Side effects and responsibility of medical informatics

Günther Gell

Institute for Medical Informatics, Statistics and Documentation, University of Graz and Graz General Hospital, Graz, Austria

Abstract

Medical informatics systems have the ultimate goal to improve the quality of health care. However, these systems have also the potential to compromise the quality of health care if they are misused, intrinsically faulty or entail unexpected side effects. The purpose of the paper is to discuss examples from the experience of the author, where well-intended medical informatic applications proved to have potentially harmful effects or side effects. It is argued that medical informaticians (MI) have an extended professional responsibility, which covers not only the state of the art technical planning, an implementation of information processing systems in medicine, but also the final result for the patient. In order to discuss professional duties of medical informaticians, a modification of the Software Engineering Code of Ethics and Professional Practice developed by ACM/IEEE is proposed as a guideline. For several examples, these guidelines are used to analyze possible actions and professional responsibility.

Keywords: Medical informatics (L 01.700); Ethics (N 05.350); Health care evaluation (N 05.715.360)

1. Introduction

This paper is based on an invited keynote lecture at the MIE2000 congress in Hannover (August 2000).

The topic of this lecture is the responsibility of medical informaticians (MI) as individuals and of medical informatics as a discipline. The purpose is not to give an exhaustive, systematic discussion of the ethics of medical informatics, but to illustrate with examples from my own professional experience the ethical relevance of our work in medical informatics and the effects that it has or may have for the well being of patients.

Let us start with the definition of medical informatics from the Handbook of Medical Informatics [1]:

“In medical informatics, we develop and assess methods and systems for the acquisition, processing, and interpretation of patient data with the help of knowledge that is obtained in scientific research”.

This is the definition of a classical engineering discipline. The classical ethics of engineers as it was understood in Germany and Austria when I was a student, 40 years ago, requires to build systems according to specific-
lications, technical standards and the state of the art. How these systems are used does not fall within the responsibility of the system building engineer but is the responsibility of the user.

A second definition of medical informatics by Hasman, Haux and Albert [2] covers an additional aspect:

“Medical informatics is the discipline concerned with the systematic processing of data, information and knowledge in medicine and health care. The ultimate goal should always be to improve the quality of health care”.

Our work should have a specific purpose—to improve the quality of health care. Timpka [3] goes one step further and states in his preliminary code of ethics for system developers in health care:

“A health informatician shall be dedicated to providing competent professional service to those who suffer. A health informatician shall assume societal responsibility and accountability for individual actions and avoid harm to others”.

This code establishes a direct link between the health informatician and the patient (those who suffer). The health informatician is also in some way responsible for the effects of his information systems on the patient.

Of course, we all have the noble goal to improve the quality of health care and provide service to those who suffer, but good intentions are not enough.

In Austria, if something has gone wrong, we excuse the culprit by saying: “… but it was well intended” and from this comes the aperçu “well intended is the opposite of well done” (Gut gemeint ist das Gegenteil von gut).

This lecture shall illustrate the fact that medical software systems, albeit well intentioned may have unexpected side effects which are potentially or actually harmful for patients.

Professional societies develop a Code of Ethics to define the rules of professional practice. The Association of Computing Machinery (ACM) and The Institute of Electrical and Electronic Engineers (IEEE) have jointly defined a ‘Software Engineering Code of Ethics and Professional Practice’ [4]. This code can be easily adapted to systems engineering in medical informatics. If we replace the term ‘public’ by ‘patient’ or ‘by patient and public’, as appropriate, if we replace further ‘software’ by ‘MI-system’ as a short-hand for medical information processing system and ‘software engineer by medical informatician’, then the ACM/IEEE code of ethics becomes widely applicable in our field.

Table 1 gives the short version of the code, i. E. the overall principles. Table 2 gives a selection of the detail rules. In both tables, software has been replaced by MI-system, software engineer by medical informatician and public by patient where appropriate. Rules are cited in the text by the numbers as given in Table 2.

2. Side effects of MI-systems

In the following, I will give examples for side effects from my own experience as a medical informatician and I will discuss some of these examples using the ACM/IEEE code. My purpose is to alert fellow medical informaticians to watch out for side effects of medical informatics systems and to feel responsible for the ultimate outcome for the patients.
2.1. Patient selection

Neurosurgeons planned a large prospective study to determine the outcome of a new endoscopic treatment versus a conservative treatment of spontaneous intracerebral hematoma. This was a cooperation between the departments of Neurology, Neurosurgery and Radiology [5]. For each patient seven variables with a total of 20 different signs were determined and the informaticians’ (i.e. Dr. Gell) task was to implement an algorithm from the literature for the stratification of the sample performing a weighted randomization. If too many stuporous patients had been assigned to the conservative treatment, the probability would increase, that the next patients would be assigned to endoscopic treatment. Table 3 gives an example of the result of the randomization for a selected variable.

The program was implemented on the PDP 11 of the Department of Radiology, which operated unattended for 24 h a day. It could be used from a terminal near the CT unit. For some time anything went well, but one evening, when I was at home eating dinner with the family, there was a call from the hospital. A young neurosurgeon told me that he had a patient with spontaneous haematoma in a critical condition. The parameters for the decision between endoscopic and conservative treatment had been collected but the computer was down and I should tell him, how to treat the patient! There was no chance to get the computer up and running in time. The obvious suggestion to flip a coin as the best approximation to the function of the program was not well received—the surgeon found this cynical. It turned out that, although a participant in the study, he was not really aware, that the program assigned patients at random to the two treatments using the electronic equivalent of

Table 1
Medical informatics code of ethics and professional practice principles

<table>
<thead>
<tr>
<th>Principles</th>
<th>Medical Informaticians shall act consistently with the patient interest</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient</td>
<td>Medical Informaticians shall act in a manner that is in the best interests of their client and employer consistent with the patient interest</td>
</tr>
<tr>
<td>Client and employer</td>
<td>Medical Informaticians shall ensure that their products and related modifications meet the highest professional standards possible</td>
</tr>
<tr>
<td>Product</td>
<td>Medical Informaticians shall maintain integrity and independence in their professional judgment</td>
</tr>
<tr>
<td>Management</td>
<td>Medical Informaticians shall subscribe to and promote an ethical approach to the management of MI-system development and maintenance</td>
</tr>
<tr>
<td>Profession</td>
<td>Medical Informaticians shall advance the integrity and reputation of the profession consistent with the patient interest</td>
</tr>
<tr>
<td>Colleagues</td>
<td>Medical Informaticians shall be fair to and supportive of their colleagues</td>
</tr>
<tr>
<td>Self</td>
<td>Medical Informaticians shall participate in lifelong learning regarding the practice of their profession and shall promote an ethical approach to the practice of the profession</td>
</tr>
</tbody>
</table>

This code was derived from the Software Engineering Code of Ethics and Professional Practice published by ACM/IEEE [4]. Public has been replaced by patient, software engineer by medical informatician and software by MI-system.
Table 2
Medical informatics code of ethics and professional practice

Examples for specific rules

**Principle 1: patient**

1.01 Accept full responsibility for their own work
1.02 Moderate the interests of the medical informatician, the employer, the client and the users with the patient good
1.03 Approve a MI-system only if they have a well-founded belief that it is safe, meets specifications, passes appropriate tests, and does not diminish quality of life, diminish privacy or harm the environment. The ultimate effect of the work should be to the patients good
1.04 Disclose to appropriate persons or authorities any actual or potential danger to the user, the patient, or the environment, that they reasonably believe to be associated with systems or related documents
1.05 Cooperate in efforts to address matters of grave patient concern caused by system, its installation, maintenance, support or documentation
1.06 Be fair and avoid deception in all statements, particularly public ones, concerning systems or related documents, methods and tools

**Principle 2: client and employer**

2.06 Identify, document, collect evidence and report to the client or the employer promptly if, in their opinion, a project is likely to fail, to prove too expensive, to violate intellectual property law, or otherwise to be problematic

**Principle 3: product**

3.03 Identify, define and address ethical, economic, cultural, legal and environmental issues related to work projects
3.12 Work to develop systems and related documents that respect the privacy of those who will be affected by that system
3.13 Be careful to use only accurate data derived by ethical and lawful means, and use it only in ways properly authorized

**Principle 6: profession**

6.01 Help develop an organizational environment favorable to acting ethically
6.06 Obey all laws governing their work, unless, in exceptional circumstances, such compliance is inconsistent with the patient interest
6.07 Be accurate in stating the characteristics of systems on which they work, avoiding not only false claims but also claims that might reasonably be

Selection from the Software Engineering Code of Ethics published by ACM/IEEE [1]. Public has been replaced by Patient, Software engineers by medical informatician and software by MI-system.

flipping a coin. He seemed to believe that the artificial intelligence of the computer made a decision for the more promising treatment. The incident left me somewhat shaken and very thoughtful (I did not dare to flip the coin myself): although I knew it theoretically that my program ‘decided’ about the treatment of the patients—the direct confrontation with this decision came as a shock. As it turned out later, the survival chance was markedly better with endoscopic than with medical treatment (Fig. 1)—so in fact, some of the patients that my program did assign to the medical group might have survived had they been assigned to endoscopic treatment. Still, I would do the study again. The results were to the best of future patients and in the absence of evidence no rational choice of a ‘best’ treatment for the actual patients was possible.
Table 3
Example for the distribution of signs in the two treatment groups as a result of weighted randomization

<table>
<thead>
<tr>
<th>Number of cases</th>
<th>Consciousness</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Alert</td>
</tr>
<tr>
<td></td>
<td>14</td>
</tr>
<tr>
<td></td>
<td>12</td>
</tr>
</tbody>
</table>

Adapted from [5].

The example provides a second lesson: one cannot rely upon that the users understand the logic of the program. Programs should be designed in order to be ‘robust’ against misconceptions of users. If this is not possible, the education and monitoring of users must be organized with great care. The problem of misconceptions and misuse is even more evident in the next example.

2.2. Renogram interpretation

Thirty years ago, one of my first tasks in the hospital was the automation of the evaluation of the renogram, an examination to determine renal function. A radioactive tracer is intravenously injected. The tracer is removed from the blood by the kidneys and flows from the kidneys to the bladder. Fig. 2 shows the arrangement.

Two detectors from above monitor the radiation from the heart and the bladder, respectively; two detectors under the table monitor the two kidneys. Digital data are recorded on a Philips type cassette that can be seen under the display to the left of the patient. The display and the keyboard are also used to enter patient identification data and to monitor the data flow. Again to the left one sees the electronics for data capture and data transmission [6].

The whole digital assembly was error prone and the resulting data contained artefacts like the one shown in Fig. 3 resulting from transmission and recording errors. To avoid a corruption of the results by these errors we established a manual quality check where the responsible radiographer had to do a visual inspection of the curves. Errors were corrected by positioning a cross-hair cursor to mark points to the left and right of the error. Then the corrupted data were replaced by a linear interpolation of the curve between the two points.

Fig. 4 shows the resulting curves, the heart with the initial peak and subsequent dilution and excretion, the bladder that starts empty and slowly accumulates the tracer and the kidneys that show a sharp initial rise, when blood and tracer flow into the renal vessels, a slower rise from excretion and accumulation of the tracer into the renal ducts and a descent when the tracer leaves the kidneys and flows to the bladder. The scales for the curves are different. The uppermost renogram shows normal function of the kidneys, the next shows two almost functionless kidneys and the lower one shows almost normal removal of the tracer from the blood but an extremely delayed flow of urine to the bladder.
The traditional interpretation of the curves was done with a ruler and a goniometer, measuring gradients, time to reach the maximum count, time to decrease to half of the maximum and calculating from that the total clearance (with an exponential model) and the relative clearances of the two kidneys. This traditional method served as the model for the computer analysis, which was in fact a one to one replica, giving no new results but saving time. The program was implemented (in FORTRAN on a PDP 15), tested and accepted and used in the daily clinical routine. Having practiced the manual method for years physicians and radiographers were perfectly aware of the function of the program and the underlying methods and limitations. Fig. 5 shows the typical output.

After years of successful operation, one day, a young doctor, relatively new in nuclear medicine asked if I had changed the program because it sometimes gave odd results that did not fit with clinical and chemical data. I had nothing changed but asked for examples and started an investigation, which gave surprising and alarming results: younger doctors had no idea about the geometrical basis of the program. For them, the program was a black box that somehow with intelligent methods derived physiological parameters from the data and they knew how to interpret those parameters. This concerned in particular the relative clearance (the relative contribution of the left and right kidney to the excretion of the tracer), which is calculated by a simple comparison of gradients. Since they did not understand the program, they could not check the plausibility of results by visual analysis of the curves. The same was true for some radiographers. They did not see the correction facility as a means to correct limited artefacts but as a miraculous universal tool to correct all kinds of problems, which relieved them from their responsibility for the quality of data. For example, when a patient moves during the examination and the kidneys, are placed outside of the sensitive area of the detectors then the data is useless and the program sends an error message. It was the original duty of the radiogra-
A young radiographer had found out that she could avoid this error message by interpolating large parts of the data between two more or less randomly selected points. Of course, the calculated results were unpredictable. False results can lead to serious consequences because if one kidney is not or poorly functioning in patients with untreatable high blood pressure, this kidney is removed. Fortunately, it could be established that actually no harm had been caused and since the whole equipment was scheduled for replacement by a gamma-camera, the problem could be solved by training the staff and explaining the function of the program.

Concerning the classical engineering ethics I was not to blame—the program was implemented according to specifications and accepted—its faulty use was not my responsibility. Still I felt uneasy—finally it was my program and in retrospect, an experienced professional should have introduced security mechanisms against misuse of the correction facility like limiting the interpolation to small segments. And finally I should have been monitoring the actual use of the program more closely. The general lesson is that users will tend to utilize systems also for

Fig. 3. Quality control of renogram data. The cross hair cursor is used to correct the negative spike—an artefact.

Fig. 4. Renogram curves. See text for explanation.
their own goals, to facilitate their work etc. This is not intrinsically bad and often leads to new insights and positive developments but it may also lead to harmful effects, in particular if the user does not understand the basis of the program or sees no reason why he should use the system in a particular way.

2.3. Image sources

I would like to give a short example, where an unforeseen use of a system created unexpected benefits. Beginning in 1985 our department did a joint development with SIEMENS for a Picture Archiving and Communication System (PACS). Images were to be sent from digital modalities like CT or MR to digital archives of (then) optical disks and to a still very experimental prototype of a reporting console. While designing the software there was some debate, whether modalities should be able not only to send but also to receive images over the network. Nobody could imagine a scenario, where it was meaningful to send images to a modality—still, out of an esthetic predilection for symmetry and abstraction, all the nodes in the PACS were configured in a way to be able to send and receive images. As it turned out the capability to send images to a modality was the most appreciated and beneficial feature of this early PACS. Before PACS and during the first years of the PACS development, each modality was connected to a filmprinter and all the digital images were printed on film for diagnostic reading. The printers were a weak spot—their not infrequent downtime meant delays in examinations and results. Now, with PACS, if the filmprinter of one modality was out of order the images could be sent to another modality and printed there, thus reducing delays and inconveniences to patients to a minimum.

In most cases, the imagination of users in exploiting the features of IT-systems in unexpected ways is to the benefit of the patient or the hospital. Still it is the responsibility of the informatician to analyze actual use not only to prevent misuse but also to learn and benefit from the creativity of the users.

2.4. Prediction

Neurosurgeons planned a study to find parameters to predict the outcome after severe head injury and enlisted my collaboration for analysis and data processing. Asking for the purpose I was told somewhat vaguely about scientific interests, being able to give information to the relatives of the patient etc. We made a study with 150 patients from two centers with 87 survivors and 63 non-survivors. Fifty eight parameters were collected daily and from the analysis eight parameters were found to have high predictive value. Tuning the system to high specificity for non-survival we were able to identify 50% of non-survivors 1 day after the trauma. None of the survivors were falsely identified as a non-survivor (0 false positives), but only about half of the non-survivors had been identified after 1 day (low sensitivity) [7]. It was only at the end of the study, that we
really started to think about the consequences of this result. The identification of a patient as a non-survivor is a statement about a high probability but not a necessity. Such a statement can become a self-fulfilling prophecy, because one cannot rule out, that a patient who is marked as having no chance will (unconsciously) be treated differently. The system therefore was shelved and never used for real predictions. We thought however about two possible uses: first triage, if after a catastrophic event with many head injuries triage is necessary one would select those patients with a real chance for survival. The second has to do with the prospective randomizing problem. If there is a new treatment that seems to provide a good chance (from first experiences), one could use those parameters with known probability for lethal outcome as a virtual control group and if results with the new method are really better do not withhold this treatment from patients.

There is a second misuse/use namely, that a prediction of non-survival might mark the patient as a potential organ donor and that might also be the cause of different treatment. This possibility did not occur to me at that time, but only later after another episode. In my lectures on medical informatics I was trying to explain to students the ethical problems with side effects and misuse. And one day, a student came to ask for advice. He had been offered a thesis, where he had to write software to determine the legal point of death from the biosignals measured at the patient. There are certain legal requirements to declare a patient dead and to take organs—e.g. a flat EEC, ECG for a certain duration etc. and they wanted to determine this legally defined point without delay in order to prevent deterioration of possible organs. Now the student told me that, alerted by my lectures, he feared that this might gradually lead to a loosening of the legal constraints—there being infallible computer programs and therefore no necessity to wait so long.

Looking at the ACM/IEEE code, we might find some guidance. Rules 1.04, 3.03, 3.13, 6.06 might be relevant.

If there seems to be a danger, it must be disclosed to the appropriate person or authorities. Feeling responsible for systems and outcomes does not mean to take away decisions from those that are legally entitled to them (e.g. physicians, the director of the hospital, the legislation etc.).

The planned system did not harm the actual patient, was according to the law and did help another patient. The potential harm did require the change in a law and therefore was a decision of parliament.

So I did advise the student, to accept the thesis, implement precisely the actual legal requirements and, if in fact a discussion about a change of the law would come up, to take a stand on it.

Our examples so far had a direct and recognizable effect on individual patients. A second feature is that in most cases ethical considerations were made more or less retrospectively, triggered by some unexpected result. The typical hospital or country wide hospital or health information systems have effects that are much more indirect, abstract and more difficult to assess. Nevertheless, they can have important consequences for patients and therefore a prospective analysis of possible side effects and misuses is particularly important. The following examples deal with more complex information systems.

2.5. Image distribution

The beginnings of the PACS have already be mentioned. In the meantime the PACS was integrated with the RIS and did expand to connect all Styrian hospitals. In the whole
state images and radiologic reports are accessible for patient care, second opinion etc. There was a critical phase, when PACS was beginning to grow outside of radiology. With conventional film based imaging methods, the images are under the control of the radiology department. Radiologists decide (of course according to rules) if and when images are sent to clinicians etc. Since films were usually sent only together with the radiologic report—that means with some delay, clinicians were always asking for faster service.

With PACS, it became technically feasible to distribute images almost immediately after the examination to the clinician. Since the PACS was run by the Department of Medical Informatics, we became the target for intensive interventions. Clinicians asked for immediate delivery of images for the best of the patients, giving examples where a delay could be (or had even been) harmful. Radiologists argued to the contrary—sending images to clinicians without the diagnosis of the radiologist may (or did) harm patients because clinicians start a treatment based on their own sometimes insufficient and wrong interpretation of the images. Basic instincts incline informaticians to distribute information quickly—but it is not our task to resolve medical controversies. Does the code of ethics and professional practice give some guidance? Rule 1.02 requires to moderate the interest of the employer, the client and the users with the patients’ interest. So for each request from a clinic to give them access to images, we build a small working group consisting of clinicians and radiologists under the moderation of medical informatics. In this group we first explain objectively, what is technically feasible (rule 1.06) and then moderate a discussion between radiologists and clinicians which usually results in a set of rules for image access, depending on the type of examination, type of request etc. We then implement these rules in the software. In practice, a set of standard rules—a standard image distribution policy—evolved and we need consensus groups only, if a deviation from the standard policy is requested.

Another example of a very complex question about the ultimate outcome for the patient is telepathology—an elegant method that allows a surgeon in a small remote hospital to get the necessary diagnostic information from a pathologist for oncologic surgery. On the surface, everything is well, the pathologist and the surgeon agree and the patient is spared the inconvenience to travel to a center. The only question mark is provided by statistics and recommendations, which state that therapeutic results are better in specialized oncologic centers than in general hospitals. What is really the best for the patient? Certainly, the question will not be decided by medical informatics—my point is only not to ‘market’ elegant technical solutions too aggressively, but to try to see not only the benefits, but also the drawbacks and address potential problems and involve medical experts and authorities (rule 1.04 and 1.05 again).

2.6. Data protection

One of the most widely discussed features of hospital information systems (HIS) or of the electronic patient record (EPR) is a possible violation of medical confidence by unauthorized access. In fact, the patients are not the only ones, whose data may be misused. A HIS and also the EPR contain a huge amount of data on health personnel (physicians, nurses etc.) that must be protected against unauthorized access. Introducing a HIS or an EPR without addressing data protection would be irresponsible (rule 1.01). What can the medical informatician (MI) do? First, of course, implement technical means
for data protection, establish secure authori-
ization and access techniques etc. (Principle
3. MI shall ensure that their products ... meet
the highest professional standards). If, for
example for cost considerations, systems with
insufficient data protection are to be imple-
mented or bought, it depends also on the
position of the MI within the organization
what he can and should do. Let’s consider
the code for advice.

If the MI is in a position to decide about
HIS and the allocation of resources, principle
1—MI shall act consistently with the pa-
tient’s interest—calls for a kind of cost/
benefit analysis. With restricted financial
resources, one has to compare improvement
in patient care provided by a HIS or EPR
with the risk that may result from weak data
protection or the additional cost to cover
every imaginable weak points.

If the MI is not in the position to decide
but is involved with the project he should
apply rules 2.06, ‘Identify, document and re-
port to the client or the employer promptly,
if in their opinion, a project is likely ... to be
problematic’ and 2.07, ‘... report significant
issues of social concern ... to the employer or
the client’. The MI should address the prob-
lem of data protection within the organiza-
tion and expose the possible dangers to the
management that have to decide. If the MI is
convinced that a system is against patient
interest, the code requires that he should not
approve the system (rule 1.03) or to 'dis-
close to appropriate persons or authorities any ac-
tual or potential danger to ... the patient ...'
(rule 1.04).

Data protection cannot be guaranteed by
technical measures like access restrictions and
access control alone. Probably the large ma-
jority of cases, where confidential informa-
tion is disclosed in some way is caused by
people who may legitimately access patient
data but use them in an unethical way—from
gossip about patients (rather common) to
leaking patient data to financially interested
outside persons or organizations (very rare).
Logging and control of accesses is needed but
the really important and effective way is to
create an awareness for the protection of
privacy within the personnel of the hospital
and also within the public at large. As an
example, in reality, my private home is not
primarily protected by locks—which could
easily be forced by any ‘professional’—but
by a broad public consensus, enforced by
law, that breaking into a house is a crime, is
something ‘one does not do’. The same is
true for the privacy of letters, which are also
mostly protected by public consensus: no-
body could get away with stealing letters
from mailboxes ‘to show how poorly pro-
tected mailboxes are’. We all know that they
are poorly protected but we rely on the hon-
esty of the citizens because otherwise the
whole system of letter distribution could be-
comeuviable.

This is precisely the case of the EPR and
the HIS. We must build a public and organi-
zational conscience that it is a crime to seek
unauthorized access to patient data and/or to
use them improperly. And we must give pa-
tients confidence that they can rely on the
privacy of their health data. Otherwise, the
HIS or EPR might deter patients who fear
disclosure of their health data to seek medical
help—a negative side effect that exists (I
know a few cases) but that is very difficult to
assess. It is the professional duty of the MI,
who ‘accept full responsibility for their own
work’ (rule 1.01), to ‘cooperate in efforts to
address matters of grave public concern
caused by MI-systems ...’ (rule 1.05) and to
‘help develop an organizational environ-
ment favorable to acting ethically’ (rule 6.01).

As an example our department has taken
the lead in developing a data protection pol-
cy for our hospital organization and in-
stalling a data protection commission that deals with those problems within our hospitals. This commission has, for example, instituted an educational procedure about data protection for the personnel of the hospitals. On a nation wide scale, the three Departments of Medical Informatics of the three medical faculties in Austria are also active in promoting a national policy for secure communication of medical data and have contributed in shaping the medical clauses of the national data protection law to find a proper balance between patient privacy and data access for medical research.

3. Conclusion

Medical informatics lies at the intersection of informatics and medicine [8]. The distinctive feature of a professional medical informatician—as opposed to an informatician who happens to develop a system, with an application in medicine—is the MIs interest in and responsibility for the patient and for the quality of care as it follows from the definition of medical informatics. If MIs feel responsible for the quality of health care, they have to ‘improve their understanding of MI-systems ... on which they work and of the environment in which they will be used’ (rule 8.04) which means they have to some extent and depending on their task to understand the health environment, the hospital organization, the medical problem, the complex sociology within health care organizations etc. to do a good job. As we have seen, MI-systems have great potential to improve the quality of health care, but there is also a potential to compromise the quality of health care by unintended side effects, improper use etc. Therefore, I would propose two additions to the code of ethics and professional practice:

A health informatician shall feel responsible for the effects of his work (of MI systems) on the patients and on the public. He shall try to a anticipate unintended uses and misuses and side effects and he shall try to prevent possible harm to patients.

A health informatician shall monitor and evaluate the clinical operation of MI systems, not only in respect to the intended effects but also to side effects and misuse and he shall correct any misuse or faulty operation that may cause harm to patients. Of course, the MI is not the only responsible one. The planning, implementation and operation of MI—systems need a cooperation between physicians, nurses, hospital managers and medical informaticians. Each of those groups has its own responsibility, but all should also feel responsible for the whole, for the ultimate goal to improve the quality of health care. For the medical informatician I propose an adapted version of the ACM/IEEE code of ethics and professional practice for software engineers as a guideline for professional practice. We must not content ourselves with good intentions but we must ensure good results.

References

