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Scientific Contribution

On the value-ladenness of technology in medicine

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Abstract. The objective of this article is to analyse the value-ladenness of technology in the context of medicine. To address this issue several characteristics of technology are investigated: i) its interventive capacity, ii) its expansiveness and iii) its influence on the concept of disease, iv) its generalising character, v) its independence of the subjective experience of the patient. By this analysis I hope to unveil the double face of technology: Technology has a Janus-face in modern medicine, and the opposite of its factual face is evaluative.

Key words: ethics, technology, value-ladenness, values

Introduction

In order to address the issue of the value-ladenness of technology in the context of medicine, it is urgent to make clear what "value free" means.[1] "Value-free" apparently does not mean that something is free of being associated with values. There seems to be a general agreement that technology is related to issues of value. Technology has widely enhanced the possibilities of acting and producing which poses the question of how we *ought* to realise these possibilities (Schrader-Frechette & Westra 1997). Rephrased we might say that what *is* urges questions of *ought*. In this respect technology is part of the general question of what *the good life* is and clearly is associated to issues of value. Understanding value-ladenness as anything that poses value issues certainly answers the question of whether technology is "value-laden". It also replies to the question of how this influences medicine: by giving rise to a variety of ethical challenges technology makes medicine "value-laden".

However, this understanding of value-ladenness does not add to our theoretical knowledge of medicine.[2] Even proponents of "value-free" technology will agree that technology is associated with issues of value. In particular they argue that the values associated with technology are values of society at large (Bijker 1990; Hollander 1997; Tatum 1997), certain social classes (Rothman 1997) or particular interest groups (Vos 1991; Payer 1992; Moss 1991; Blume 1992).

Therefore in this study "value-free" will mean that values are aspects external to technology as such. Correspondingly, the claim that "technology is value-laden" will denote that values are related to technology qua technology. Technology does not only generate issues of value, but it is related to values as such. In other words, if technology is value-laden, it is not only a matter of what *is*, but also what *ought* to be, not only of what *could be done*, but what *ought* to be done.

Hence, the objective of this study is to analyse the value-ladenness of technology in the context of medicine. How then, can technology be conceived of as value-laden? There appears to be two major approaches to answer this question. The most common way to analyse the value-ladenness of technology is by an overall theoretical approach. There are several positions conceiving of technology as value-laden. It has been argued that technology represents an imperative enforcing humans to act in certain ways. Technology, under cover of being a mean, directs human ends and values. This position has been labelled *technological determinism* and its main issue is to investigate this *technological imperative* (Ellul, 1964; Winner, 1977; Smith and Marx, 1994).

From a phenomenological position it is claimed that technology is part of human understanding of being (Heidegger, 1953; Idhe, 1990). Man and his world are shaped by technology, which is of value not only as means for certain ends, but as a basic part of our being.[3]

An alternative approach to this theoretical analysis of value-ladenness of technology is to analyse technology's value-ladenness from a practical point of view: How do we recognise values of technology in medical practice? Instead of subscribing to any of the mentioned monistic perspectives on technology and value, I will try to analyse how values are related to technology on a practical and detailed level. In other words, I will investigate whether the monistic theories of technology are adequate for analysing the issues of value. In particular, I will analyse a collection of well known examples to illustrate the wide range of value-ladenness related to medical technology. The examples will demonstrate how difficult it is to comprise technology's value-ladenness within a monistic theory. As a framework for this analysis I will investigate some key characteristics of technology in medicine. Technology is characterised as being:

i) *Interventive:* Through technology medicine has changed from assisting the healing capacity of nature to controlling and manipulating bodily healing itself.
ii) *Expansive:* Due to its interventive capacity technology has greatly expanded the field of medicine and increased its specialisation.
iii) *Defining disease:* By providing the basic phenomena to be studied and manipulated in medicine, technology strongly influences the concept of disease, and hence medical action. It defines what is diagnosed and what is treated.
iv) *Generalising:* It represents a general method for diagnosis, palliation and treatment. Its ability to generate reproducible results has made medicine a science.
v) *Liberating:* Technology has made medical knowledge independent from the subjective experience of the patient.

Hence, the objective is to investigate these characteristics in order to analyse the value-ladenness of technology in the context of medicine. In particular, it will be argued that technology does not only generate (external) issues of value, but it represents issues of values as such. Technology is value-laden on a constitutive level, which becomes particularly clear in medicine.

1. Interventive medicine

Hence, one of the main characteristics of technology in medicine is that it is interventive (*interveniere*). It has come to control and manipulate the organs, functions and processes of the human body. Conditions that earlier were fatal are today treated and cured. This interventive capacity of technology has greatly expanded the field of medicine, and it has changed medicine in several ways.

Firstly, whereas medicine earlier mainly was explanatory, it has now become manipulative. The function of humoral pathology was mainly to explain the observed phenomena. Practical measurement of and intervention with the processes of nature were of little interest (Hippocrates: *On ancient medicine*). The role of medicine was to explain and foresee the processes of nature. Today its function is to intervene in the observed processes. Practice comes before theory: Interventive methods are applied if they prove effective, independent of whether their mechanisms are known.

Secondly, the interventive capacity has altered the content of medicine. The explanatory entities of assistive medicine have been replaced by the manipulatory entities of technological medicine. Physiology, biochemistry and molecular biology have become basic subjects in medicine because they identify entities that can be manipulated. The interest, for example in the chemical substances of the human body, is due to the possibility of manipulating them. Hence, the interventive capacity of technological medicine has changed the subject matter of medical knowledge.

Thirdly, technological medicine has strongly influenced the classification of diseases. What is possible to manipulate and treat has been defined as a disease. The influence of technological medicine on the concept of disease will be dealt with later. Suffice it here to note that its interventiveness has influenced medical taxonomy. It influences what is and what is not subject to medical attention.

Fourthly, technology's interventive capacity has changed the status of medicine. Through the extended potential of action it represents power. The medical profession has gained power by the interventive and manipulative capacity of technology.

Altogether, the interventiveness of technology has altered medicine in a profound way, and this is an issue of value in several aspects.

Evaluative aspects of interventive medicine

This is not the place to enter into a discussion of the vast number of examples of evaluative challenges inherent in the *interventive capacity* of medicine. Only some issues will be investigated to illustrate the spectrum of fundamental evaluative issues: Firstly, technology challenges the concept of the patient. Secondly, it urges medicine to define its goals, and thirdly, to set limits to its activity. Additionally, there is an extended responsibility inherent in the extended potential of technological medicine.

The interventive capacity challenges the concept of the patient. It gives rise to the question: Who is the subject of the treatment – who is the patient? Technological medicine involves other subjects than the traditional one-to-one patient-physician relationship. Transplant technology forces the physician to pay attention to the donor. Foetal surgery forces health care professionals to balance the concerns for the mother with the concerns for the child. In vitro fertilisation poses similar challenges. Perfusion of a brain-dead mother until her foetus is viable or of an anencephalic child until its vital organs can be transplanted into another baby represent similar types of evaluations. Xenotransplantation and cloning are other examples. These cases illustrate how technology challenges traditional values in medicine: the personal physician-patient relationship.

Moreover, the interventive capacity of technology challenges the goals of medicine (Kass, 1975; Hanson and Callahan, 1999). The case of life-sustaining treatment is a widely applied example. The possibilities for keeping comatose patients alive with respirators forced us to answer the question of *why*: What is the end of such treatment? Is it survival and extension of life, or is it the welfare of the patient? Inherent in issues of foetal surgery, human enhancement and genetic engineering there reside questions concerning the purpose of interventive treatment. The same questions are posed in cases where technological medicine is applied in excess, is futile, or is detrimental.[4] If the interventive capacities of technological medicine influence the actions and ends of medicine, they are issues of value. They do not only tell us what is, but also question what ought to be.[5]

Determination of the goals for interventive medicine touches upon an additional evaluative question: *Whose* goals? Does the interventive treatment serve the patient, the relatives, the professionals or society? The case of *hypoplastic left heart syndrome* might illustrate this (Bove and Lloyd, 1996; Hagemo et al., 1997; Kern et al., 1997). Here it is not obvious whether the complex, painful and risky treatment with low efficacy and effectiveness serves the benefits of the child, the parents, the skills of the professional or society. The difficulty of defining the goals of interventive medicine therefore relates to the concept of *who* is the subject in medical treatment. Hence, the interventiveness of technological medicine challenges patient autonomy.

Related to this urge for defining the goals of medicine due to technological interventiveness is a requirement to set limits to its activity. Where are the limits to what medicine should do? When the possibilities of treatment are substantially extended it becomes important to know when to abstain from or when to terminate treatment. Inherent in technology's interventiveness there is an issue of its limits, which is clearly displayed in medicine.

Additonally, the comprehensive capacity of interventive medicine is associated with an extended responsibility. The thalidomide case illustrates how the increase in interventive capacity of medicine also increases the seriousness of its consequences if applied erroneously. An increase in the possibility of doing good also enhances the potential of doing wrong. The extensive possibilities related to technological medicine lead to extended responsibilities.[6]

So, as a result of the interventive capacity of technological medicine, the concept of *patient* in medicine is challenged. Due to the increased interventive capacity the goals and limits of medicine have to be redefined, and physicians face an enhanced responsibility. Altogether, what is possible in technological medicine is related to the questions of what *ought* to be done. *Can* implies the question of *ought*. Hence, inherent in the interventive capacity of technology in medicine we encounter issues of value. Inherent in factual issues of *how* to do things, there is an evaluative question of *if* and *what* to do. The new possibilities force us to cope.

2. The technological expansion of medical knowledge

Related to the expanded possibility to intervene, there is an expanded possibility to know. Due to the interventive capacity and the widespread application of technology, the *Corpus Medicorum* has become more extensive and specialised than ever.

This has given rise to a set of demanding questions: Is the new knowledge *good or bad*? Furthermore, *how* is this comprehensive knowledge to be applied? For example, is it right to clone humans, or to make hybrid pigs for xenotransplantation? How shall we ration technological medicine? It has been argued that the evaluative aspects of this expansion of medical knowledge have been ignored (Jonas, 1985; Gadamer, 1993) and, as a consequence, that medicine does more harm than good (Illich, 1975; Lewis, 1977; Stewart-Brown and Farmer, 1997; Sharpe and Faden, 1998; Fischer and Welch 1999). Is it true that we have grown to become technological giants, while we are still to be considered as ethical embryos? Science and technology does not appear to liberate medicine from ethical issues, on the contrary: "It is paradoxical, perhaps, that to apply the creations of our newest scientific disciplines, physicians must reexamine the moral principles by which they act, and turn to ethics, one of our oldest humanistic disciplines" (Reiser, 1977, p. 55).

It is beyond the scope of this study even to sketch the features of this technologically determined expansion of medical knowledge. Only the case of predictive testing will be employed to exemplify the expansion of medical knowledge and its evaluative challenges.

Predictive testing – a case study

Particular to predictive testing is that it can be used to detect cases of disease where the patient has no subjective experience of being ill. Such *asymptomatic diseases*[7] seem to be rich in evaluative consequences. The aims of treatment are altered from removing causes and symptoms of experienced illness to treating unperceived disease. This represents a fundamental epistemological and evaluative change in medicine. Epistemologically, medical knowledge seems to be independent of the patient's subjective experience. This will be discussed in detail later. Evaluatively, the initiative of care and cure is shifted from the patient seeking help to the health care provider offering assistance.[8] Hence, medicine seems to have liberated itself from the initial initiative of the patient.

It has transgressed its traditional ethical basis where a person seeks help because of pain, discomfort, weakness, or ailment. Furthermore, medicine's independence of the patient's illness gives health care unrestricted power to prescribe treatment. Misuse of such power is not difficult to imagine, and how to manage this power is obviously an evaluative challenge. Predictive diagnostics, therefore, represent a change in the ethical status of the patient.

Additionally, some cases of *asymptomatic diseases* would never have become apparent to the patient if they had not been detected by a predictive test. The patient would never have developed symptoms during his or her lifetime. (Black and Welch, 1993; Stewart-Brown and Farmer, 1997; Kevnanagh and Broom, 1998). Papillary carcinoma of the thyroid, ductal carcinoma in situ of a woman's breast and adenocarcinoma of the prostate are examples of such cases.[9] So far, there is no way of predicting who will develop symptoms and who will not. If all the detected instances were followed up therapeutically, more healthy persons would be treated. Predictive testing, hence, increases the prevalence of the disease. Whether it is *good* or *bad* for medicine to "make people diseased" in this manner is a question of value.

Correspondingly, knowledge of a detected disease may make a person anxious and ill. The uncertainty related to this kind of medical knowledge may have a negative physical and psychosocial effect.[10] It has been shown that technological markers, e.g. foetal ultrasound, can result in anxiety and can have a negative influence on health (Malone, 1996). In this respect the technological expansion of medical knowledge can be harmful.[11] This illustrates the evaluate aspects related to new knowledge, which is especially important with diagnostic methods where no treatment exists for the detected disease.

Furthermore, predictive tests embody the evaluative issue of how much pain and inconvenience a person should be exposed to in cases where the probability for a disease developing is small. Is it right to remove the colon of a patient who has a hereditary polyposis and a mutation of the APC-gene (Ponder, 1997)? There is a profound difference between a person who is ill and needs help and a person who is not ill, when it comes to exposing them to treatment and the related pain and risk (Skrabanek, 1994, p. 36).

Altogether, predictive tests can make people diseased. Firstly, they can define people who do not feel ill as diseased. Thus they transgress the initiative of the patient. Secondly, they might lead to treatment of persons who never in their lifetime would have developed symptoms. Thirdly, the knowledge of an unperceived disease may make people both ill and diseased. They force us to deal with risk and uncertainty. Hence, predictive tests represent a *medicalisation* of human conditions. At what level we will allow this to happen is not a purely factual matter, but a matter of values as well.

Epistemic insufficiency

One of the difficulties due to this technological expansion of medical knowledge is, as argued, knowledge of disease without illness. But the opposite situation might also be problematic: where the patient is ill, but no disease can be detected. Is the patient then not diseased? Does he not qualify for treatment or care? If he does, by what means? Is he socially, but not medically diseased (Räikkä, 1996)?

Cases of illness without disease equally represent basic evaluative challenges to technological medicine. Despite the impressive amount of medical knowledge in ever more specialised sub-domains they illustrate an *epistemic insufficiency* in medicine. The knowledge of technological medicine is imperfect (Thomas, 1977). "There is a vast ocean of ignorance at the heart of medicine" (Le Fanu, 1999 p. 178).[12] This does not, however, differ from other systems of medical knowledge. All theoretical frameworks of medicine seem to be insufficient. The difference is that technological medicine appears to be *omnipotent* and *omniscient*. If the limits of medical knowledge are not acknowledged, many patients may suffer. Thus, ignorance of the *epistemic insufficiency* appears to be an issue of value. Ignoring the *docta ignorantia* in technological medicine is a matter of *good* and *bad*.

In addition there is a high turnover of medical knowledge. Yesterday's method is out-dated today. This turnover pushes the evaluative questions forward: What knowledge is *good* and how ought it to be applied? Is it immoral not to offer patients help according to the most up-to-date knowledge? In particular it raises a practical question highly relevant for clinicians: How is it possible to be updated? When is the right time to change to a new method? How much better must a new method be before its benefits outweigh the costs of abandoning a well-established method? How are we to evaluate the efficacy, effectiveness and efficiency of new methodology?

Furthermore, technological medicine presents more possibilities for diagnosis and treatment than available resources can realise. Thus technological medicine has enhanced the problem of triage and forced us to ration recourses (Reiser, 1978; Aron and Schwartz, 1984; Anspach, 1987; Rothman, 1997). Some of the patients with diseases that can be detected and treated will not receive treatment. Which patients are to be given a heart-transplant? Who shall be treated for cataracts or have dialysis and who shall not have? The questions of *whom* shall be given health care services and *who* is to decide are practical and evaluative questions. They cannot be answered by simply referring to the descriptive powers of technology or resolved by implementing more technology.

Hence, the technological expansion of medical knowledge includes evaluative challenges. Knowledge of *how* the human body works and reacts, and *what* to do to influence it, comprises the question of *when* and *how* this knowledge *ought* to be applied and when to recognise its limits.

3. The technological constitution of disease

Technology appears to have become a paradigm in medicine by prescribing ways of detecting, identifying and treating disease. Disease now can be measured with objective instruments (Twaddle, 1993, p. 9). *Epilepsy*, originally conceived as a spiritual influence (Hippocrates: *The sacred disease*), through technology (electroencephalography, microscopic techniques, chemical analysers) has become a disturbance of electrical activity of the brain caused by paroxysmal malfunction of cerebral nerve cells. In the same manner a variety of cardiac conditions are defined by specific ECG-patterns, ultrasound flow measurements and radiographical morphology. The ability to measure blood pressure and to identify *Helicobacter pylori* has made such signs and markers define disease.

The technological influence on the concept of disease is not, however, limited to diagnosis. The success of technology in medicine has made technology the criterion of demarcation for treatment (Brown, 1985, p. 317). The methods of technology determine what is treatable and thereby set a precedent for what is to be treated.[13] Medical technology has become the measure of all things; a kind of *ars mensura*, or a *technê metriké*[14] of the modern age, being the measure of what is good and bad, what is diseased and what is not diseased, what is to be treated and what is not to be treated.

Therapeutically, the technologies of corrective surgery, blood pressure regulation and artificial fertilisation have made health care professionals treat these conditions as diseases: *hypoplastic left heart syndrome, hypertension* and *infertility*. Decisions and prognosis have come to be based on technology (Anspach, 1987; Tijmstra, 1989). Mitcham elegantly summarises this influence of technology on concepts of medicine:

> Medicine is increasingly defined ... by the type and character of its instruments (from stethoscope to high-tech imaging devices) and the construction of special human-artefact interactions (synthetic drugs, prosthetic devices). Indeed, the physician-patient relationship, medical knowledge, and the concept of health are all affected by technological change. (Mitcham, 1995, p. 2477).

Technology is not only involved in defining disease, but also in generating knowledge of disease. It has become the *definiens* of disease and appears to have become the paradigm method of medicine. Technology constitutes the categories of the medical gaze. "The technology mediates between the seer and the seen and what is seen becomes largely constituted by technology. This is why practices change with the development of new technologies" (Cooper, 1996, p. 394). Advances in technology facilitate the identification of new markers that will be treated as disease (Whittle, 1997). Technology comprises the physiological, biochemical and bio-molecular objects and events that constitute the disease entities in both diagnostics and treatment. For example, angiography, echo-doppler and tissue-velocity-imaging have resulted in an extended classification of myocardial infarction. Thus, epistemologically, ontologically and practically, technology is involved in constituting the concept of disease.

Technology, disease and value

Does this technological constitution of disease mean that technology has enabled a descriptive conception of disease? This does not seem to be the case. As previously argued, the interventive capacity of technology and its expansion of medical knowledge is not able to transcend issues of value. The concept of disease will be subject to the same evaluative challenges as the technology that defines it. Some of these have already been discussed. However, other evaluative aspects appear to be related to the technological constitution of disease as well.

Defining disease by setting limits to what is normal and what is pathological is a matter of value (Canguilhem, 1991). Although technology offers a method of reproducible detection and identification of diabetes, defining the limits of normality is nevertheless an evaluative issue. The limits of diabetes defined by the American Diabetes Association (ADA) or by WHO are not factual descriptions. If one applies the WHO limit instead of that of ADA, then the prevalence of the disease is almost doubled (Wahl et al., 1998). Hence, the WHO definition of diabetes makes people diseased. The definition of normality, and thus disease, is an evaluative matter (Robinson and Bevan, 1993).

Furthermore, the sensitivity to the markers used to detect disease is continuously improved, as technology develops. This *increased sensitivity* expands the range of conditions qualifying for the status of disease. Thus, technology lowers the limits of disease and increases its prevalence. The detection of increasingly milder cases results in treatment of an increasing number of conditions. In practice technologically increased sensitivity results in a *lowered treatment threshold*. Increased sensitivity and lowered treatment comprise the evaluative issues of what is *good* diagnosis and what is *good* treatment. They include issues such as futile treatment and medicalisation (Fischer and Welch 1999).[15]

Moreover, technology has altered the end-points of medical activity. Technology defines the entities and markers to be studied and manipulated. In practice it tends to make medicine pursue *soft end-points* like *cardiac blood flow* and *cholesterol concentration*, and constitutes such conditions as diseases. When these markers are within normal limits, the patient is per se healthy.

However, the selection of end-points is a matter of value, and manipulating soft end-points does not guarantee results in terms of *hard end-points* such as survival and morbidity. Clinically the prevalence of prostate cancer in men aged between 60 and 70 is about 1%. However, by applying transrectal ultrasound or MRI more than 40% of men in the same age group have been diagnosed as having prostate cancer (Monti et al., 1989). Technology's focus of attention is on diagnostic and therapeutic impact and not on patient outcome (Bruke, 1994; Pickering, 1996). This technological affinity to soft end-points can be conceived of as a form of medicalisation and a form of disregard of patient autonomy.

Thus, inherent in the technological constitution of disease the measure of disease is changed, the limits to normality must be set and the prevalence of disease and the outcome of treatment are altered. Hence, the *technological constitution of disease* is a matter of value. It influences who is diseased and who is not, who is entitled to treatment and who is not, who will receive economic support, and who will not.

The objective here was neither to give a detailed description of a technological conception of disease, nor was it to give an exhaustive analysis of the evaluative issues of the disease concept. More modestly, the objective was to argue that the conception of disease is influenced by technology and that this reveals its value-ladenness. The issues of value cannot be removed from a technologically constituted concept of disease.

4. Generalising technology

One important characteristic of technology is its generalising ability. Technology facilitated the study and identification of the general in the particular. The ECG and X-ray rendered an objective way to scrutinise disease.

> Ophthalmoscope, broncoscope, etc. allow him [the physician] a direct view of the conditions of many parts. Experimental medicine enables the physician to interpret his findings so as to translate the language of symptoms and tests into the language of physiological processes. Here then is a scientific approach to individual sickness (Temkin, 1963, p. 636).

Technology eliminated both the singularity of the patient and subjectivity of the physician (Reiser 1978) and strongly influenced the postulates of causation in medicine (Evans, 1991). In short, technology made medicine a science (Temkin, 1963; Cassell, 1993, p. 38).

Technology facilitates the translation of individual illness into the objective language of physiology (Ferkiss, 1969; Jonsen, 1990, p. 25).[16] Through technology medicine gains objective data (Jonsen, 1990, p. 25), and technology represents a standard method of detection, identification and treatment of disease. In this way technology accounts for the reproducibility of results and for the accumulation of nomological knowledge. The MRI-machine presents a standard image of the human brain and automated laboratory analysers produce positive test results when the number and shape of blood cells deviate from normal statistical values.

This abstracting and generalising characteristic has been crucial for the argument that technological medicine is value-neutral (Sundström, 1998). Nevertheless, rather than escaping the evaluative, the generalising attribute of medicine emphasises its value-ladenness. This value-ladenness can be illustrated by scrutiny of some of the flaws of this generalising characteristic.

Evaluative aspects of generalising technology

Let me briefly mention four flaws due to technological generalisation frequently referred to in the literature and then investigate some of the value related issues. Firstly, technological generalisation is based on populations rather than on the individual. The single patient might gain from general methodology, but might also suffer from it, due to natural variation in a population (Jonas, 1985; Gadamer, 1993, Delkeskamp-Hayes and Cutter, 1993).

Secondly, no technological method is absolutely effective, nor perfectly accurate and reliable. The same blood sample tested with the same chemical analyser may give different results for consecutive tests, e.g. blood gas measurements. There is statistical variation in the results due to the technological method. This might lead to erroneous diagnosis and treatment. The test can fail to detect disease and can detect disease when there is none.

Thirdly, inter-observer and intra-observer variability reduces the effectiveness of the method. Even if there was no variation in the population and the method was perfectly accurate and reliable, there would still be variation in the application of diagnostic and therapeutic technology. Different physicians apply technology differently in different cases (Jennett, 1988; 1994). Hence, the practical implementation and particular application of even a perfect method might be flawed.

Fourthly, technology is applied to different populations than the one they are tested on. Obviously tested technology is not applied to the test population again. This calls for careful judgement. It is well-known that diagnostic procedures and types of treatment that have been tested on hospitalised patients have been applied in general practice, and methods tested on men have been applied to women, which has resulted in erroneous diagnosis and treatment.

These profound flaws of the technology of medicine present evaluative challenges. On a general basis it is argued that the generalised method in medicine is erroneous (Gorovitz and MacIntyre, 1976, Leape, 1994). How we handle this inherent error in medicine is a matter of *value* and not only of *fact*. Let me briefly investigate some of the evaluative aspects.

Firstly, the question of how we handle the insufficiency of the generalising technology is an evaluative matter. How many false positives and false negatives will we allow? What level of significance do we accept? How much are we willing to let some patients suffer to help others? What responsibilities do health care professionals have towards the healthy persons that are treated and the diseased persons who are ignored? The very definition of confidence intervals is evaluative and the concepts of false negatives and false positives are issues related to *good* and *bad*.

Secondly, the ability to communicate the possibilities and restrictions of medicine due to its generalisation relate to ethical matters such as patient autonomy, informed consent and paternalism. Does the patient understand the uncertainty and risk? How do we act if he does not?

Thirdly, it has been claimed that the generalising method of technology in medicine tends to alter the physician's responsibility for the individual patient (Jonas, 1985; Gadamer, 1993, Delkeskamp-Hayes and Cutter, 1993). It is accused of freeing the physician from personal obligation towards the patient. "Western medicine and the modern paradigm of knowledge are heavily biased towards abstraction, we all tend to feel drawn away from the attempt to identify with the patient's experience" (McWhinney, 1997).

In other words, generalisation by technology leads to what might be called an *epistemic abstraction* from the particular patient, which has adherent evaluative aspects. Whether this *epistemic abstraction* also results in a corresponding *evaluative abstraction* from the patient will be discussed in the following section. The point here is that the generalising characteristic of technology does not make medicine escape issues of value. Handling the *epistemic abstraction* and its flaws is not a matter of how nature *is*, but of how we *ought* to live. The technological generalisation in medicine is in itself an evaluative matter.

5. Technological emancipation from the subjective patient

A crucial aspect of the technological generalisation discussed above is its abstraction from the individual person. Technology has altered the relationship of medicine to its subject matter: the patient. In other words, the objectivity of medicine is achieved by making the patient an object and liberating itself from the patient's subjective experience. However, this independence from the patient is an evaluative issue.

It is argued that before the Eighteenth Century, medicine was based on the patient's narrative of his or her symptoms. In addition to this subjective portrait of the illness, the physician observed the patient's appearance and behaviour as well as any signs of disease. During the Eighteenth and Nineteenth Centuries medical instrumentation enabled and extended the physical examination of patients, which made the physician less dependant on subjective narration (Reiser, 1995, pp. 1–90). The stethoscope gave the physician direct access to the disease. Measuring blood pressure gave an objective measure of internal conditions in the patient. The introduction of machines such as the ECG, X-ray and chemical laboratory analysers during the Nineteenth and Twentieth Centuries further enhanced the objectivity of medicine (Reiser, 1995, pp. 91–157). In addition to removing the subjective errors introduced by the patients, technology also reduced the number of erroneous judgements made by physicians. Technology liberated medicine from the subjective, individual and emotional factors, which confused the conception of the real objective disease. "Twentieth-century technology with all its progress had tended to push the human dilemmas of illness out of the doctor's thoughts, and replace them with laboratory facts derived from tests on the patient's body" (Reiser, 1978, p. 225).

Due to the generalisation in medicine the individual patient today contributes to the *Corpus Medicorum* only as one of many. The epistemic significance of the individual is reduced to a statistical entity. Accordingly, technology creates a physical distance between the physician and the patient (Jennett, 1994, p. 862), making it a 'stranger medicine' (Veatch, 1085; Rothman, 1991).

"Technological methods move the evidence employed in diagnosis away from the patient and reduce the impact of the patient's particularity on the physician" (Cassell, 1993, p. 36). The capacities of technological medicine have excluded the individual patient as the epistemic basis of medicine (Le Fanu, 1999 p.194). The essential question following from this is whether the evaluative status of the patient has been altered correspondingly.

Critics of modern medicine claim that technology's focus on the objective and the general has resulted in a neglect of the individual patient (Glover, 1977; Pellegrino, 1979; Jonas1985; Cassell, 1993; Gadamer, 1993). This transgresses the traditional normative basis of medicine. Ever since the awakening of medical self-consciousness, the raison d'etre of medicine has been to heal and help the individual patient.[17] The objective of medicine was the *good* of the particular patient. With technology in medicine there has been "a detachment from the suffering of [the] patient" (Cassell, 1993, p. 34). This is a detachment of the professional from the personal, disease from illness and signs from symptoms, making medicine face profound evaluative challenges such as medicalisation, reductionism, curative bias and paternalism. As already mentioned, there is a shift in initiative due to technology: the patient does not seek the health care system because he or she feels *bad*, but because the technological method detects something that is considered to be *bad* for the patient. The evaluative initiative is shifted from the patient to the health care system.

Hence, there appears to be a reduction of the evaluative status of the patient corresponding to the reduction in epistemic significance; there is an *evaluative abstraction* from the patient matching the *epistemic abstraction*. This represents what might be called an *evaluative ignorance of the individual* in technological medicine.

Evaluative characteristic of technological medicine

Altogether, the technology of medicine has been characterised by the following attributes:

i) *Interventive capacity:* Taking on an interventive and manipulative attitude.
ii) *Epistemic expansion:* The substantial extension of *Corpus Medicorum* due to technology.
iii) *Constituting disease:* The influence of technology on the concept of disease.
iv) *Generalising:* The technological generalisation of medical knowledge.
v) *Liberating from the subjective experience of the patient:* Making medical knowledge independent of the subjective experience of the patient.

The practically oriented analysis of these characteristics has revealed their inherent evaluative aspects. Within the possibilities of technology resides the question of whether it is *good* or *bad* to realise them. In concert with the potential of technology we face issues of *how, when, why, for whom*, and *by whom* it is to be applied. Within the knowledge of what *is* and what *can* be done with medical technology resides the challenge of what we *ought* to do. At the same time as technology expands our potential for action it urges us to define the ends of and set limits to its application. The relationship between technology and value comes particularly clear in medicine, explicitly dealing with issues of *good* and *bad* of the body (and mind).

In this study I have not dealt with the details on how in particular values relate to technology. This is the issue of another study. Here the main objective has been to argue that there is a close relationship between technology and value, particularly apparent in medicine. In other words: there is a close relationship between technology and ethics. Technology represents a Janus-face in medicine. The opposite of technology's descriptive face is evaluative.[18]

Concluding remarks: The Janus-face of medicine

The investigation of the relation between technology and value seems to be rich in consequences. Firstly, it is apparent that technology does not exclusively represent value-neutral means towards an external end. The study seriously questions the commonplace value-neutrality dictum.[19] The evaluative challenges related to technological medicine are not issues of conflicting external ends and cannot be resolved by agreeing upon external goals of medical activity. Technology, being inherently evaluative, constitutes medical knowledge. Technology makes medicine a scientific, but also a moral enterprise.

Secondly, even though the study has made me question the value-neutral dictum of technological medicine this is done without subscribing to one of the monistic theories of technology. The examples illustrate a wide range of value-ladenness of technology in medicine and demonstrate the difficulties of subscribing them all to one of the traditional critiques in the philosophy of technology. The monistic theories appear to fail to comprise the vast variety of value-aspects of technology in medicine. Additionally, the analysis shows the fruitfulness of a detailed approach to medical practice.

Thirdly, medicine is particularly suitable to study the value-ladenness of technology because its evaluative aspects are easily recognisable. Issues of value are widely recognised in medicine, and (bio)medical ethics is an important branch of moral philosophy (Toulmin 1986).

Hence, the conclusion of the study can be phrased: "*is* implies *ought*", but in the sense that the matter of what *is* in medicine comprises the evaluative issue of how it *ought* to be. There is reciprocity between *is* and *ought*; between the possible and the actual; between knowledge and its application; between fact and value. That is, there is a constitutive relationship between values and technology in medicine. By stepping into the doorway (*januae*) of technology we are already in the realm of value.

Notes

1. There appear to be many kinds of value: economic, esthetical and moral. To restrict the topic, "value" will in this study refer to moral value.
2. Value is not related to technology as such, but in the same manner as value relates to other objects and actions: they can be of value.
3. In the philosophy of medicine we can recognise both the position of technological determinism (Bennett, 1977; Hellerstein, 1983; Tijmstra, 1989; Cassell, 1993; Davidson, 1995; Muraskas et al, 1999) and the phenomenological approach (Cooper, 1996).
4. In particular, see (Illich, 1975; Reiser, 1978; Jennett, 1986; Payer, 1992, pp. 37–52; Cassell, 1993; Schneidermann et al., 1995; Tijmstra, 1989; Fischer and Welch, 1999).
5. Screening is a case that further exemplifies the difficulties of defining goals of medical treatment (Black, 1993; Stewart-Brown and Farmer, 1997; Kevnanagh and Broom, 1998; Kerbel et al., 1997; Whittle, 1997; Malone, 1996; Chevenak, 1998). The benefits of discovering disease have to be weighed against their costs, such as medicalisation of people, false positive or false negative results, detection of cases that are untreatable, anxiety among patients, and application of technological methods by doctors who lack clinical competence. The task of weighing the ends involved in such complex situations is certainly an evaluative matter.
6. The substantial increase in malpractice suits may be an indication of this.
7. Cases of detected disease without any symptoms have also been called lanthanic diseases (Feinstein, 1967).
8. Cases of health care where patients do not request help have been called non-iatropic diseases (Feinstein, 1967). Such cases seem to be of ethical relevance in profit maximising health care systems appealing to people's uncertainty, anxiety and concern for their health.
9. Cases of detected disease that would never have become appearent to the person have been called pseudodiseases (Helman, 1985; Fisher and Welch, 1999, p. 449).
10. See for example (Tijmstra, 1989; Green, 1990; Black and Welch, 1993; Kevnanagh and Broom, 1998).
11. The way that technological knowledge may be harmful can be called technological stigmatisation.
12. The incompleteness of medical knowledge is also demonstrated by the fact that a large number of diseases have unknown aetiology. In many cases medicine can only treat the symptoms and not the causes.
    However, can technological medicine ever reach complete knowledge? Gorovitz and MacIntyre argue that medical knowledge will always be incomplete, and that ignorance of this fact makes medicine errenous (Gorovitz and MacIntyre, 1976). Gadamer also argues that there is an epistemic insufficiency in technological medicine. "Aber trotz allen Fortschritten, die die Naturwissenschaften für unser Wissen um Krankheit und Gesundheit gebracht haben, und trotz dem enormen Aufwand an rationalisierter Technik des Erkennens und Handelns, der sich auf diesem Gebiete entfaltet hat, ist der Bereich des Unrationalisierten hier besonder hoch" (Gadamer, 1987, p. 259). Correspondingly, Paul argues that there is a theoretical insufficiency due to a gap between theory and practice in medicine, termed "Hiatus theoreticus". This is an epistemological void typically inherent in the stock of medical knowledge itself (Paul, 1998, p. 247).
13. The technological focus on treatment has contributed to what has been called the curative bias in modern medicine, which also is rich in normative consequences.
14. See (Gorgias 356d4–e2).
15. Among these are cases that would otherwise have healed by themselves (*trivia*).

16. For example, the stethoscope enabled the physician to listen to sounds from vessels. The classification of these sounds (Korotkoff) gave a general method of measuring blood pressure. This facilitated the correlation of blood pressure and certain pathological states.
17. See (Hippocrates: *The oath; On the art* III). Both Plato and Aristotle recognised that the challenge in medicine was not the content of medical knowledge, but how it should be applied in particular cases (*Phaedrus* 268a7–c4; *Nicomachean Ethics* 1104a4–6; 1137a10–25; 1097a11–4; 1143b18–32; 1180b5–23).
18. Temkin discusses the "Janus-face" of medicine in the context of the history of medicine (Temkin, 1977). The one face looks into the past, enabling the other to view into the future of the profession. In this study the concept of 'the Janus-face of medicine' is applied to emphasise the relationship between medical technology and ethics. The one face looks into the world of how things *are*, the other how they *ought* to be.
19. In the philosophy of technology the value-neutrality dictum has also been characterised as the voluntarist position (Winner, 1977, pp. 53–54; 60–63; 76–77).

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