Medical Informatics – Challenges of Applied Information Technology in Medicine

Medizinische Informatik – Herausforderungen der Informationstechnologie in der Medizin

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In 1977, Reichertz has defined medical informatics from the viewpoint of information logistics: to provide the right information at the right time at the right place [1; 2]. The analysis of medical information and (bio-)signal processing contributes substantially to an improved information provision. Therefore, medical informatics is an applied science in the best sense of the word. The special requirements of the medical domain continuously promote innovative processes in computer science, e. g., we refer to the invention of expert systems in the context of medical diagnosis.

Almost 30 years later, medical informatics is still an emerging field of research and applications that aims at information logistics, but the process also continues beyond this goal [3]. Just providing information is not sufficient anymore. Since the amount of information available in electronic form is exploding, information selection must also be supported by medical informatics. Furthermore, information needs interpretation in order to gain knowledge.

Reflecting an intensive discussion in scientific literature ten years ago [4–8], Haux has defined the following grand challenges for research in health informatics [9]:

1. diagnostics ('the visible body');
2. therapy ('medical intervention with as little strain on the patient as possible');
3. therapy simulation;
4. early-recognition and prevention;
5. compensating physical handicaps;
6. health consulting ('the informed patient');
7. health reporting;
8. healthcare information systems;
9. medical documentation;
10. comprehensive documentation of medical knowledge and knowledge-based decision support.

Aims 1 to 5 consider a patient-centered treatment, based on sensor, signal, and imaging informatics. For recent reviews in this fields see, e. g., [10–13]. Tasks 6 to 10 aim at information and knowledge logistics, as defined 30 years ago. The major problem in this field of research is the determination and formulation of medical knowledge. The key question is *how* physicians interpret patient data, bio-signals, and images and whether computers can support or even take over (part of) this interpretation [7]. With respect to recent trends in public health, not only physicians,

but multi-disciplinary teams and the patients themselves form nowadays the target group of medical informatics. The answer to these challenges is based on a more fundamental question, i. e., what *is* medical knowledge and how can it be gained from patient data and medical information, formalized, managed, and adequately presented with respect to the different user groups?

For example, the actual trends in biomedicine strongly enforce innovation in medical informatics. There is an increasing importance of biosciences in the clinical context that deal with an extremely data rich and dynamically evolving domain. On the other hand, increasing economic constraints due to demographic trends and technological progress foster an improvement of clinical processes, quality management, sharing of resources by means of telematics, and the advent of evidence-based medicine. To face these challenges, methods and means are required for the communication and representation of new scientific results in the context of all day routine.

This special issue of *it – Information Technology* dedicates five invited papers to a variety of chal-

lenges of applied information technology in medicine:

- *Health Information Systems* play a key role in medical information technology, since these systems have not only spread across institutional borders but also essentially gained in functionality.
- *Telemedicine* is an important component of these systems, offering new possibilities for distributed health care processes. In particular, teleconsultation, teleradiology, telepathology, and telesurgery are emerging fields of research. The establishment of electronic healthcare records via national and international standards is another challenging task.
- *Information Retrieval* becomes more and more important, since databases become more and more interconnected and the volume of medical data stored electronically is continuously increasing. Consequently, medical informatics must provide methods and means to efficiently browse and retrieve the data.
- *Knowledge Management* is another challenge in medical informatics. Here, information technology aims at providing tools for externalization, combination, internalization and socialization of knowledge. Applications are authoring tools, computer-based learning or the support of basic research.
- *Bioinformatics* is one of such areas of basic research. In the past years, enormous efforts have been made in understanding the dynamics of life. However, these insights are still restricted to certain conceptual levels (genomics, proteomics, metabolomics). Based on information technology, integration of information extracted at the different levels will help to understand the mechanisms of cell dy-

namics at the metabolomic level.

Of course, the selected fields are incomplete but exemplary for the broad spectrum of medical informatics – a scientific discipline of systematic processing data, information and knowledge in medicine and healthcare.

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