TECHNOLOGY AND THE STATE: THE EMERGENCY OF HEALTH CARE RATIONING

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One has only to travel from Hong Kong to New York or from Buenos Aires to Moscow to appreciate the power of technology as a force for standardization in contemporary life. Similarities in architecture, in mass transit facilities, and in department store wares are visible reminders that technology transcends political ideology. Public discussions of nuclear arms limitations are psychological reminders of the unforeseeable anarchistic and irreversible nature of much technological development.

In this paper we examine the role of technology and the "technological network" in health care, identifying and discussing many questions about the contributions of technology to life and health, questions which are particularly troublesome because they often invoke considerations of morality and economics simultaneously. The questions, though difficult, are real, and responding to them with sensible, reasoned policy is one of the challenges for health policymakers in the coming years.

The Technological Network

Our perspective on our subject is broader than some. We are impressed by the pervasiveness of interconnectedness in health care technology. In strict definitional terms, the French definition of technology differs slightly from its Anglo-Saxon equivalent. The Larousse dictionary makes an explicit reference to industry and its processes, while Webster's defines the word as the totality of means employed to procure for man the objects necessary for his subsistence and comfort. "Technology" is an extension of the word "technique." Anything which uses or involves technical intervention can be called technological. In

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the area of health, consideration of technology should not be limited to the instruments and techniques used by doctors. It extends to the entire spectrum of the work of health care professionals from the use of the telephone to computer programing. Technology in health care also means documentation and modern methods in pedagogy and promotion. It includes the vast field of prostheses and instruments which change the lives of handicapped people. Modern services are included, as is genetic engineering for industrial purposes, because knowledge about the interaction between living organisms and their evironments is beginning to be explained by technological processes (genetic recombination). Technology thus comprises a whole network of sciences which are increasingly interdependent. Modern biology, for example, would not exist without optics, computer science, and solid physics.

A modern hospital is a particularly dense concentration of the technological network. Although the network is more dispersed in what we call private practice, a general practitioner is dependent upon pharmacists, radiologists, and laboratories, which assist his diagnosis and prescribed treatment.

The interdependent character of technology in health care makes evaluation difficult. The example of a new X-ray machine illustrates the problem well. It is certainly possible to evaluate the quality and cost of the prints it makes in comparison with those already on the market. But the real question is whether the machine can produce new information. Then it must be determined if this additional information is useful, if applicable therapies exist, and if trained personnel are available. To evaluate the machine fully, one must refer to its necessary complements.

The notion of a "network" allows us to describe the source of future developments. Innovations have essentially two sources. They may come from the linear development of a single concept or from the conjunction of two previously independent branches of technology which creates new uses and further developments. The former is illustrated by the modern stethoscope, which differs only slightly from Laennec's first model although it is made of material unknown in the 19th century. Telecommunications are descendents of the telephone and the computer. Their proper applications go well beyond the domain of their parent technologies.

What can we expect from this network with regard to the health sector? Can it be controlled? What sort of choices confront us in the coming years? These questions are addressed in the following pages.

The End of Empiricism

Since the beginning of this century, life expectancy in Western societies has increased considerably while morbidity rates have declined. At birth, life expectancy for men is 70 years and for women 76 years. In fact, infant mortality has decreased considerably also. The most common illnesses are chronic diseases affecting the elderly.

Technology has contributed measurably to this evolution. Vaccines and antibiotics have made redundant most hospital beds intended for infectious illnesses. Yellow fever has almost disappeared. Diabetics can live. But in certain areas little progress has been made. There are no cures for numerous cardiovascular and cerebrovascular illnesses as well as most cancers. Few major discoveries have been made in the last 20 years, and many of those that have been announced and heavily publicized, such as interferon, have not lived up to expectations.

The case of interferon is instructive. Many articles were written about this "miracle protein" before conclusive laboratory results were available. The actual substance tested was often impure, control groups were inappropriate, and dosages varied widely from test to test. In addition little was known about how it functioned on the molecular level, nor was it certain whether patients had differential sensitivities to this drug. However, the wave of publicity created great expectations in the absence of empirical evidence.

This is not an exceptional case. There have been other examples of what can be called "expectation inflation." At the beginning of this century, no effective treatment for cancer existed. The first positive results of radiation treatment in certain cases of skin cancer have been extended today to other tumors, even when effectiveness has not been demonstrated. Today it is not unlikely that a particular cancer therapy regimen is used as much because it is codified and priced as becasue it is effective. It is difficult to avoid becoming caught up in the wave of increased expectations; the only control, albeit imperfect, is the ethics of scientists.

For most of us, however, the gaps between promise and performance do not destroy our hopes. We must accept the inevitable side effects of effectiveness; technology has its risks. If it cures, it can also injure or even kill, particularly where there is negligence, lack of scientific knowledge, or imperfect training of medical personnel.

Technology in health is expensive, not so much because of equipment costs, but because of the need for qualified personnel. They are thus the origins of a "prescribed" demand by practitioners, which poses the problem of their justification, and validation of their widespread use on the basis of scientific methods.

Technical Innovation, Cause or Product of Increased Health Care Costs?

To a large extent, technical innovations are statistically linked with growing consumption of medical services, and these with growing costs. When the components of medical care are analyzed, it is evident that the sector showing the most rapid increases in cost are those in which technical advances have recently emerged. Thus, in France, in the area of outpatient services, laboratory tests and radiology have expanded rapidly, with respective annual growth rates of 22% and 7.6% while traditional medical acts such as house calls and group consultations have progressed slowly. In the United States, total domestic shipments of X-ray apparatus and electromedical devices increased at an annual rate of approximately 24 percent between 1972 and 1977.

This evolution is most visible in the public hospital sector in France because this is the privileged domain of high-technology therapy. The growing role of technical services in hospital care is illustrated by the growth of radiological acts and laboratory tests per admission for all categories of hospitals (table 1). Private practice also reflects the role of innovation. In France, radiology accounted for 12.6% of medical activity in private practice in 1959. In 1976 the figure was 20.2%. Technical progress as measured in consumption of technical procedures accounts for about 2/3 of the increase in volume of medical acts independent of price increases.

Table 1

Public General Hospitals (France)

	Number of "Z" *		Number of "B" **	
Year	By Admission	By Day	By Admission	By Day
1965	22.48	1.0	250	7.8
1970	30.59	1.7	298	16.4
1973	37.54	2.4	394	25.1

Annual Growth Rate in Percentage

1965-1973	6.6	11.6	12.6	16.7
1970-1973	7.1	12.2	9.8	15.2

* - X-ray procedures are evaluated according to "Z". The more complex a procedure, the higher its "Z" number.

** - Biological tests are evaluated according to a "B" number.

The causal relation between accelerating technical progress and growing expenses is difficult to determine. Increasing costs can be linked to technological advances in many cases, but in a few instances, costs for individual treatments are reduced. For policy purposes, the direction of causality is of fundamental importance. If one accepts the innovation-push hypothesis, efforts to improve productivity in the health care system should be aimed at qualitative control, requiring judgments about the future potential of an innovation in the earliest stages of its development.

The alternative hypothesis explains technical innovation as the response of human genius to legitimate needs. In this view, only excessive use and consumption should be criticized. The eventual control of use would be wholly quantitative; the nature of technical innovation would not be questioned, only its long-term effect. Although these two hypotheses theoretically are not mutually exclusive, differences in the casual priority they assign to innovation and the resulting differences in implications for health policy effectively force a choice between them.

The Justification of Technical Progress

Technical progress and care quality

The introduction of a technical innovation is normally justified on the basis of an improvement in the quality of services rendered by the health care system. Although it is a classic opposition to set off the notion of qualitative evaluation (subjective) against quantitative measurement (objective), it is possible to analyze the marginal benefits of technical progress by breaking down the notion of quality into five components, each objectively measurable:

--technical efficacy (better diagnosis, more effective treatment)

--security

--cost factor

--comfort (respect for the patient, speed and painlessness of care)

--accessibilty

Each of these factors must be evaluated on different scales and can be analyzed separately. But the overall evaluation of an innovation can be thought of as a complex function of these five independent variables.

Technical Efficacy

Efficacy can be evaluated in terms of decreased mortality, morbidity, and illness rates. Recent examples of technological advances that would rate highly on this dimension include:

--The use of chemotherapy in treating hematosarcomas. What was a mortal illness 10 years ago is now usually curable.

--Artificial prostheses (hip joints in particular) which have transformed prognosis of traumatic and rheumatoid pathology for the elderly.

--Intensive care facilities which can sustain vital functions. Progress here has even led to charges of overuse (artificially prolonging life).

It must be noted here that scientific evaluation procedures for new therapies are generally applied only to innovations in medication, and not to advances in medical instruments. Several explanations are usually advanced to account for this fact:

--Controlled therapeutic tests would be difficult to organize for instruments because of problems in random selection and the composition of test groups.

--Progress is more tangible in the area of instrumentation than in that of medication. Strict experimental protocol is not yet needed here; whereas in the domain of medication we are dealing with active molecules where only marginal improvement over existing projects can be expected.

In our opinion, these are questionable arguments which are themselves not based on objective criteria. We must also point out the total lack of methods for determining the efficacy of organizational innovations.

Cost Factors

Many innovations have brought about a reduction in unit costs for treatment. The development of simple tests and instruments (chemically reactive paper tests, enzyme analyses, etc.) exemplifies automation of numerous analytic techniques in biology.

We must consider, however, that at least in France the substitution of a new technique for an old one is progressive and that for a certain time the new technique can be very profitable because the tests performed are reimbursed according to the existing procedures classification.

In the case of laboratory equipment, this factor has played an undeniable role in the rapid diffusion of new techniques. Ease of use and a reduction in unit tests, both consequences of automation, are also incentive factors which explain the rapid growth of consumption in this sector. We should also mention in this regard the development of home usage of renal dialysis machines. Unit treatment costs have been reduced by 50%.

Comfort and Security

Innovations may seek to minimize the following accidents and inconveniences which treatment can create for the patient and those around him:

--accidents and therapy

--pain

--waiting

--violation of privacy

--side effects on family or social life

The increased current effort to develop "noninvasive" techniques is an example of how such an aim can supersede the technical efficacy of treatment. The following recent innovations are examples of this trend:

--electrocardiography

--isotope scintography

--echo-tomography, echo-cardiography (ultra-sound)

--thermography

--computerized axial tomography (C.A.T. scanning)

These examples all have in common a relative innocuousness. These tests may be repeated without risk and are usually based on automated techniques which makes them simple to use. These two features are particularly favorable because they free us from traditional inhibiting factors in the diffusion of technical innovations and training of highly skilled personnel.

One consequence of this is rapid expansion of the applications of these techniques, a phenomenon especially visible in the case of C.A.T. scanners. Another almost caricatural example of this trend is the widespread use of thermography. It is generally accepted that this technique is of practically no diagnostic benefit except in the confirmation of breast cancer, a condition which can be precisely diagnosed by histology.

Accessibility

In France and the US, the development of home care and "day hospitals" permits easy access to quality treatment and avoids traditional hospitalization in the future. Improvements in telecommunications (such as information retrieval, optimal organization of hospital consultations, and long-distance consultation) will move us in the direction of better access to health care systems. The result is sure to be an increase in demand. Unless substitution effect can be achieved by reducing the capacity of present health care facilties, we can expect an increase in consumption generated by the addition of new services to preexisting ones.

Overall, then, any improvement in one of the above-mentioned variables, even if it doesn't affect the technical efficacy of the system, can be considered as a contribution to the quality of care. As long as there are positive results in one area, it can be argued that general improvement has been made even if the introduction of an innovation causes a drop in performance in another variable. This is the case, for example, with certain pain-relieving therapies in terminal cancers, where a gain in comfort is sometimes achieved against a decrease in life expectancy. On the other hand, the higher risks of a difficult operation are sometimes preferred in hopes of a more effective cure.

If one accepts this reasoning and the existance of

substitutions within the notion of "quality of treatment," a classic formula taken from the economics of goods and services can be applied. A demand function can be constructed in which the traditional variable "price" (whose variations determine consumption) will be successively replaced by the variables "risk," "pain," (or comfort) and difficulty of access. Intuitively we see that an improvement in these factors is capable of increasing demand. This dynamic is well-illustrated by any empirical observations which show an increase in consumption of technical procedures.

Addition and Substitution of Techniques

Diffusion is not identical from one technique to the next. In some cases the new technique is efficacious, simple to apply, and inexpensive. It thus diffuses rapidly. Frequently, however, the new technique is complex and requires new equipment and a trained medical staff. It is expensive and its effectiveness is not apparent at the time of its introduction, but rather must be determined by studies over several years.

The place of innovation in the arsenal of diagnostic methods and therapies will then be usually integrated into the treatment process as supplemental element. The marginal cost will not be taken into account (it will rarely be budgeted) and it will only be a question of the marginal benefit, however small this may be. It will be studied (theses, articles, demonstrations, etc.) because it shows the different "actors" of the health care system in another light, different from the normal market relationship where supply and demand are equalized.

A most striking example of a new technology added to the market is the case of vascular X-ray examinations, angiography. The radiological technique for exploring arteries is several decades old; it is also dangerous, costly, and painful. The necessary equipment is very expensive (about 500,000 francs or $90,000). The norm in France is one such apparaturs per million inhabitants. The appearance of the scanner and echo-tomography in France around 1975 should have drastically altered the treatment situation since these two techniques permit a reduction in vascular radiography. However, an evaluation of the years following its appearance shows that in reality vascular X-ray installations have maintained a steady level of activity during this time. Nowhere was a significant reduction in the number of anteriographies observed. On the contrary, authorizations for the purchase of vascular X-ray machines are relatively easy to obtain while scanners are difficult to obtain.

Perhaps in the coming year technology will contribute notably to cost reductions in certain diagnostic examinations or

certain therapies. It is, however, unrealistic to expect the kinds of overall reductions in costs in health that are generally associated with technical progress in other sectors, where increased productivity means falling prices.

The C.A.T. scanner is a case in point, and its history is intriguing. The initial idea was not new but had never been exploited in the United States, where it had been discovered. The inventors, a neurologist and a physicist, never succeeded in interesting either doctors or Americal industry in the idea.

A British engineer, G. Hounsfield, and a firm, EMI, however, took up the idea and succeeded in construction in 1967 an instrument capable of producing section images of objects (tomographies) far superior to those produced by conventional radiological techniques. In 1976 an apparatus for medical use derived from this principle was constructed with the aid of the British Health Ministry. The first prototype was installed in the Atkinson Morley Hospital in London in October 1971.

Clinical experiments quickly demonstrated the potential of the machine, particularly in the diagnosis of brain tumors. The first international publication appeared in 1972. In June 1973 the first two commerically functioning units were installed in the Mayo Clinic and the Massachusetts General Hospital and were an immediate success. Siemens and Ohio Nuclear brought out machines in 1974. By the end of 1975, there were 20 builders, the largest being EMI (Great Britain), Pfizer, and Ohio Nuclear (US).

In August 1976, 328 machines were functioning in the United States, and by 1978, more than 1200. There is now a ratio of one machine per 250,000 inhabitants, of which 2/3 are "head only" and the rest "full body" machines. The highest concentrations are in Florida and California.

According to most authorities, this is an excessive concentration, even if 80% of these machines are located in large university hospitals. They argue that these machines are expensive to buy and also very expensive to operate. The proponents of the technology point to three essential advantages it offers:

--The scanner is a "noninvasive" apparatus and extensive delays in diagnosis can thus be avoided or reduced in duration.

--The scanner replaces other tests (angiography, encephalographs) which are more costly and dangerous.

--By improving precision in diagnoses, the scanner can

reduce expenses for certain unnecessary therapies which are dangerous and always expensive.

These are all valid arguments, but an analysis of the machine after a number of years of experience indicates that the scanner is certainly not an "economical" instrument. Justification for its use is above all medical. In other words, it improves the conditions of the patient being examined (reduced waiting time, risk, and discomfort), while raising the level of technical precision in diagnosis.

Such qualities are without doubt sufficient to establish the scanner as a valuable technical advance. But in addition to its pure "technical" interest, the scanner is also a prestige instrument, which makes it a symbol of the art equipment. It is thus very attractive to the doctor as well as to the public. It is also a relatively simple instrument to use.

For all of these reasons, the scanner can easily become a high-demand item, whose only present limiting factor is "medical judgment." But can doctors really use "judgment" in this domain? Is this new demand justified? Does it lead to an improvement in the general quality of medical care?

These three questions are basic to the general problem of technical progress in medicine. In effect, by its own technical progress it imposes a special burden on the populace, which as a result has the right to demand a limit on the expenses which it supports.

What will be the basis for these justifications? Will the criterion be diagnostic efficiency of the apparatus or survival rates of patients? The example of the scanner is particularly interesting since it illustrates the clear opposition between these two aspects. It is undeniable that the new technique has completely changed X-ray diagnosis in all intracranial pathology and considerably improved pelvic exploration.

On the other hand, how can we fail to observe that little progress has been made in the treatment of brain and pancreas tumors and most secondary metastases in the last ten years? Because the medical profession places as much value on the "diagnostic" as on the "therapeutic" states of its activity, it is virtually incapable of judging the "ultimate" effectiveness of a particular technique. Such questions involve thought processes which are by and large foreign.

An entirely different problem is that of the geographical distribution of equipment. Given that a certain technique is medically useful, how many machines are necessary to satisfy

needs and where should they be located? In France, for example, the "optimal" norm has been defined as one scanner per million inhabitants according to the directives of the "carte sanitaire," which governs the distribution of "heavy" equipment designed for medical use. Yet no one can really say at this time if the French norms conform more to needs than the American "fait accompli." The economic justification for the "norm" is that it locates control at the level of supply instead of at the level of demand. But how does or should one judge the reasonableness of this justification? This brief discussion of the scanner example illustrates many of the difficult questions of social philosophy and policy that must be addressed as new medical technologies are developed and begin to diffuse.

3. Technology Under Surveillance

Can technology be controlled in its development as it is in its applications?

Few today would seriously propose a moratorium on technological research. Many advances are still to be made, and developments which encourage fundamental hopes for society are not likely to be stifled. Progress is the issue and with it, the will to better the human condition. Even if desirable, a moratorium would be virtually impossible to carry out. No country, however powerful it may be, has a monopoly on research in this domain. If any one country halted production of a particular technology, it would run the risk of ensuing economic difficulties. What that country did not make another would, and there would be strong pressure to import new products. The arms race continues despite the dangers and economic hardships it causes the nations who participate in it. How realistic is it then to expect a halt in the race for medical progress, a race which is generally considered to have beneficial human consequences?

On the other hand, the demand of patients and doctors for ever more costly new techniques, techniques whose benefits do not always match purchase and operations costs, seems virtually limitless. Given that moratoriums on research are unlikely and that demand for new technology is likely to remain strong, what policy options are available? Two alternatives deserve comment: (1) evaluating the quality of techniques as they appear and developing only the best (this is the aim of technological evaluation), or (2) orienting research towards those areas where need is greatest and where potential benefits are largest.

What can be expected from these two alternatives?

Testing Medical Techniques

Technological evaluations should strive, on the one hand, to verify the actual performance of a techique, and on the other hand, to pass judgment on its total effect, the advantages and inconveniences it causes the individual and society. Evaluation methods of this sort have long been used in the biomedical field, particularly in the area of pharmaceutical products where the development and commercial exploitation of new drugs is circumscribed by legislation and a complex controlling apparatus.

Until recently, the instruments and apparatus used in medicine have been much less rigorously controlled, although as with drugs, they may have harmful as well as beneficial effects. New initiatives in evaluation methods are thus chiefly concerned with instrument technology, and specific methodology must be developed to deal with the particular aspects of this field.

The procedure manual of the Office of Technology Assessment (OTA), created in 1973 by the US Congress, defined four evaluation criteria:

1 - The expected benefit, even if multiple, must be identified and measurable.

2 - The field of medical application of the new technique must be rigorously defined.

3 - The evaluation must be made in reference to a given population.

4 - Application conditions must be precise.

There is, of course, no such thing as an abstract evaluation whose objectivity would satisfy all. At a certain point it is always necessary to make a vain judgment, to ponder advantages and inconveniences. For example, effectiveness and safety standards will differ for each technology. Effectiveness is defined in terms of benefits; whereas safety is expressed in terms of acceptable risk. Often measured separately, the qualities are, however, often interdependent. A classic example of the interrelation between effectiveness and safety is the case of mammography or the systematic detection of breast cancer. The potential benefits of this technique are derived from a test which itself submits the patient to an appreciable risk. The benefit and risk factors can not thus be considered separately, and indeed, the study panel on breast cancer detection of the National Institutes of Health recommended that this technique not be used systematically on women under the age of 50. Each doctor is of course free to interpret this ruling in his daily practice.

Many cases are less simple than this one. For example, two methods for treating chronic renal failure exist, transplantation and dialysis machines. Dialysis treatment is more expensive, and life expectancy of a patient so treated is less than for the case of transplants. However, there is an appreciable risk involved in the operation. The transplant patient thus has a longer average life expectancy, but at the same time a higher short-term mortality risk in the six months following his operation. Which is, from his point of view, the best choice, assuming he has a choice, which is not always the case? The answer varies from individual to individual even though, collectively speaking, transplantation seems better because it is less costly and more effective.

In addition to these difficulties in principle, there are methodological problems.

1. Side Effects

When the effectiveness of a method is measured, the number of beneficial effects is usually limited. On the contrary, the search for undesirable and unexpected side effects cannot be limited to the area of specific investigation. Surveillance of harmful effects is usually more complex and expensive than the simple measuring of benefits.

2. Number of People Concerned

A technology is considered effective if it affects a large enough number of beneficiaries. On the contrary, the risks involved in the use of a technology should be considered even if they concern only a small proportion of patients. A comparison of risk and benefits for a medical technique will depend to a large extent on a necessarily objective appreciation of the importance of the problem for the concerned population.

3. Delay in Cause and Effect

The beneficial effects of a medical technique are usually noticed before the adverse and harmful effects, thus making long-term evaluation necessary. And in the case of certain diagnostic and therapeutic methods, this delay can reach even the level of a generation; e.g., the thalidomide case or diethylstilbestrol.

Finally, as in the case of renal failure treatment, the different parties view the situation very differently primarily because the collective financing of health costs causes each individual to be involved in an infinity of individual choices. The patient whose choice is a key element in the system is

especially sensitive to considerations of effectiveness, comfort, and security. Often the collective level disparities in equipment and access to care seem unjust to him, and he has a tendency to accept technology as a guarantee of quality. Health professionals are familiar with this outlook, and they often seek to satisfy the constant demand for technical progress. This phenomenon explains the rapid deployment of scanner equipment in the United States, an illustration of the popular adage "We have to keep up with the Joneses."

The attitude of agencies whose responsibility is to reimburse costs for medical procedures linked to technical advances is sometimes characterized as retrograde and restrictive. But one needs to understand that they cannot always pay for everything for everyone.

The Emotional Component

The specter of limiting availability raises emotional issues around freedom of choice for the patient, equality of access to quality treatment, and the potentially life-saving benefits of certain techniques. Indeed, the foundations of free enterprise in a free society enter the debate. On the other hand, the motives of those raising these issues can be questioned, and suspicions can be voiced about the competence and professional ethics of doctors. A conflict often ensues, especially since we are dealing with emotional issues. The subject of technical progress is extraordinarily difficult to treat dispassionately. The arguments advanced by the two factions are often buttressed by statistical "evidence" carefully chosen to support their point of view.

The situation is further complicated by the fact that judgment about the intrinsic value of a technique, its utility and necessity, are not adequate. Its use must also be evaluated.

When a technology is placed on the market, its evaluators no longer control it, and it is not always certain to be used judiciously. We can draw an analogy with traffic lights. Any technique has a green-light zone for which it has been proven useful. It also has a red-light zone where technique is useless and nothing is gained by employing it. But it also has a yellow zone which can be very large. In this zone either the effectiveness has not been proven with certainty, or its use is mitigated by inconvenience. In this case, it could be used when conventional treatment fails. In our opinion, the size of this intermediate zone explains the difference in practice from one country to another or from one region to another or from one doctor to another in the same country. In the absence of a yellow zone, it

would be hard to explain why states which have technologically comparable systems of health do not have the same norms and practices. But they certainly do not, as is illustrated by the fact that at the beginning of the 1970s the US citizen was 38 times more likely than a Swede to undergo a coronary bypass.

A priori evaluation is not sufficient; practices must be controlled and comparisons made between different ideal standards and actual concrete utilization. This is the whole idea behind health care quality evaluations. But this entails a change in the nature of evaluation. It is no longer simply a matter of examining an isolated technique. The way in which individuals or even medical teams use the technique becomes a matter for serious attention. This shift raises the visibility of individual performance substantially, and is not likely to be warmly embraced by the medical profession.

Despite the complexity of the methods necessary for this type of evaluation, their development is apparent today, especially in the United States. However, the effect of these measures on health expenditures is not clear for the immediate future. We think it justified to see that, in the long run, these measures will not stop cost increases and that they perhaps favor it. In the near and distant future, these measures will probably eliminate a number of abuses such as unnecessary operations and examinations. But the proof of ineffectiveness here must be overwhelming to actually stop a practice. However, clinical proof is not always easy to find because of the methodological limitations which doctors and social science researchers must contend with. And when in doubt one follows Wildavsky's dictum:

"You can always do something."

But there is no reason to assume that there will be a reduction in costs as practice approaches the norms desired by the clinical specialist. The norms will be applied in all cases and in all hospitals. A different norm for rural hospitals as opposed to university hospitals is inconceivable. This would go against egalitarian principles, and such a proposition would not be politically viable. The consequences of this will be an impetus for development of subspecialties and heavy equipment in medium-sized cities. In effect, if the criterion for results in the health system is technical medical performance, it is easy to show that subspecialists of a technique who are familiar with the use of heavy equipment are more effective. But the measure of efficacy is of course produced by the subspecialties. In evaluating doctors, we adopt that ideology. What counts is the doctor-patient relationship and not the health of individuals living in society. The quality control system, as it is

conceived in the United States and as it tends to develop in Western European countries, is not a measure of the overall efficacy of the medical system and its impact on the health of the population; it is a measure of the efficacy of medicine, formulated by doctors with their instruments of measure. This is certainly not without interest for the patient and even for the public. They can better organize medical expenditures since they control the functions of production. But medicine has other functions than technology. And despite great progress it is still in its infancy in many areas where needs go unmet.

Evaluation is not useless. It is difficult, restricted, and often biased, but it gives a necessary guarantee to consumers. It reduces abuses, and defines what is known and what is not, all very important services. We would even say that the development of technological evaluation and quality control of treatment are the major innovations of the last 10 years in the area of health policy and that their consequences will be felt in the coming years. However, these methods are not a panacea, and it must be noted that they do not suffice by themselves to control the development of technology and still less to limit health care cost.

Science Policy

Given the difficulty of controlling the utilization of a technique once it has been introduced, an alternative would be to orient research so that only potentially useful techniques are developed.

But are we searching in areas where there are problems, or do we continue to find in areas where there are solutions? The answer to this question constitutes, in our opinion, a preliminary to all scientific policy. If we work in areas where there are solutions and where the development of knowledge will eventually allow us to solve problems which are not necessarily the most socially important ones, then science policy will simply be a matter of financing research and guaranteeing the autonomy of researchers. This is certainly not an insignificant role, but one of limited importance. If, on the other hand, we search in areas where problems exist, science policy will become an instrument of choice in the economic and social development of nations and, in our case, of health policy.

It thus seems important to examine how this question has been answered. One could argue that such examination is unnecessary, for we need only observe the evolution of science policies in Western countries to conclude that these policies seem to have become an element of general policy after a long period of

isolation from economic circumstances. In effect, science policy seems to be increasingly subordinated to general economic strategies, to employment policies, and to regional government policies, whereas in its beginnings it was relatively independent of these contingencies.

Science policy was created at the demand of men of science, but these scientists from the beginning conceived of their participation in policy planning as an evil necessary to their research. In certain instances, the attitude has become decidely noncooperative or even hostile. Although they are used to accepting the means accorded them to carry out their work, they have accepted with great difficulty the notion of controlling agencies outside of their own community. In less than 30 years, they have gone from near total freedom to an ever more restricted and controlled freedom.

An analysis of the texts on biomedical research taken from different national plans in France clearly shows this evolution. In the Second Plan one reads:

"Experience has shown, especially in the case of medicine, that the most productive means of research is to leave initiative absolutely in the hands of researchers as well as the choice and means of their research programs. Profitable applications usually arise in unpredictable fashion from pure research. It is the role of governing bodies of research to assure them this liberty."

This is a way of saying that although research structures can be planned, their subjects and methods certainly cannot be and should be left entirely to the researcher's initiative.

In the Seventh Plan (1970-1975), the language changed dramatically. "Priority objectives" such as the biology of the brain were invoked. The socioeconomic importance of each subject was studied, and certain themes such as "the functional organization of the neuron" were indicated for development.

A long road has been traveled between these two plans, and we can distinguish three phases in this evolution of science policy since the war.

The first phase had its origins in the evolution of the amount of funds necessary for research. When a laboratory and a few instruments were no longer sufficient scientists were led to demand subsidies from the state. To justify these demands, they alluded to the importance or even the necessity of their work in obtaining certain technical "payoffs" in the fields of defense and the economy. It goes without saying that once the size of

the "pie" had been defined, they were the only masters of its pieces. The text from the second plan is very characteristic of the first phase.

The second phase proceeds naturally from the first. In effect governments believed the scientists' argument according to which scientific research was the driving force behind military independence and social and economic development. This belief was based on a premature generalization derived from a few cases (the atomic bomb, the transistor, etc.). It was no longer only a question of defining the pieces of the pie to be shared, but also, and above all, the respective size of these pieces.

The third phase dawned with the recognition by governments that not only did science have a social impact, but also that science could be used to attain certain objectives. The guiding principle of scientific research was no longer the simple desire to solve theoretical problems or to further our understanding of nature. It had also become a search for solutions to economic, political, and social problems. A significant event of this third phase appeared in the American political scene after President Nixon's "war on cancer," and the resultant National Cancer Act met with, if not defeat, at least an unending struggle without spectacular victories. In 1971, Nixon had declared "the time has come for the same type of concentrated effort which smashed the atom and brought man to the moon to be oriented towards the conquest of this terrible disease. Let us make the national commitment to attain this objective." The analogy here was simple; if we can send a man to the moon, we should be able to find a cure for cancer. But, in the words of a scientist at the time: "Could we send a man to the moon if we didn't know Newton's Laws?" It seems not. We do not know if cancer is a single disease of cellular malfunction or if it is more than a hundred distinct diseases which occur in four general forms. Ten years after the unprecedented effort, the answer to this fundamental question has not been found.

This intrinsic difficulty led Lewis Thomas to conclude that, in research policy, there are only two approaches. The first is a direct approach which can be used when there is a 90% chance for success. This was the case, for example, in the struggle against polio. After it had been established that the disease was caused by a virus with three types of antigens, it was only a matter of determining if a vaccine based on a dead or active virus would be the most effective. The types of possible solutions were thus known, as were the means to this end. This is not always the case. In most instances there is no analogy or model to base research on.

The potential solutions are unknown, and here Thomas advises

us to "measure the quality of work by the degree of surprises it produces," that is to say by the difficulties between the expected results, the common sense of the scientific community at a given moment, and emperical results which challenge this common sense. In brief, surprise is the mark of success. Thus it is not easy to orient research, and its results are not always foreseeable.

Similarly, in a comparative study of cancer and respiratory disease research in France, Jean de Kervasdoue has shown that the needs of the population based on morbidity and mortality statistics had a negligible role in the relative importance accorded to these two fields of research. The evolution of research in these two disciplines was primarily influenced by the evolution of scientific paradigms on one hand and by institutions on the other.

For example, the Pastorien paradigm was a dominant influence, not only in the research and discovery of the tuberculosis bacillus, but also in the development and implementation of different prophylactic methods. The demonstration of the utility of the paradigm made it possible to maintain and strengthen a number of social hygiene measures despite resistance to these frequently unpopular prophylactic policies.

The influence of institutions is also certain. Either the institution assures communication between different disciplines, all of which profit from the experience, or it prevents or restricts such contacts.

During the 20th century in France, several governments responded to growing social pressure and individual demands for a solution to cancer. They aided in the creation of specialized research institutes for cancer where the scientific tradition could develop. Since cancer was designated as a high-priority problem, large sums of money were set aside for research in this area.

This attracted researchers who might not have come simply out of interest in the problem to be solved. There was a social demand which scientists could easily satisfy, all the more so since clinical application was still far in the future. However, it is not certain that this situation, which is ongoing, will produce the desired result--the rapid discovery of a therapeutic solution for cancer.

The mechanisms which explain quantitative and qualitative differences between two close domains of research depend on numerous factors. Among these, the objective definition of the problems plays only a small role. The pressure of certain

groups, the existence of institutions, and chance happenings can aid or restrain diversify or restrict the evolution of research. Having said this, although one can argue that the meager diversity of French researh in lung disease limits its originality, one cannot argue that greater diversity will necessarily result in systematic solutions to the problems considered. One can search where there are problems, but one is not certain to find solutions.

It must not be inferred from these preceding arguments that science policy is without effect. For example, the state must compensate for industry's tendency to finance only what will be profitable in the near term. This practice is not always consistent with a reduction in social costs. The state must also create openings and points of contact between complementary disciplines, but here they are dealing with the unforeseeable. Technology will not be controlled by science policy because discoveries are difficult to predict and because no single country has a monopoly on knowledge.

Industrial competition and secrecy are the norm today; whereas 20 years ago, an atmosphere of openness, universalism, and the desire to increase knowledge and benefit mankind was more characteristic of the scientific community. The desire to maintain employment, to balance the trade deficit, and to export takes precedence today. To export, a nation must produce, and high-technology items with diverse applications, especially in the biomedical domain, are particularly attractive products.

France has tried to develop a national industry in medical technology although this sector had been heavily dominated by foreign industry. This is also why biotechnology was chosen in France as a priority sector to receive aid for technical and scientific development. But even if this policy succeeds, control will be difficult to exercise. Business will in all likelihood invoke the following argument:

"If you want us to penetrate foreign markets, we must first grow domestically. You, the representatives of the state, must let us sell the technology which we develop."

Managerial methods which will by themselves control and organize health care systems do not yet exist. Only a global approach can attain this. In our view, the most viable option is rationing, rationing which is based, above all, on political and ethical criteria. Russel's recent study of the diffusion of new technologies points in this direction. She concluded that it is no longer reasonable to expect societies to pay for technologies which offer the promise of saving the life of one person. Simple economics, then, dictate the need for a more global view, a frame

of reference to arbitrate among various interests.

Certain countries such as Great Britain are better equipped than others to move into this new phase. Others must change profoundly the organization of their health care systems. This is the case for France and the United States. But before considering the countries separately, we must return to the principle of rationing, its necessity and its consequences.

The word is likely to scandalize. In France it evokes for older people the period of the Second World War, ration tickets, long lines, the black market, etc. To say that rationing is the future seems paradoxical or even funny, or that one has a dark sense of humor. It does not seem a serious possibility. And yet it is the simple consequence of two phenomena.

We treated at length the first: the growth of technological innovations ever more numerous and costly in a field where consumer appetite seems insatiable and where manufacturers have no personal interest in limiting costs. The second is the fact that values and laws exist in western societies which make it unthinkable to let the health sector be governed entirely by the dynamics of the market. The inequities which would result would be unacceptable for most people in those societies.

Some form of social security will continue to exist. It cannot, however, continue to pay for everything indefinitely. We have seen that the evolution of prevention as well as technology, even if they achieve notable gains especially in the coming years, will not significantly reduce spiraling health costs. This will be the prime point of conflict among different professional and political groups.

To limit cost increases, a global framework must be defined, and the criteria of definition can only be "political" in the most noble sense of the term. The synthesis must be based first on moral values which take into consideration economic, sociological, and technological factors. Cost restrictions lead necessarily to rationing. Rationing itself, however, raises important moral questions that would need a specific treatment.