be less of a technology-oriented activity in a developing country and more oriented to solving problems[36]. It should, for example, devote more attention to tropical diseases, nutritional problems, and the promotion of hygiene, health education, and primary care[1]. Still, advanced and capital intensive technology is also transferred to developing countries, especially to the larger hospitals, and it too must be assessed.

Developing countries may initiate their own technology transfer activities by purchasing certain machines, sending personnel abroad for specific training, or inviting outside experts to advise them. Technology transfer, however, is often carried out by non-governmental organizations or through bilateral or multilateral aid.

At present, developing countries lack many important health care technologies. Annual per capita expenditure for medical equipment is around $118 in the United States, $92 in Japan and $53 in countries of the European Union but only $12 in Asia and less than $1 in sub-Saharan Africa[37].

Table 1 compares developed and developing countries on several important hospital-based technologies. As can be seen, for these five technologies, from 66% to 90% of the world's supply is concentrated in the industrialized countries that account for only 16% of the world's population[38]. Japan and the USA alone account for 70% of the world's magnetic resonance imaging (MRI) devices. Tables 2-5 present data on selected technologies and

Table 1. Percentage of the world's supply of selected hospital technologies by country, 1990.

	CT	MRI	ESWL	CU	LA
Japan	35.1	20.0	20.2	10.4	11.2
USA	35.0	52.5	23.2	21.1	45.3
EU	6.2	13.6	14.5	24.8	16.3
OECD	88.2	90.2	73.8	66.5	78.3
Non-OECD	11.8	9.8	26.2	33.5	21.7

CT = computed tomography scanners; MRI = magnetic resonance imaging scanners; ESWL = extracorporeal shock wave lithotripsy; CU = cobalt radiotherapy units; LA = linear accelerators.
Source: Reference 38.

Table 2. Number and frequency of computed tomography scanners, selected countries, 1990.

	Number	Per million population
Australia	235	13.7
Canada	190	7.0
China	329	0.3
France	409	7.2
Germany, Fed. Rep.	750	12.2
India	136	0.2
Japan	6850	55.4
Mexico	185	2.2
Netherlands	109	7.3
Sweden	90	10.5
United Kingdom	250	4.3
USA	6715	26.8

Source: References 38, 2.

Table 3. Number and frequency of magnetic resonance imaging scanners, selected countries, 1990.

	Number	Per million population
Australia	11	0.6
Canada	20	0.7
China	23	0.02
France	70	1.2
Germany, Fed. Rep.	143	2.3
India	17	0.02
Japan	800	6.5
Mexico	16	0.2
Netherlands	14	0.9
United Kingdom	55	0.9
USA	22076	8.4
Sweden	12	1.5

Source: References, 38, 2.

Table 4. Number and frequency of extra-corporeal shock wave lithotripters, selected countries, 1990.

	Number	Per million population
Australia	7	0.4
Canada	10	0.4
China	204	0.18
France	41	0.7
Germany, Fed. Rep.	109	1.7
India	17	0.02
Japan	308	2.5
Mexico	15	0.17
Netherlands	12	0.8
Sweden	10	1.2
United Kingdom	18	0.3
USA	349	1.4

Source: References 38, 2.

Table 5. Number and frequency (per million population) of cobalt and linear accelerator radiotherapy units, selected countries, 1990.

	Cobalt units		Linear accelerators		Total	
	Number	Frequency	Number	Frequency	number	
Japan	250	2.0	516	4.2	766	6.2
USA	506	2.0	2084	8.0	2590	10.0
France	195	3.5	140	2.5	335	5.9
Germany, Fed. Rep.	178	2.9	187	3.0	365	5.9
Mexico	15	0.17	3	0.03	18	0.20
India	85	0.10	17	0.02	102	0.12

Source: References 38, 2.

selected countries. Radiotherapy is an important example of an advanced technology. Many women in developing countries die of cervico-uterine cancer that could be treated by radiotherapy. Yet the 84% of the world's population in poor countries have access to only 25-30% of the world's radiotherapy machines. Furthermore, as will be seen below, the richer of the developing countries have the majority of the complex hospital technologies to be found in such countries.

At the same time, a great deal of waste is apparent in technology transfer activities in health care. Large resources are spent on dubious technologies. For example, electronic fetal monitoring devices, which are considered not to be effective in many industrial countries, are now diffusing into developing countries, often with the support of aid programmes[39]. Cesarean section and antibiotics are examples of technologies that are often over-used in developing countries[39,40].

Furthermore, waste can be seen in the fact that many technologies are not used or are sited and used inappropriately. In one South American country, it was estimated that 40% of a $5 billion inventory of medical equipment did not work[41]. A study in another South American country of 1 289 pieces of equipment bought with European aid during the period 1974-79 found that 95% was not functioning. Reasons included inadequate numbers of maintenance personnel, poorly trained maintenance personnel, lack of spare parts, and lack of clinical expertise[42]. Machines may not function because the power source is inappropriate or inadequate. They may cease to function because of environmental conditions.

The relatively rich private sector often has the major share of technological resources. In Argentina in 1985 it was found that 93% of computed tomography scanners, 84% of gamma cameras, 70% of linear accelerators, and 76% of cobalt units were located in the private sector, which serves a minority of the population[43].

Aid programmes usually do not address such problems, and sometimes they actually cause serious problems in the acquisition of technology. Bilateral aid often requires the purchase of the national product, leading to a mix of equipment with different specifications and different needs for expertise and spare parts[44]. All too often, aid agencies do not base their decisions on any kind of assessment of either the needs of the country or the technological options available[39]. Countries are often influenced in their purchase of technology by non-technological considerations. One anecdote is that the Republic of Korea, which wished to purchase the basic radiological system from a European manufacturer, was pressed by the USA to buy US equipment at several times the cost. The Christian Medical Commission of the World Council of Churches has prepared guidelines that can be used by donors who wish to improve their provision of medical equipment[45]. These guidelines are summarized on the following page.

Problems with equipment at the hospital level include: the selection of technology to be incorporated (such as the problem of knowing what options are available); installation, operation, and maintenance; gaining access to spare parts; organizing appropriate technical and clinical training; lack of supporting technical materials; lack of follow-up by the

GUIDELINES FOR THE DONATION OF EQUIPMENT

RECIPIENT	DONOR
* Standardize your equipment. This ensures: - economical purchasing and store-keeping of equipment and spare parts. - equipment support in spare parts, maintenance, and instructions. - simplified operation for users and maintenance procedures for technicians. - selection of appropriate equipment.	* Communicate with the recipient. Make sure you have a comprehensive description of the equipment required. * Supply fully functional equipment. Test it and complete it before shipment and include essential spare parts and consumables. Do not supply old, broken, or redundant equipment.
* Involve technical departments. Technicians will consider and advise on: - aspects of installation, operation, and maintenance requirements. - staff and training requirements for users and technicians. - essential spare parts requirements. - appropriateness of equipment, based on economical operation and technical design.	* Supply all technical documents. Installation, operation, maintenance, and repair manuals and diagrams should be made available in the language understood by the users and technicians. * Supply initial requirement of consumables and spare parts to last at least two years. Include a complete list of spare parts and indicate name and address of authorized dealer.
* Specify clearly items to accompany the equipment: - a full set of technical documents in a suitable language. - a reasonable quantity of spares and consumables. - a document of warranty for new equipment.	* Ensure proper packaging and shipping: - use strong and sturdy packing materials and make easy to handle. - include a comprehensive packing list. - supply shipping documents promptly. * Offer technical assistance by promoting, recommending, and providing training for users and maintenance personnel.
* Make a check-list including the aforementioned issues. This ensures that you communicate to the donor adequate information for his appropriate response.	* Understand important laws of the recipient's country. Assess the ability of the recipient to pay local custom duties and other accompanying costs.

company that sold the equipment[44]. These problems are heightened when the purchases and donations are of older, used equipment that might be perfectly good with a supporting infrastructure but which tends to fail without it.

The problem faced by an individual hospital and the nature of a proposed solution depend very much on the nature and size of the hospital. However, the Christian Medical Commission guidelines can be of help to any recipient hospital that wishes to improve its acquisition of equipment.

7. AN IDEALIZED PLANNING PROCESS FOR TECHNOLOGY

Each government needs a clear hospital policy as part of its national health policy[20]. A health policy depends in part on effective health planning.

Effective health planning in turn requires information on health needs and how they may be addressed by technology. In an effective health service, appropriate technologies are applied to important health needs. To plan, one must be able to estimate the health benefit and put this in relation to the costs of the technology. Planning also requires some idea of the social context of the technology. Will it be acceptable to patients? Will it be considered ethically and culturally acceptable? Will physicians and other providers use it?

One scheme for a planning process that integrates technology assessment is shown in the figure[46]. The planning process, which was developed in Canada, begins with the burden of illness. Technologies can then be identified that seem to have the greatest potential for reducing this burden of illness. The efficacy (potential benefits) of any technology can be estimated from the literature and from collected data. Those in need must be accurately identified to allow decisions about numbers and placement. An estimate of community effectiveness allows one to estimate the benefit-harm ratio, as well as determining what other measures, such as special training, may be necessary. These outcomes can be related to costs. With all this information, recommendations can be made and implemented. It is then necessary to monitor and reassess the application of the technology and its effects on the burden of illness.

8. MECHANISMS AVAILABLE TO ENSURE APPROPRIATE USE OF HEALTH CARE TECHNOLOGIES

A variety of public policy mechanisms available for dealing with health care technology are shown in Table 6. Governments fund research and development. Drugs are regulated for efficacy and safety. Medical devices and equipment are similarly regulated in some countries. Physicians are licensed to practise medicine and may gain a certificate of specialization. Hospitals and other facilities are licensed and accredited. Health planning bodies regulate institutions and sometimes have the authority to forbid the other facilities are licensed and accredited. Health planning bodies regulate institutions

Table 6. Policies on medical technology and the organizations that implement them

Policy	Organization
Experiments (R&D)	Research institutes
Regulation of products	Government agencies
Planning	Planning organizations
Hospital equipment	Government agencies
Budgets, investment controls	Management, payers
Professional certification	Medical societies
Payment	Payers, tariff
Evaluation	Technology assessment organizations
Quality assurance	Quality control organizations
Publication	Editors of journals
Education and training	Medical faculties,
Consumer information	The media

and sometimes have the authority to forbid the location of certain facilities and equipment. And payment policy may be an important determinant of technology use. Payment for health care services by sickness funds and insurance companies means that patients and physicians use technologies at little or no cost to themselves. Technologies can be excluded from the package of benefits to be provided and paid for. Hospital, regional, provincial, or even national budgets severely constrain technology acquisition. In addition, conditions may be attached to payment, such as levels of pay to encourage or discourage use, or payment only when the technology is provided to defined groups of patients.

These mechanisms are increasingly visible in industrial countries and are beginning to be used in a coherent fashion for technology control. Abel-Smith[15] has examined the 12 member countries of the European Community to compare policies for cost-containment, which generally include policies for direct technology control. The main convergence he found in these countries was the use of the budget as a system of control, reinforced in some countries by manpower controls, especially limits on the number of staff positions in the public sector. Entry to medical education and to insurance practice was limited in almost all countries. He found that all countries used some cost-sharing, as in the payment for pharmaceuticals and dentistry partly by the patient and partly by the insurance scheme. Finally, he found general attempts to control expensive medical equipment, such as regulation of the numbers and placement of certain kinds of equipment. Abel-Smith's overall conclusion is interesting: " . . . the main message from the experience of the European Community is that costs have so far been successfully contained mainly by controls on supply rather than controls on demand." The most common effective control on supply has been an overall ceiling on expenditure (that is, a fixed budget).

The issue of manpower planning deserves emphasis, since physicians, especially specialists, have the main responsibility for using technology. Some countries now limit

the number of specialists and encourage general practice in order to help ensure public access to primary care and to give society more control over hospital technologies. One idea that is gaining currency is for hospitals to require physicians to have specific training before being allowed to use certain high-technology devices such as lasers and endoscopes[47].

Newer methods and policies are now being considered. Quality assurance and appropriateness reviews have not been very familiar outside North America and the United Kingdom, but they are now spreading rapidly in Western Europe[24]. Medical and professional societies are being asked to take a more active role in assessing and ensuring the appropriateness of technology use. Hospital associations are likewise being asked to examine hospital care, and in some cases hospital associations have established formal programmes of technology assessment. Information campaigns can educate the public that services are available or that certain services are not considered to be effective or appropriate.

Health systems are often based on the idea of regionalizing services, in which hospitals and clinics are organized in a hierarchical system that clearly defines the tasks and responsibilities at each level[4]. The Swedish system is considered to be the archetype, with its four hospital tiers. At the fourth and top tier of the Swedish system are seven regional hospitals, each with a population base of about a million people. These hospitals provide the highly specialized services such as neurology, radiation therapy, thoracic surgery, neurosurgery, cardiac surgery, and so forth, to the Swedish population. This type of system tends to deal with many technological choices itself, ensuring the appropriate acquisition and use of technology at each level.

Of particular interest to hospitals are the units for technology assessment, which are becoming more and more typical, especially in hospitals in the USA. These units may also decide or advise on equipment acquisition and so will be further described in the next section.

The role of technology assessment is to support all these policies, including those addressed to physicians, hospitals, and the public. A number of countries in North America and Europe now have public bodies at the national and regional levels for this purpose, and more are being established almost every day. For example, in Spain, the decision has been made to include new technology in the benefit package only after an assessment, but the assessment agency to carry out this work was only formally established in 1994.

Perhaps the main lesson in this brief review is that one cannot say that any country has found the "solution" to rationalizing technology and controlling costs. All industrial countries are engaged in a rapid process of policy evolution, evaluation, and change.

9. A SYSTEM TO ENSURE THE AVAILABILITY OF PROPERLY FUNCTIONING MEDICAL EQUIPMENT

Part of a system for ensuring the appropriate acquisition and use of health care technologies is that dealing with the choice of medical equipment. In industrial countries equipment tends to be selected only after some consideration of its benefits, risks, and costs. Most developing countries have no system for this purpose[44,48].

Ideally, a system for medical equipment would have a national unit, probably in the Ministry of Health[44]. It would also have provincial and district units. Finally, each hospital would have a unit or committee for dealing with medical equipment.

The key to success of such a system is a team approach. At present, decisions are often made by an administrator, usually a physician, without consultation with others. The technical person - an engineer or technician - tends to be completely excluded from such decisions, when in fact such a person may be in the best position to give advice[49]. An ideal team is made up of one or more physicians, a public health specialist, a technical person, and an administrator or finance person. Such a team can consider all aspects of a proposed piece of equipment.

The task begins with the selection of equipment. The team makes contact with, and negotiates with, potential suppliers. After the decision is made, the team ensures that appropriate contracts are drawn up, covering not only the equipment itself but the supporting technical material, spare parts, specialized support where necessary, and so forth. The team ensures that appropriate training for the staff is organized. Finally, the team ensures that there is an appropriate stock of spare parts and that ordinary maintenance and repair are carried out. A wealth of information on these subjects is available in a number of reports[50,51,52].

A national system would maintain local, regional, and national inventories of equipment. It would also operate a structure of repair and maintenance facilities. One specialized facility with one or more engineers would be located centrally. In the provincial hospital, a unit would ensure appropriate functioning at that level. Finally, a unit in the district hospital would not only oversee the hospital's equipment but would be responsible for that in the primary health care centres.

10. EXAMPLES OF RATIONALIZING HEALTH CARE TECHNOLOGIES

Although technology planning and technology assessment are still relatively new activities, quite a number of countries have had success in rationalizing their technology choices. This section gives some selected case histories.

The introduction of the computed tomography scanner into Sweden

The computed tomography (CT) scanner was introduced into Sweden in 1973, the same year that the United States acquired its first scanner. Planners in Sweden did not view the introduction of CT scanning to Swedish hospitals as a simple case of adding another machine[53]. They viewed CT as a technology that would partially replace other diagnostic tests, so that these could be allocated fewer resources. Therefore, when the first head scanner was installed by the Karolinska Hospital in Stockholm, an evaluation was immediately mounted to rationalize further purchases of CT scanners.

A team of planners from the Swedish Planning and Rationalization Institute carried out a study weighing the costs of the CT head scanner against those of cerebral angiography and pneumoencephalography at various levels of examination. The basic question was this: how many angiographic and/or pneumoencephalographic examinations would have to be replaced at a given hospital by CT scanning for the costs of the scanner to be economically justified? Only equipment, hospital, and personnel costs were included in the analysis, although other benefits, including the medical and psychological value of the innovation, were listed.

The cost-effective level for installation of CT scanners was found to lie somewhere between the levels of the regional and central general hospitals[54] (Jonsson, 1980). Since some of the large central hospitals did almost as many brain examinations as the smallest regional hospital, the evaluation did not recommend which institutions should acquire CT scanners. Rather, it published charts that county councils could use to graph specific levels of usage of angiography and pneumoencephalography at a given hospital in order to determine whether replacement of these modalities with a CT scanner would be cost-effective.

The success of the Swedish evaluation was probably due in large part to its timeliness. The county councils needed information to help their decision-making. The information was available when it was needed, and it was credible. Most Swedish hospitals waited for the report and followed its recommendations. Only two scanners had been installed in Sweden by the time the report was released. By December 1978, Sweden had eight head scanners, all but one at regional hospitals, and six total body scanners, two of which were located at the largest central hospitals. An important factor was that the county councils expected the CT scanners to pay for themselves from replaced procedures. Hospitals therefore received only a small additional budget when they purchased a scanner.

By May 1978 Sweden had only 1.6 scanners per million population, while the USA had 4.8 scanners per million[53]. This is surprising, considering that Sweden originated the specialty of neuroradiology and has been a leader in radiology and radiotherapy. One might have predicted that such medical and scientific leadership would have led to a rapid diffusion of such an exciting medical innovation as CT scanning.

While the CT scanner has continued to diffuse in Sweden, it has been continually monitored and has never been out of control, as it has in some other countries[2]. Table 2 shows that Sweden had a frequency of CT scanners in 1990 approximately one-fifth of the frequency found in Japan.

The introduction of the magnetic resonance imaging scanner into Canada

Magnetic resonance imaging (MRI) was introduced into Canada as a research tool in 1982. The first clinical uses began in 1985. The provincial governments were generally sceptical of the value of MRI and, since the images with MRI and CT scanning were similar, they wished to be assured that the MRI scanner was truly important[2].

The initial diffusion of MRI scanners was restrained by the global budgeting system of Canadian hospitals; it was difficult for hospitals to buy MRI scanners without additional funds. The national and regional concerns about levels of health-care spending had tended to promote scepticism about new technology. In addition, a severe recession in the late 1980s led to further concerns about such high technology.

In 1988, the first technology assessment body was established in Quebec, and similar bodies have since been established in some of the other provinces. A report to the Ministry of Health and Social Services in 1990 noted that the "diagnostic superiority" of magnetic resonance imaging remained unproven and recommended that MRI be considered as a service specific to university centres. Projected demand was estimated to require eight units in the province, of which three were operating and three were under construction when the report was published. The report also proposed several general approaches to the new technology including: (1) a systematic selection and follow-up of patients receiving MRI to ensure that only those in which MRI would be the first choice of diagnostic investigation were in fact receiving it, thus reducing waiting lists to a minimum; (2) payment and budgeting mechanisms based on general categories of diagnostic services rather than specific modalities; and (3) modelling to establish an optimal distribution of MRI technology[55]. On a population basis, Canada has many fewer scanners than has the United States, as Table 3 shows.

The introduction of neonatal intensive care to the Netherlands

Modern, sophisticated neonatal intensive care began to develop in the Netherlands in about 1970. By 1978, there were 31 fully equipped neonatal intensive care beds in the seven university hospitals. Subsequently, smaller regional hospitals began to establish such units, leading to concerns about poor quality of care. In 1979, when the situation with neonatal intensive care had become critical, the Minister of Health asked the Dutch Health Council to assess the scientific development of neonatal intensive care facilities and report on the future need for them. The recommendations were published in 1982 and were as follows[56]

(1) Neonatal intensive care should be restricted to ten fully equipped supra regional centres (eight university hospitals and two non university centres).

(2) The future need (1985-90) for neonatal intensive care units in the Netherlands was calculated to be 140 intensive care beds and 228 high care and medium care beds.

(3) The minimum size for a centre was put at 10 intensive care, 12 high care, and 10 medium care beds.

(4) Neonatal intensive care should be concentrated in these 10 centres by means of legal regulation, by applying article 18 of the Hospital Facilities Act.

It was not until five years later that the Ministry of Health published a planning document in which the 10 centres were actually named. Between 1986 and 1991 the Minister of Health made the development of these centres one of his priorities, approving the building of new facilities and increasing the budgetary allocations.

Although during these years the capacity of the neonatal intensive care units in these centres had almost doubled, it became clear that the shortage had not been resolved. Therefore in 1989 the Minister again requested the Health Council to report on future developments in intensive care. This new report was ready in 1991[57]. It contained a survey of the use of neonatal intensive care facilities in the Netherlands, showing that the demand for neonatal intensive care was structurally growing. It also contained an assessment of the effectiveness of these units in improving survival and preventing handicaps. Finally, the need for neonatal intensive care was estimated to be in the range of 165 to 202 beds (at 80% occupancy) in the period 1990-95, to be realized in the existing 10 centres.

This time the Minister of Health did not take long to act. In January 1993 a new planning document was published that set the future need at 168 beds (at 90% occupancy rate). Peripheral hospitals that provide neonatal intensive care on a small scale but have not been authorized under article 18, will have to terminate this type of care but some are being allowed to continue until the capacity in the 10 centres has been expanded.

Assessment studies have played an important role in the development of neonatal intensive care units in the Netherlands, and the two assessment reports issued by the Health Council became the basis for the policy pursued by the Minister of Health.

The introduction of lithotripsy into France

Extracorporeal shock wave lithotripsy became commercially available in 1982, and two lithotripters were acquired by French centres, one in Paris and one in Lyon[58]. Because this was an expensive machine, the French government preferred to purchase a French product if one was available. However, although French companies had begun to develop a lithotripter in 1980, there was no model available in 1982, and the two machines had to

be imported. This aspect of industrial policy was important in the French policy toward lithotripsy.

The purchase of further lithotripters was prevented by national regulations concerning high technology. To purchase a large machine for routine use in France requires that it be listed on the "health map". In addition, because of the high costs, grants from the Ministry of Health were essential. The government therefore encouraged the evaluation of lithotripsy in the centres in Paris and Lyon as a basis for further decision-making.

The Paris lithotripter was intended to service the public hospitals (Assistance Publique) of Paris, and these hospitals set up an autonomous structure at the Necker Hospital involving 10 urologists. Each urology service in the public hospitals had access to the lithotripter one day every two weeks. The shared site made multicentre evaluation possible, and all users of the machine were involved. The evaluation gave a wealth of information concerning the outcomes of lithotripsy. In summary, lithotripsy was able to lead to the removal of almost 100% of stones without surgical intervention. The government accordingly added lithotripsy to the health map in June 1986, by which time the French lithotripters were approved and ready for marketing. However, the number of lithotripters has continued to be regulated, so that France now has a modest number of lithotripters in relation to some other countries[59].

Because of this experience, among others, the French government decided to establish a national agency for technology assessment in 1990.

Hospital technology assessment programmes in the United States

In the USA each hospital is essentially isolated in making its technological decisions. Although resources in health care begin to be limited in that country, especially through the prospective payment system of the Medicare programme[2], 1994), medical centre managers have little guidance on the criteria that would be useful for determining whether to invest in new technology or for structuring the most effective process to make such determinations. While most hospitals have no explicit technology assessment process, they do have a capital budgeting process requiring them to monitor the acquisition of equipment[59]. Technology assessment needs to be integrated into this capital budgeting process[60].

The American Hospital Association has for some years had a technology assessment programme that makes information available to its member hospitals on important technological changes. ECRI, a non-profit institute in Pennsylvania and a WHO Collaborating Centre, also evaluates technology, focusing on equipment, and makes the information available to hospitals by subscription.

A few hospitals and health systems in the United States do have special committees and processes for deciding whether or not to acquire new technology. The Kaiser Health

Maintenance Organization is one system that has such a structure[61]. The University of Rochester Medical Center, the Johns Hopkins Hospital[62], and the Massachusetts General Hospital also have processes for this purpose[59]. The Johns Hopkins Program for Medical Technology and Practice Assessment assesses the clinical efficacy, safety, and cost of specific technologies, evaluates the costs and benefits of alternative approaches, and examines the clinical and economic impact of proposed innovations. Programme activities have had a direct impact on decision-making within the Johns Hopkins health system[62].

At the Mayo Clinic, each proposed major purchase is referred to the Equipment Subcommittee of the Clinical Practice Committee. A member of the subcommittee, usually a physician, reviews each proposal and makes a recommendation. A number of other committees are asked for their input during this process.

Duke University Medical Center has an Office of Science and Technology to identify new and emerging technologies and bring those thought worthwhile to the medical centre. The Office facilitates vendors' access to the medical centre for the testing of experimental agents and devices. Members of the staff stay abreast of developments by attending forums and trade fairs and by developing direct relationships with vendors.

These programmes are considered successful by the institutions that have developed them but they are still of limited scale and their successes and failures have not been formally evaluated. What is clear is that formal technology assessment can be used at the hospital level to guide decisions[59,63]. An assessment process can also help balance organizational goals and community needs[64]. Hospitals can profit from the rapidly growing amount of information available on specific technologies[65].

Essential input lists in Mexico

In the early 1980s, Mexico restricted imports of equipment by national law. However, such restriction was impossible under the rules of the International Monetary Fund, and the policy was ended in the late 1980s.

Still, because of a continuing economic crisis, health care authorities had to place the highest priority on the evaluation of decisions concerning the purchase, transfer, and incorporation of equipment for medical use.

The problem was addressed by structuring the health system in levels, each with standard facilities according to technological complexity[66]. Manuals were prepared for each standard facility regulating the material inputs and personnel to be made available and specifying the technology required, according to size, complexity, location, and level of medical care.

The major tool was the essential input lists, which were established to regulate the demand for medical devices, supplies, implants, prostheses, and drugs. In addition, a

policy of consolidated purchase was adopted so that public sector institutions could obtain better prices by buying in large volumes.

Through these actions, the costs of medical care were reduced. At the same time, preference was given to domestic suppliers in awarding contracts when they were competitive in quality and price. In this way, the government also stimulated industrial development[66].

Preoperative routine testing in Sweden

Sweden was involved in health care technology assessment very early, through the introduction of the CT scanner.

In Sweden, controls over health care technology include the regionalized system of care; the training and regulation of health care professionals; and the natural prudence of the Swedish population, which leads it to seek out interesting and useful information on technology[4]. Although the state has decentralized control over the system, it still attempts to control the general direction of the system through both regulation and subsidy.

The Swedish government created the Swedish Council for Technology Assessment in Health Care in 1987 and confirmed its permanent mandate in 1992. The Council was envisaged as an organization both to assess important technologies and to serve as a focus and coordinating body for activities in Sweden. The Board of the Council was made up of representatives of all important organizations in health care. The permanent Council began to function in 1992 with a budget of $1.5 million[2].

The first technology assessment of the Council concerned preoperative investigations in elective surgery[67]. The study team reviewed the literature and concluded that there was little justification for the routine use of preoperative X-rays, electrocardiograms, or laboratory tests. A survey of practice revealed considerable variation in the use of such tests; some hospital departments always perform them while others never do. An economic analysis showed that the cost for complete preoperative investigations in Sweden totalled about $90 million. The Council recommended that preoperative routines should not be used in the absence of specific indications. An extensive promotional effort was made to convince surgeons and anaesthesiologists of the wisdom of these recommendations.

Follow-up surveys of practice were carried out in 1990 and 1991 to evaluate the impact of the report. The evaluation in 1990 showed a significant decrease in routine preoperative testing, which continued in the 1991 measurement. The actual saving in economic terms was $6 million per year, or five times the yearly budget of the Council at that time[2]. The increase in quality of care could not be quantified.

11. DEVELOPING SOURCES OF INFORMATION ON HOSPITAL TECHNOLOGY

National and regional programmes have clearly developed rapidly during the past few years to ensure that technology is assessed before it comes into widespread use. National programmes now exist in Australia, Canada, France, Sweden, and the United Kingdom. In addition, programmes covering geographical regions or large sickness funds exist in the Netherlands, Spain, and the USA.

The largest amount of support for health care technology assessment is found in the United States, where both the government and private organizations support extensive technology assessment activities. The most important governmental organization is the Agency for Health Care Policy and Research, which supports a number of activities related to health care technology assessment. One of them is to develop on-line information on health care technology assessment. In 1993, the National Library of Medicine, part of the National Institutes of Health, established a new information centre to make such information more widely available. One activity of the centre is to include health care technology assessments in on-line data bases, such as the MEDLINE system.

Representatives of the most important of the health care technology assessment programmes met in Paris in September 1993 and formed the International Network of Agencies in Health Technology Assessment. The main purpose of this activity is to share the results of each others' work. For this purpose, abstracts of all completed and ongoing projects are being submitted to the Network's office in Ottawa, Canada.

Within Western Europe, the BIOMED I programme of the European Commission has granted support to EUR-ASSEA - a coordinating group of health care technology assessment agencies in Western Europe. All important programmes in Western Europe are members of this group. The group will concentrate on standardizing methods of setting priorities, carrying out assessment, disseminating the results, and evaluating their impact. In addition, the group will examine the methods being used by payment programmes, including sickness funds, to decide which technologies should be adopted. The Steering Committee of EUR-ASSESS had its first meeting in June 1994 in Leiden, the Netherlands, and its second in November 1994 in Barcelona.

12. SUMMARY AND CONCLUSIONS

Controlling health care technology in hospitals is necessary to maximize the benefits while minimizing the cost (which may not be purely financial). The word "control" has both a positive and a negative meaning. The positive is to encourage the adoption and use of effective and cost-effective health care technology. The negative is to prevent the adoption of unproven technology that may be ineffective or even harmful.

Hospitals come under many pressures to adopt technology and increasing attempts are being made in many countries to rationalize the process. The situation is gradually being

improved, and one aspect of this improvement is the design of policies on health care technology. The most promising policy is to limit hospital budgets thus controlling costs and forcing choice among competing technologies. Budgetary policies, however, need to be reinforced by other policies, such as manpower planning and regulation of the placement of expensive equipment.

This paper has stressed the importance of the rapidly growing field of health care technology assessment. National agencies to assess health care technology have been formed (or are in the process of formation) in North America and Western Europe (as well as in Australia and New Zealand), and some developing countries are also moving into this field. All countries can profit from the information made available through the activities of such agencies. A challenge for the future is to see that this information is widely disseminated to assist in efforts to improve public health everywhere.

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