

Where to in the Next Ten Years of Health Informatics Education?

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Summary

Objectives: To explore whether education in health/medical informatics^a should continue to evolve along the lines pursued since the early seventies, or whether a change is advisable.

Methods: Roots and key resulting characteristics for European and US American approaches HI education are identified. In Europe holistic approaches based on a synthesis of medicine and informatics (= computer science) with programs ranging from vocational training through university programs to doctoral and post-doctoral programs were characteristic. The US American approaches emphasized the higher levels of education and a diverse selection of specialized subjects. Changes in health and health informatics are summarized.

Results: Two types of changes are identified: high-tech applications arising at the interface of imaging, robotics, and the -omics (genomics, proteomics, metabolomics), and invasive applications centering on consumer health informatics and a move from curative to prospective health care.

Conclusions: It is proposed that curative medicine is adequately served by current educational approaches, but that the move towards prospective health care requires a move towards education and change management for health professionals and health informatics professionals.

Keywords

Medical informatics, education, prospective medicine, historical aspects

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1. Introduction

Educational programs in the area that we nowadays refer to as medical informatics or health informatics are well established. In some cases, in particular some initiatives in North America, the conceptual roots for such programs lead back more than thirty years [2]. Activities spearheaded in Europe led eventually to what we now know as the International Medical Informatics Association (IMIA)^b. This organization evolved from a ‘Technical Committee 4 (TC4)’ of the International Federation for Information Processing (IFIP)^c. The TC4 set up an international working group, T.C. 4.1 in 1969 with the aim to provide an ‘extension of medical, paramedical and administrative staff’s education in the field of data processing’ [3]. Related developments in Germany were strongly influenced by a conference that took place in 1973 and was based on several years of pertinent work leading up to it. A review of some aspects of the subsequent history has been published elsewhere [4]. But the comparatively long history of the evolution of our programs should raise the question, whether a continuation of evolutionary programs along the established tracks is appropriate, or whether there are, perhaps, circumstances that would suggest a change of directions and approaches.

In order to address these questions, I will try to characterize the evolution so far, in particular in Europe and North America. Subsequently, I will try to emphasize some recent

changes in the fields of health and informatics (= computer science), and then try to draw some conclusions with regard to our approaches to education in health informatics.

2. Where Do We Come from?

Looking at the programs for education in health informatics from the late sixties in the USA and the early seventies in Europe, some contrast is conspicuous.

2.1 The European Model

The European model arose from an effort to complement existing curricula – particularly in medicine and informatics/computer science – in such a way that people with competencies in “medical informatics” – a term that started to be used in Europe in the early seventies – would result. Related international efforts advanced in TC4.1 identified the competencies required for health professionals, such as doctors and nurses and administrators, and related educational needs at three levels of didactic competencies [3]. The work was based on two rounds of information gathering by questionnaire from 36 experts from around the world and set the scene for application-oriented education at different levels of demand from an orientation of essentially users of information processing technology, to the level of contributors to the advancement of system development. The volume also contains an interesting review of ten educational endeavors promoted at the time in Belgium, France, Germany, the Netherlands, the UK, and the USA in the form of brief sketches.

^a The terms health and medical informatics are used as interchangeable synonyms here in the sense of Shortliffe et al. [1].

^b <http://www.IMIA.org/>. Accessed 040720

^c <http://www.ifip.or.at/>. Accessed 040720

One year before publication of this book, P. L. Reichertz had organized an invitational conference in Germany, at which computer scientists and “medical informaticians” debated reasonable goals for and possible approaches to implementation of education programs in health informatics [5].

Overall, these discussions led to an integrated concept based on informatics and medicine as main components that can be envisioned in two dimensions:

- 1) from applied to theoretical, and
- 2) along an axis of increasing academic demand.

Consequently, the European developments included programs from the level of vocational colleges, through university education on to doctoral and post-doctoral level education. This axis of increasing sophistication has an analogy in the six-level model of health informatics applications proposed by van Bommel in the late seventies [6, 7]. This model layers health informatics applications, starting with input/output operations, and leading on to data storage, algorithmic processing, automated classification, modifying intervention – such as therapy – and culminating in research and scientific endeavors. It has guided the Dutch and other European educational programs and approaches [8, 9]. I am citing it here because in conjunction with the German models it lends support to the notion of a common holistic pursuit which characterized the European approach to education in health informatics.

Another interesting feature of the European developments is that, while much of the activities centered on introducing health professional students and health professionals to informatics, the seed was also planted for developing a new type of professionals specializing in health informatics, a profession that is sometimes referred to as ‘health informaticians’ or ‘health informaticists’ [10, 11].

2.2 The US American Model

The US American model arose from research initiatives of individual institutions and with support from the National Library

of Medicine [2, 3]. As a consequence, there is a dominance of emphasis on theoretical rather than merely practical advances, and of the doctoral and post- doctoral level of academic demand^d.

The question of an underlying common core was not addressed until about a decade after initiation of the first of these programs, in the form of a conference and subsequent publication sponsored by the Special Interest Group Biomedical Computing (SIGBio) of the Association of Computing Machinery (ACM) [12]. The recommendations resulting from this endeavor were, however, not directly translated into actual programs, even though the same group issued also recommendations for a “doctoral level program in medical computing” [13]. And it took until the late eighties, before programs with larger numbers of other than health professional students emerged at the undergraduate and graduate levels that evolved from the American programs for health records management^e.

In summary, the European approach was primarily holistic, based on an integration of computer science – usually referred to as “informatics” – and medicine. It catered to a broad undergraduate studentship with some of them eventually proceeding to higher academic levels. Early on, it resulted in moderate impact on medical education [14, 15], sometimes in the form of fairly sophisticated electives offered to medical students [16, 17], sometimes in the form of a common core of exposure to informatics offered to all medical students [18].

The education in the USA, in contrast, was dominated by highly specialized sophisticated education linked to a variety of disciplines, such as epidemiology, biomedical engineering, computer science in addition to clinical and theoretical medicine, and despite strong advocacy since the early eighties [19, 20], the impact on medical training and education continues to be comparatively slight [21].

3. What Is New

A lot has changed, of course, in the period of more than one generation since the late sixties and early seventies. But what of it is relevant to our approaches to education in health informatics?

On the side of information and communication technology, we have seen the emergence of highly integrated networked information systems. The advances in imaging technology, combined with simulation made precision approaches to radiation therapy possible. The genomics revolution brought among much else highly detailed patient-specific information within clinical reach that can be used to predict health risks from a variety of diseases as well as side effects of common therapies. Telematics and robotics allow executing minute surgical interventions as well as surgical interventions at a distance.

But we also have seen a popularization of computer-supported approaches that surpassed every imagination. This went along with an integration of imaging, video and communication technologies, and with an improvement of user interfaces, that puts “programming” within the reach of everybody. All this has led to the evolution of new areas such as consumer health informatics and telehealth. These new approaches may be even more important for what and how we teach in health informatics than the achievements referred to in the previous paragraph. The reason is that the former approaches are probably adequately served by the traditional models of education in health informatics, both the European and the North American version. The latter, however, require a paradigm shift and new qualities in education.

A case for the importance of the approaches subsumed under such labels as consumer health informatics can be made by a look at current threats to health. These are led by new infectious diseases such as HIV/AIDS, SARS, West Nile Fever, and lifestyle-related diseases, such as the growing tendency towards obesity and its complications and sequelae, such as Type 2 diabetes mellitus, hypertension, cardiovascular disease, myocardial infarction and stroke,

^d Compare, e.g., <http://www.nlm.nih.gov/ep/AwardsTrainInstitute.html>. Accessed 040719

^e Compare, e.g., <http://main.uab.edu/show.asp?durki=3397>. Accessed 040719

cancer, hepatobiliary disease, osteoarthritis, gout, etc. HIV/AIDS is a phenomenal threat arising at the intersection of infectious and lifestyle-related diseases. The consequence of this is a situation characterized by a continuing escalation of healthcare cost and concurrent increasing morbidity of our populations, i.e., a worsening cost-benefit relation. It is clear that this trend is not sustainable in the long run. A fundamentally different approach to health care is needed.

One sensible suggestion is to move from curative medicine to prospective health care. These concepts have been promoted very convincingly by R. Snyderman [22]. Snyderman paraphrases the curative approach as “find it – fix it”. After a health problem has occurred, every effort is put into correctly identifying it and resolving the problem on this basis. But the approach is essentially reactive rather than proactive. The interventions, which have gained in power as well as in cost, are provided in a fractioned delivery system that incurs redundancies as well as gaps in procedures, results, communication, etc. [22]. In addition, it is physician-directed in a fee-for-service environment, which provides little incentive for the reduction of the number of interventions and their cost.

Snyderman proposes a contrasting concept of prospective health care: This approach focuses on proactively identifying potential health problems before they arise and preventing their occurrence. “Predict it – prevent it – fix it” is the slogan for this contrasting approach, which – so it is proposed – could be realized in an integrated system of health care delivery that is interactive, involving the variety of health care professionals and in addition the “health-care consumer”.

This modified approach has, of course, profound implications for health information systems. The curative medicine model is based on a detective-like process that proceeds from a chief complaint via the components of history and clinical examination to laboratory investigations, diagnosis, therapy and the follow-up of therapy. The result is the patient record, and its electronic equivalents are the computerized patient record, the electronic health record, etc. This information system is designed to meet

the needs of the provider community. The subject of it all, the patient, is left in a passive, a “patient” role without active involvement.

The prospective health care approach, in contrast, is based on the accumulation of a health profile. This includes not only disease episodes, but comprehensive information on environmental and lifestyle factors relevant to health, as well as the increasingly relevant and increasingly available information based on the -omics (genomics^f, proteomics^g, and metabolomics^h). On this basis, a health risk analysis is conceivable that identifies risks arising from a number of factors, including genetic diseases as well as genetically determined abnormal reactions to drugs. The results can then be incorporated in a proactive health plan that identifies appropriate actions – foremost for the individual – but also for its environment and the health professional community so as to guide healthy behavior. A complex intervention to the way we live is the goal, one which makes us want to pursue a healthy life style.

There is at least one model where these concepts are in the process of realization: the Malaysian Telehealth Initiative [23]. Malaysia pursues an ambitious comprehensive vision of becoming a modern nation and a leader in the information age by 2020. This ‘Vision 2020’ⁱ is based on an aggressive plan including^j:

- electronic government;
- electronic design and manufacturing;
- “Smart Schools”;
- a multipurpose electronic identifier; and
- “Telehealth”.

The latter stands for a complete redesign of the health-care system under the label of telehealth that has [23]^k:

- a Lifetime Health Plan;
- mass-customized and personalized health information and education;
- continuing medical education; and
- tele-consultation as components.

This enumeration makes a number of characteristics obvious, which position the Malaysian model closer to prospective than to curative medicine: The Lifetime Health Plan has high priority and is compatible with the health plan proposed by Snyderman. Education components figure prominently:

- in the form of education for ‘health consumers’, i.e., ‘people’ at large,
- complemented by education targeting health professionals.

Education of people is geared to provide guidance to groups of people, such as diabetics, and takes individual characteristics into account – hence mass-customized and personalized health information and education. Interestingly, tele-consultation, the support of curative medicine through telehealth, is named last.

The entire approach is comprehensive and pursued for about a decade already. Comprehensive documentation is readily available^{j,k}. Therefore, it might suffice here to state that the Malaysian approach to telehealth is much more than merely support of the traditional curative approach through ICT. Conversion to prospective health care is at the core of the Malaysian approach. The concept is powerfully pursued in the context of the pursuit of “Vision 2020” in a prototyping environment that connects the capital Kuala Lumpur with the Malaysian International Airport, approximately 50 km to the south. This area, roughly 15 × 50 km, is called the Multi-media Super Corridor^j and contains nine universities and other institutions of higher education, Cyberjaya, the seat of “electronic government”, and Putrajaya, a modern ICT R&D city, as well as advanced traffic and telecommunication infrastructure. It looks therefore likely that the far-reaching goals will be achieved.

In summary, the Malaysian approach is an example of the realization of the prospective health-care paradigm in a comprehensive effort to modernize a national health-

^f <http://www.medterms.com/script/main/art.asp?articlekey=23242>. Accessed 040719

^g <http://www.medterms.com/script/main/art.asp?articlekey=16299>. Accessed 040719

^h <http://www.medterms.com/script/main/art.asp?articlekey=23519>. Accessed 040719

ⁱ <http://www.wawasan2020.com/vision/>. Accessed 040719

^j http://www.mampu.gov.my/EG/EG_MSCFlags.htm. Accessed 040719

^k <http://www.mdc.com.my/msc/flagship.asp#telehealth>. Accessed 040719

care system. This example provides an illustration of the type of impact that this new orientation in health care has on health information systems. And it is also a testimony of international consensus of leading health-care innovators on

- a new health-care paradigm;
- the organizational context for it; and
- a model for its realization.

What then are the consequences for health informatics and education in it?

4. Consequences for Health Informatics and Education in it

Prospective medicine has at its core a responsible involvement of the “health-care consumer”. In the extreme, this will mean that the “health-care consumer” will become his or her own antithesis: the health-care provider. Aided by knowledge about health risks facing him or her, in an environment that fosters health protection and preventive medicine, he or she can lead a healthy and happy life.

In order to support this vision, the focus of health informatics will have to shift from the provision of systems and services for and to health-care providers, to the provision of systems and services to everybody. These systems will have to be more integrated than ever. The traditional provider-oriented systems will have to serve health-care governance and health-care administration as well as providers. This requires integration beyond the currently common level. In addition, however, health systems will have to feed and to draw on personal health records and personal health plans. The latter will have to be integrated with the systems that everybody uses at work, for leisure and entertainment.

Undoubtedly, the new health-care paradigm will also lead to new professional roles. In countries like Canada, that have in recent years seen a turn towards telehealth – predominantly starting out as support of curative care through ICT – a new professional role arose in the form of the “telehealth coordinator” [24, 25]. This are persons with organizational and management skills that

are able to motivate for and promote the use of telehealth equipment. But it has been shown that clinical experience and skills are also highly desirable in order to handle the situations where persons with health impairment are assisted via telehealth.

A similar experience resulted from a project aimed at introducing a personal health record in the form of a web page for patients with identified risks, such as metabolic diseases, or states after invasive therapy for conditions like cancer, etc. The goal was to give the patient command over their health data and make them easily available to health providers through the Internet [26]. It turned out though that the abstraction of the health records in such a fashion that the patient was able to understand them – so as to truly be able to exert control over the data – was a major undertaking. Qualified physicians were required to fulfill this role of medical record abstractor.

Both examples, that of the telehealth coordinator and that of the records abstractor, can be taken here as mere indicators of the types of new roles that we can expect to emerge as we move from the curative to the prospective paradigm. Much of our work in recent years has also shown that the mere provision of the right information at the right time and place does not necessarily effect the desired changes. Comprehensive change management, motivation and education are necessary in order to achieve the changes. This, however, will mean that we have to strive beyond the traditional goals of creating computer engineers with an understanding of medicine and of health care, or of medical practitioners that are health informatics “literate” [21]. We have to include in our goals people that are “animators” – in the sense of the “animateurs” at ClubMed resorts –, i.e., educators, entertainers and leaders. And we have to build systems that support these in their tasks. We have to build education systems that people want to use, and we have to build health education into the systems that people use because they want to use them.

All this, however, means that we also have to extend the bases of the science pillars on which we build our education models and education programs for health informatics. Beyond medicine and infor-

matics, as in the old days, we have to include the cognitive sciences, education and pedagogy, and the social sciences in the subjects that we represent in our teaching. And the result should affect not only the education in health informatics, but must also affect the education of health professionals and lastly also the education of everybody. Health professionals have to be given not only certain levels of “literacy” with respect to ICT, but a thorough command of health informatics, health promotion and their integration into health services delivery by members of integrated, coordinated teams.

The education of health informatics professionals will probably have to be differentiated to cover more roles, ranging from the traditional engineer and/or architect of information systems to the educator and motivator advancing health through information and education systems. And the latter will also have to assume a key role in the design, development, deployment and management of the health educational systems for the general public, be that in the form of a personal health record, a lifetime personal health plan, or general systems for health education and motivation.

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