The current model of technology assessment treats ethics itself as just another problem-solving technology. Ethics should resist this model to play a more critical role in technology assessment by better understanding the complex relationship between society, medicine, and technology—and by recasting how problems are defined.

Although several assessment studies of implant technology are underway, this kind of critical perspective is not brought to bear; it does not fit well into the usual format of technology assessment programs. Usually it is argued that the host of social, legal, and ethical questions raised by the application of new technology, particularly in health care, can be systematically examined with a metatechnology, consistent use of which will clarify such nontechnical issues and make them amenable to policy and management.

For example, the Dutch government's Committee on Choices in Health Care argued that not everything in medicine that is technically possible ought necessarily to be introduced into the health care system. New technologies should be evaluated before they are applied. That implies systematic research (identifying, selecting, testing, and evaluating specific technologies), which includes consideration of the ethical, legal, and social implications of a new technology as well as rational decision-making based on the results.

The call for evaluation has indeed led to a growing number of technology assessment (TA) studies and programs. Yet despite concern for the ethical implications of technological development, it is rare to see TA programs in which systematic analysis of such implications is an integral and substantial component. Though intended to be attentive to a variety of dimensions of new technologies (namely, medical, economical, social, psychological, ethical, legal), in practice research focuses almost exclusively on its biomedical implications. Here we have a curious paradox. Wishing to control the processes by which medical technology is developed, introduced, and used, and being concerned about the moral implications of new technologies, governments, agencies, and individual scholars have developed programs of technology assessment; however, such programs mainly focus on effectiveness and safety, and hardly address in a systematic way the moral concerns that were part of their genesis. The aim of this article is to elucidate this paradox. That ethical analysis is rarely incorporated in technol-
ogy assessment studies has to do with the particular conceptualization of technology assessment and the demarcation of technology prevailing in current evaluation practices. However, it also has to do with the tendency to consider ethics as a specific technology itself, which can be applied to resolve the moral consequences of the use of medical technologies. A repositioning of ethics will be necessary to uncover and analyze the moral dimension of practices of developing, testing, and using technologies in the context of health care.

The Concept of Technology Assessment

Some argue that the popularity of technology assessment should be regarded as a response to the wave of criticism toward science and technology in the 1960s and 1970s. Initially, the term technology assessment was employed in the areas of environmental problems and developments in the physical sciences; later, the emphasis was increasingly on medical technology. One of the most important objectives of TA is to anticipate and, when possible, prevent negative and harmful effects of technological development and to facilitate positive effects. Joseph Coates, for example, defines the concept of technology assessment as "the systematic study of the effects on society that may occur when a technology is introduced, extended, or modified, with special emphasis on the impacts that are unintended, indirect, and delayed."5

In this definition, the relationship between technology and society is regarded as unilateral. Emphasis is on the effects upon communal life and the social repercussions that may accompany the introduction of a new technology; the various influences of social conditions upon technological change itself are disregarded. The definition also conceptualizes the social effects in a specific way: research should primarily be directed toward the unintended and indirect effects of technological change that are less significant and only become manifest in the long run. The moral dimensions of new technologies therefore are considered secondary or "second-order consequences." Similar tendencies may be observed in the Office of Technology Assessment's definition:

Medical technology assessment is, in a narrow sense, the evaluation or testing of a medical technology for safety and efficacy. In a broader sense, it is a process of policy research that examines the short- and long-term consequences of individual medical technologies.6

Here, also, a distinction is drawn between a central and a peripheral assessment process. The core of evaluation studies has to do with the question of whether the technology can be applied safely and effectively. Special problems arise when the technology is applied within a social context, requiring a more encompassing evaluation design. The definition at least suggests that such a broader study has a secondary status: it is only feasible when the core processes have been studied. Studies that are restricted to these core processes, however, may also be called technology assessment studies.

The OTA definition refers, furthermore, to another important aspect of technology assessment studies: they intend to produce data to facilitate more informed policy decisions.7 Thus as Coates has noted, technology assessment is a class of policy studies, a rational contribution to present-day health care policy confronted with the need to control rising costs and regulate the use of medical technologies. For some authors, however, the relationship between technology assessment and health care policy is not that stringent. They prefer a two-phase approach to assessing medical technology. The first phase of assessment is "systematic information generation to support societal decisions on medical technologies."8 Only when reliable (and preferably quantitative) data are available is the second level relevant: developing health care policy and making practical decisions concerning the use of technologies. Ethical issues will only arise at this second level when the data of technology assessment studies must be implemented in medical practice.

Presumptions about Technology

Such definitions of technology assessment sequester ethical questions as second-order concerns that are significant only at the level of policymaking. Such delineation originates from a restricted view of technology that presupposes a set of specific relations between technology and society, knowledge and its application, information and decisionmaking, and the medical and nonmedical domains that are problematic philosophically.

The current concept of technology assessment radically divorces technology from social context and assumes that we are initially confronted with a new technology and only secondarily with the effects of this technology on society. It is argued, for example, that changes in health care under the influence of technology have led to increasing concern about "societal side effects."9 This terminology is significant: a new technology is introduced, applied in health care practice, and then produces "side effects." Technology and society are considered independent entities; problems arise because the first entity has a particular impact upon the second.

The philosophical literature and data from science studies indicate that the relationship of technology and society is much more intricate.11 Technology is not only a cultural product, but itself a producer of culture. The construction of a new technology always requires a specific setting, the concomitant construction of a world in which the technology can be applied appropriately. In other words, instead of assuming that technology has social effects, it is better to say that a technology constitutes a particular practice which is medical and social at the same time. For example, new technologies in medical testing (such as chemical analysis of urine) will only "work" when a particular examination practice has been established with rules and prescriptions that determine how doctors must proceed and how patients must be treated.12 It is not the case that, once obtained, new knowledge is simply available for introduction into existing practices. Rather, development and application of knowledge go together with redefinition of those
practices in any of several ways: by changing the objectives of intervention (not treatment but testing), transforming normative status (chemical interactions (newly demarcating disease)), or modifying social analysis (a patient who superficially seems healthy), or modifying social interactions (newly demarcating duties among physicians or between medical advisor, examining doctor, and insurance agent, as well as between doctor and patient).

The definitions of technology assessment assume that knowledge comes first and application follows, and that it is therefore possible to identify innovations and to evaluate them prior to their general use. This presupposition is reflected in the well-known idea of the life cycle of a technology, as well as in the notion that there is a critical moment for initiating an assessment study. It is taken as common knowledge that the process of innovation, research and development, and diffusion of new technologies has a fixed pattern. A familiar graph, representing the scale of use of a technology over time, shows a typical phase model: first, the discovery of new knowledge (the phase of fundamental research); second, the incorporation of this knowledge into a new technology (the phase of applied research prototype development); third, the evaluation of safety and effectiveness (the phase of clinical trials); fourth, the development of programs to demonstrate the applicability for worldwide implementation (the phase of demonstration programs); fifth, diffusion and general acceptance (the phase of adoption by professionals); sixth, training in use and application in several categories of patients. The model finally assumes that the scale of use stabilizes and levels off over time, as the particular technology becomes obsolete, discredited, or replaced through new, more promising technologies.

Such a life-cycle model implies that technology assessment studies must be executed at the right moment. Evaluation is most important when the diffusion process of the technology is beginning to unfold. Early in the developmental life of the technology, evaluation data are usually scarce and incomplete; evaluation of a technology when it is already disseminating in medical practice, however, is too late to be of any support for policymaking.

Recent studies have criticized this linear model, showing the complex simultaneity of knowledge and application. In his analysis of the 1952 poliomyelitis epidemic in Copenhagen, Ger Wackers showed how in clinical practice, changes occur simultaneously in scientific knowledge, medical technology, moral evaluation, and social context. In the Copenhagen hospital for infectious diseases, consultation of a free-lance anesthesiologist led to the reduction of the high mortality rate of bulbar polio: this outsider interpreted the patients' lethal condition not as a metabolic alkalosis, but as a respiratory acidosis, transforming the condition into a ventilation problem, manageable by manual positive pressure ventilation.

The effectiveness of the intervention was so obvious that medical students were mobilized in shifts to ventilate manually (up to 700 patients at the same time, twenty-four hours per day). This case illustrates how an existing technology (manual positive pressure ventilation was known for centuries) is applied as soon as a problem is identified for which it is a solution. Knowledge is application. Application, however, also requires the creation of a social network for the appropriate use of the technology, such as the establishment of anesthesiology as a medical discipline or the discovery of useful actors who can easily learn to apply the technology. At the same time, efforts are undertaken to control this network better—in this case, by making "mechanical students," namely, building respirators. Wacker's study finally shows how a technology will "find" another practical setting as soon as the initial problem has become less urgent. By the time the polio epidemic was extinguished and effective vaccination available, the first intensive care units had been established; respirators were already being transferred to other medical areas in which respiratory failure was a significant problem. The technology's success in

Unlike biological organisms, medical technologies tend to expand without inherent constraints.
When medical technology is available, it seems inevitably to be used, even in the face of objective data that it is inappropriate.
tionship with moral issues. Technology is not considered an integral component of society; it is not studied as a social practice. When social and moral problems arise, they are understood to be secondary to the introduction of the technology, and related to the application phase of new knowledge, abilities, and instruments. For the analysis and resolution of these problems, a new type of technology—technology assessment—has been developed that generates objective information to facilitate rational decisionmaking. According to this conception, technology is not a problem, but rather itself a solution to problems. In a decontextualized view of technology like this, moral issues necessarily come to belong to the periphery of scientific interest. Thus the ambivalent relationship between technology assessment and ethics has to do in part with the narrowness of the current view of technology.

Yet this is only one part of the story. Ethics itself is not untouched by technological change. In a certain sense, ethics has become part and parcel of the technological order. It has been professionalized as an autonomous discipline external to medical practice. It is dominated by an engineering model of moral reasoning and impregnated with the idea of technical rationality, applying principles to practices.22

In theory, medical technologies offer three separate possibilities for ethical research, depending on when in the process of technology development moral questions arise. Preliminary and preconditional moral questions concern moral issues that must be clarified before an innovation can be examined in clinical circumstances (for example, informed consent, burdens and benefits). Usually, review boards address these questions when scrutinizing research protocols. Practical moral questions arise during the execution of an assessment study. They concern, for example, the interactions between professional and patient/client, or the definitions, descriptions, and data presented to invite cooperation in research or therapy. Moral issues that might arise during advertising, applying, and perfecting new technologies are rarely explored in assessment studies.

Finally, consequential moral questions concern the impact of the introduction and application of a technology. When ethical analysis is connected with technology assessment, it is usually focused on questions of this type. For example, when in vitro fertilization is applied in medical practice and leads to the production of spare embryos, the moral question is what to do with these embryos. Similar questions concern the criteria for application of the technology: should IVF be used for postmenopausal women? Such moral questions are generally accepted as legitimate components of a technology assessment study. Analyzing these questions is useful since it may help to demarcate the applications of the technology that are acceptable within a particular society. However, given the other points at which moral questions may arise, in the practice of technology assessment the exploration of ethical issues remains quite restricted.

A proposal to promote the examination of moral issues in technology assessment has recently been published by a committee of the National Hospital Council in the Netherlands, which made a plea for systematic “ethical assessment” of medical technology.23 The committee also distinguishes three categories of ethical questions: preliminary questions, application questions, and regulatory questions. This categorization, however, does not depart significantly from current practice. The first set of questions is ex ante, the other two are ex post. The design of technology assessment studies can remain unchanged: certain moral issues relating to foreseeable consequences have to be settled prior to the start of study (using the help of IRBs); other issues will follow from the application and introduction of the technology in clinical practice, and they can be resolved by defining what is responsible application and how the technology should be applied. By adding a few questions to the standard protocol, the “ethical aspects” can therefore easily be accommodated in an evaluation study.

The committee suggests what kind of questions are relevant. Nearly all of these questions regard the appropriate use of a technology; the technology as such is never considered to be a problem. The committee ultimately transforms ethics itself into a technology. When ethical issues are just one aspect of the technology, they should indeed be examined in basically the same way as any other. The questions intended to identify the ethical aspects can be arranged within a checklist that may be used by everyone who wants to make “a generally accepted ethical judgment on the good usage of health care technology” (p. 14). In fact, the list presents a simple framework, with the principles of respect for autonomy, beneficence, nonmaleficence, and justice on one side, and the three categories of relevant questions on the other. Ethics is nothing but a technology to make a particular set of (potential) problems manageable and controllable.

Repositioning Ethics in Technology Assessment

A rather different approach emerges when a somewhat different distinction is drawn among ethical issues in connection with medical technology.24 There is first the category of moral questions arising within the framework of the technology. Examples are debates about the moral status of the embryo or the conditions for surrogate motherhood. Questions of this type remain inside the framework of the technology; they proceed from an acceptance of the technology as a datum, trying to define its responsible and appropriate use. The second category consists of moral questions concerning the technology itself. Under this category analysis focuses on the question of whether the technology as such is justified in light of moral values. Technologies are expressions of fundamental values, such as the search for knowledge or the relief of suffering; however, these values are no longer taken as implicitly given, but as the starting point for a debate on (other) motivating values in society.

Usually, only the first type of moral question is addressed in technology assessment studies—in those studies that include any ethical analysis at all. This restriction shows not only that the focus of ethical analysis is too narrow, but also that it is not self-critical.
The fact that we are confronted with more and more moral problems is basically related to the penetration, domination, and "colonization" of our life and world by science and technology. The answer to such problems cannot be given (at least not solely) by an ethics that is itself technologically oriented. In fact, when moral problems are primarily approached in an engineering way, technically applying principles to cases and dilemmas, ethics itself becomes another manifestation of the same basic problem.

The fundamental objection against focusing upon the first type of ethical questions, then, is that in doing so ethics is incorporated into a technological model to evaluate and calculate effects, and to control and eliminate problems. Within such a model, the criticism that this conception of " techno-ethics" is itself a component of the fundamental problem that brings us to moral debate in the first place can have no force.

A new approach to technology assessment should be more self-critical and should address the second type of moral questions mentioned above. Ethicists might contribute more helpfully to evaluating medical technology by recasting the way problems are defined, by exploring the interrelationship of technical and nontechnical issues, and by analyzing technology itself as problematic.

Technological developments translate problems in both senses of the word: they recast the initial problem into a new phraseology that may create new concepts; they also relocate problems and may shift responsibility for finding acceptable solutions. An example of this translation process is presented in a study of changing definitions of death under the influence of intensive care technology. Another example is the emergence of specific conflicts and dilemmas, ethics itself becomes another manifestation of the same basic problem.

Finally, changing technology itself can become the object of analysis as ethics focuses, not on the social effects of medical technology, but on the technical rationality manifesting itself in and through technology. Ethics might ask, for example, what we ought to do when this type of rationality dominates our response to complicated human situations and experiences of suffering, bodiliness, finiteness, disability, and illness. There is no doubt that the fascination and power of technical rationality has brought us many positive things, but we also know well how it is associated with compartmentalization and diminishment of experiences and interpretations. For example, in the history of the evolution of technology in medicine, the relevance and importance of the subjective experiences of the patient have been diminished, leading to a decline of the clinical dialogue. Technology seems to go hand in glove with a tendency to value objects, things, instruments more than people. Another example is the emergence of specific conflicts of interest since the introduction of technology in clinical practice; the treating physician now is in many cases at the same time a scientific researcher and it can no longer be naturally assumed that the interests of the individual patient will prevail over other important interests. The availability of technology may also induce in patients some alienation from their own subjective experiences. The possibility of kidney transplantation in children and the better results with organs from living related donors place family relations in a different perspective. The availability of reproductive technologies is changing the meaning of female bodiliness; reproduction and fertility as body functions are reinterpreted against an implicit norm of productivity. The tendency of technology to reorient and dominate our experiences and practices has, of course, been known for a long time and has been the topic of much philosophical thought. However, modern health care ethics has only rarely taken this as an explicit theme of reflection. Instead of modeling itself on technology and adopting technology's methods, ethics should explore and articulate the fundamental discontent evoked when medical technology becomes the basic source of moral issues, and should seek out new perspectives.
Such an approach need not proceed from pessimism concerning the overwhelming power of technical rationality; it should start from the notion that understanding the power of technology also yields insight into the limits of a technological world view. Not despite but because of technology, man is able to obtain a better understanding of the condition humaine. The power and dominance of technology stimulates us particularly to search for other aspects of being human than mere technical, instrumental action. The more the human body, human life, and suffering are molded and controlled by medical technology, the more we can discover that the meaning of human existence is not reduced to increasing regulation and control of life and world. In other words, precisely the dominance of technical rationality gives us cause for breaking out of the technological framework. If ethicists do not use this opportunity for philosophical reflection, who will?

References

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