Reflections Towards the Future of Medical Informatics

A Farewell Lecture after Almost Half a Century of Biomedical and Health Informatics Activities

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Summary

The aim of this lecture is to provide guidance on the future development and role of medical informatics, or biomedical and health informatics, in the form of reflections.

In order to make these reflections on the future of medical informatics more understandable, it seemed necessary for the author to report on his previous work as a medical informaticist, which spans almost half a century. It began in 1973 when he started to study medical informatics. In 1978, more than four decades ago, his professional work started. He will retire at the end of the 2021 summer semester. This was the occasion to prepare this farewell lecture.

In 20 reflections, thoughts are presented on professional careers (R1 - 'places'), on medical informatics as discipline (R2 - 'interdisciplinarity', R3 - 'focuses', R4 - 'affiliations'), on research (R5 - 'duality', R6 - 'confluences', R7 - 'correlations', R8 – ‘collaboration‘), on education (R9 - 'community', R10 - 'competencies', R11 - 'approaches'), on academic self-governance (R12 - 'autonomy'), on participation (R13 - 'Sisyphos', R14 - 'professional societies', R15 - 'respect', R16 – ‘tightrope walk'), and on good scientific practice (R17 - 'time invariants', R18 - 'Zeitgeist', R19 - 'knowledge gain', R20 - 'exercising').

Keywords: medical informatics, biomedical and health informatics, research, education, academic self-governance, participation, good scientific practice.

The 20 Reflections

Reflection on Professional Careers

R_1 – 'places': *The changes to different institutions have been good for me. Things that were taken for granted, be it in the methodology or in the interaction with each other, were put into perspective; one's own horizon became broader; also the appreciation of things that were previously simply taken for granted. Not only as in my case with university careers should changes be supported and made possible in as simple a way as possible, also in an international context.*

Reflections on Medical Informatics[1] as discipline

R_2 – 'interdisciplinarity'*: Medical informatics is part of medicine/health sciences and of informatics/computer science. The field is highly interdisciplinary, which may include multidisciplinarity up to transdisciplinarity. This requires an interaction with other medical and informatics disciplines, both in terms of methods and tools as well as in terms of the goals to be achieved. In addition, there is the exchange with further disciplines. People working in medical informatics must be able to work interdisciplinarily and in a team. This interdisciplinarity, which is, as far as I can see, particularly evident in this field, should be taken into account and promoted in medical informatics education as well as in the work in medical informatics institutes.*

R_3 – 'focuses'*: A question that has arisen again and again, at least since my professional activity as professor, is whether medical informatics at universities should be lived as an 'experimental and observing' discipline or also as a 'practising' discipline. In other words, should medical informatics institutes at universities experimentally investigate and prototype new methods and tools and observe and evaluate their application in the practice of health care according to scientific methods, but do not practise themselves? In this case, medical informatics at universities would be an experimental and observational discipline just as most disciplines with their research institutes are at universities. Or should medical informatics at universities also contribute to the practice of health care, as is the case in some engineering sciences, for example, or as is the case for many clinical disciplines in which research, teaching and patient care are regarded as unity? Contributing to practice could mean that digital diagnostics and therapeutics are also offered through these institutes or that they are also responsible in managing information systems of university medical centers. Both variants have become established worldwide in a wide variety of forms. This question should be discussed again and again in the future.*

R_4 – 'affiliations'*: If medical informatics belongs to medicine and to informatics, to which faculty within a university, for example, should an institute for medical informatics be assigned? I recommend an affiliation with both faculties, medicine and informatics, as has been achieved, for example, with the establishment of the Peter L. Reichertz Institute. Other organizational solutions, up to an independent faculty in a university are plausible, too, and have also been implemented. Such affiliations are not self-evident. They have to be promoted in the sense of lived interdisciplinarity also in the future.*

Reflections on Research

R_5 – 'duality': *The duality of medical objectives and informatics methodology described here is probably typical for medical informatics research. Living this duality is challenging and motivating at the same time. Also in the future, 'real' medical informatics research will probably only exist in this duality. As already mentioned in R_2, it is important to give scientists the opportunity to practice this duality.*

R_6 – 'confluences'*: At least for me, but probably also for many other colleagues, topics as well as methods relevant for dealing with these topics were changing. Contents and methods are 'flowing', so to speak, sometimes back and forth. A broad methodological as well as content-related basis was important for my research and can, in my opinion, only be recommended. For example, skills in study design and data analysis acquired in the priority program on viral hepatitis research were very helpful for our research on long-term home monitoring of geriatric patients with mobility-impairing fractures using health-enabling technologies in the GAL research program - at first glance a completely different topic. Boundaries of disciplines were and are changing. They should always be reviewed and adjusted.*

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[1] or biomedical and health informatics, or …

For an adequate orientation, the definition of medical informatics as a field, given here, may serve as orientation.

***R_7 – 'correlations'**: For medical informatics research, it seems important to me to realize that health care is to be seen as an integral part of life: Health care starts when people are born and ends when people pass away. Sometimes, the relative share of health care in our lives is small, sometimes it becomes higher. Health care includes life situations such as prevention, treatment of acute and chronic diseases, or care. It is provided by health care professionals, such as physicians or nurses. It is also provided by informal caregivers (relatives or other close persons). Last but not least, the persons themselves have to be mentioned. Settings where health care takes place are professional settings such as hospitals, medical offices or nursing homes, but often also settings such as the home or the workplace up to other places of daily life such as vehicles. Medical informatics research has focused primarily on health care delivered by physicians or nurses in professional care settings. This research remains important, both in diagnostics and therapy, and in information systems. The methodological and technical progress achieved in recent decades now also makes it possible to consider health care in other life situations, with other groups of people and in other settings in our research and thus to take further into account that health care is an integral part of life. This applies both to research on care processes and to research on gaining new insights into diseases and their diagnosis, therapy and prevention.*

***R_8 – 'collaboration'**: The entities to be considered in medical informatics research that are involved in health care have also broadened in the context of scientific and technical progress. In R_7 health care professionals had been mentioned as well as patients/persons and informal caregivers. In future, I believe that functionally comprehensive, 'intelligent' machines as well as other living entities such as animals and plants should be increasingly included. Their collaboration, which could be described as the collaboration of natural and artificial intelligence, might be of importance for the health care of people.*

Reflections on Education

***R_9 – 'community'**: Even though it is really not medical informatics specific, it is important for me to mention this in the reflections. University means community of teachers and students, in their joint objective to search for new knowledge and truth. How can todays universities create good conditions for this community? It is a topic that must be considered and discussed again and again.*

***R_{10} – 'competencies':** Education at universities has to be oriented towards the needs of our students and their future work, be it in practice, in research or wherever. Which knowledge and which skills are to be taught in medical informatics? There are international recommendations on this for medical informatics. Yet, in addition, this also needs to be reassessed and determined again and again. In the case of university education, medical informatics institutes should also be able to combine this teaching to a large extent with their current medical informatics research or with their activities in the practice of health care, of course in advanced courses, but if possible also already in the basic courses. This is demanding and by no means easy to implement. On the other hand, at least in my opinion, medical informatics education at universities should have this ambition in the interest of our students.*

***R_{11} – 'approaches'**: How can one become a medical informatics specialist? There are two approaches to medical informatics worldwide: a so-called health-care-related approach and a so-called informatics-related approach. In the case of a health-care-related approach, students often first study medicine or another program in biomedical and health sciences, either with a focus on medical informatics or with an additional degree, later achieved. The informatics-related approach is available through dedicated medical informatics programs or within computer science programs with respective specialization. Both approaches, the health-care-related and the informatics-related approach, are important and should be offered and implemented*

Reflection on Academic Self-Governance

***R_{12} – 'autonomy'**: Even if the professional work, the work in research and education is central in all universities, participating in academic self-governance is an important 'secondary matter', which for some colleagues can also become the 'main matter' at times. Independent universities form an important, though by no means always easy, component of our societies. Academic self-governance is not specific to medical informatics. As with all other disciplines, engagement of colleagues in self-governance be expected and should be demanded.*

Reflections on Participation

***R_{13} – 'Sisyphos'**: Something that is especially true in research and in participation: Not everything is successful. Not everything is positively received and supported, no matter how well justified and prepared it may be. This can be very disappointing. In addition, an important characteristic in research is doubt. We, who are in research, have to question results and conclusions and have to try to verify and/or reproduce them. This doubt is necessary and also concerns our own research. What could have been done better? Shouldn't I have achieved more? Why was it not possible to achieve a goal that would have made an important methodological or substantive contribution to good health care? Why was I not able to convince the decision-makers involved and motivate them to act, despite good arguments and good preparation? As I said, this doubt is a necessary prerequisite for science. What have I learned over time? What can I recommend? Live with doubt and accept that not only successes, but also failures are perhaps sometimes necessary further steps. If you are convinced on your methodological or content-related goals, do not give up and try again.*

***R_{14} – 'professional societies'**: Independent professional societies, such as GMDS, EFMI, and IMIA in my case, represent an important component at the national and international level, both in scientific exchange and in scientific advice not driven by interests, such as the recommendations on education mentioned above. Another field of activity for such societies could be the 'fair' communication of knowledge of its members, possibly together with university libraries and publishers. Fair means, among others, that copyrights and rights of use remain as far as possible with the scientists who have developed this knowledge. Fair can also mean that this knowledge, which is often publicly funded, is then freely available to the public. Professional societies are successful when the scientists of their field are engaged in them. This commitment, be it in working groups, in task forces or wherever else, will also be of great importance in the future.*

***R_{15} – 'respect'**: Again, regarding the objective of medical informatics stated at the beginning: "Its objective, beyond borders: contribute to high quality as well as affordable health care for the people in our world and to the progress of sciences." Why was it important for me to include "beyond borders"? IMIA's statutes state, "In order to achieve IMIA's objectives to contribute to the health and quality of life of the people in our world through dissemination and use of informatics for high-quality, efficient health care and public health and for high-quality research in biomedicine and in the health, information and computer sciences, IMIA's members collaborate in a tolerant and peaceful way, transcending nations, cultures, and political or social structures." (see IMIA's web site). When these statutes were approved in 2010, I felt this statement was self-evident. During the last few years, national egoisms and hate-filled speeches, even from leading politicians, have increased. And 'fake news' - an unacceptably trivializing term for nothing but lies - became an accepted means of asserting interests for some persons. Since then, I have become aware again that respect is self-evident and that one must continue to be committed to it, also in medical informatics. And maybe it is easier to live this and to support values like health, dignity, participation and informational self-determination in our field, which is, perhaps, comparatively less driven by politics and interests and which is about the health of the people in our world.*

***R_{16} – 'tightrope walk'**: With digitization, we are on a path that has brought a lot of good, but which also has considerable 'side effects', also in living together. Like almost every field, medical informatics can bring about positive things but also cause harm. This has always been and must continue to be considered. Especially when, as in the case of health-enabling technologies, we find ourselves to a considerable extent in the most private areas of individuals. Even if, for example, it is the clear wish of frail elderly people to be supported by 'intelligent homes' so that they can continue to live in their familiar home and social environment, the extent to which informational self-determination is still possible must be weighed up. Questions on appropriate information and communication architectures as well as ethical and legal issues play a role here. Medical informatics research and practice must be aware of this balancing act and draw attention to it. These are questions about how societies - that is, we - should approach them, how laws should be adapted, and how new ways of living and care can be implemented.*

Reflections on Good Scientific Practice

***R_{17} – 'time invariants'**: What are important time-invariant criteria for good medical informatics research? As in many other disciplines, medical informatics research can be evaluated by whether it is relevant in terms of its objectives and original in terms of the methods and tools developed or applied. If research projects meet both criteria - originality and relevance - then it is medical informatics research. If research projects meet only one of these characteristics, then one should consider whether it is truly*

medical informatics research. It could also be research in another field of medicine or informatics. If research projects do not fulfill any of these properties, then one must reflect on whether it is research at all.

***R_{18} – 'Zeitgeist'**: During these nearly five decades in medical informatics, the priorities for research, education, or practice that were considered important by politics, scientific organizations, or university leadership varied considerably, as did the indicators used for evaluation. What was considered of little importance or even criticized in certain years could be seen as particularly important in other years and gain public recognition. In contrast, the objectives of medical informatics and the principles of good scientific practice remained essentially invariant. They formed, so to speak, time-invariant cornerstones for good research and education as well as for the adequately contributing to the practice of health care. Of course, there were and are other time-variant indicators for research. At present, these are, for example, the impact factors or H-indices for publication achievements of scientists or their acquired third-party funds. It makes little sense to ignore the respective time-variant indicators completely, especially since they can characterize research performance, although in a limited way, as in the case of the indicators mentioned. Moreover, at least in my experience, a primary focus on the important, time-invariant criteria of originality and relevance is positively correlated to such time-variant criteria.*

***R_{19} – 'knowledge gain'**: How should research projects in medical informatics be designed in order to achieve the best possible knowledge gain? This question is difficult and there is probably no simple and unique answer. During my professional career, I have noticed that the approaches to this question differ both within the fields of medicine and informatics and, in particular, between medicine/health sciences and informatics/computer science. While in computer science, for example, single demonstrators are used to test findings, in medicine empirical studies are often necessary for this purpose, where it is essential that findings are obtained on a sufficiently large number of entities. This is related to variability. For medical informatics research, it seems important to me to conduct more carefully planned studies on a scientific basis in the future. This could be the case, for example, in the evaluation of health-enabling technologies or other digital diagnostics and therapeutics. An assessment of diagnostic relevance or therapeutic efficacy based primarily on technical feasibility or on individual case studies would not do justice to this complex issue in medicine and healthcare. A knowledge gain based on comparative interventions, preferably by means of randomized trials, should also be established as an important method in medical informatics.*

***R_{20} – 'exercising'**: How can good scientific practice in medical informatics be exercised? How do original and relevant research questions emerge? Unfortunately, these questions are also difficult to answer. They already concern curricula of medical informatics programs and then especially how medical informatics research is practiced in our university institutes and in professional societies. In this respect, institutes and professional societies are likely to play an essential role in this good scientific practice. Their focus and organization must be repeatedly reviewed and adapted in this respect.*

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