Institute of Medical Informatics, Biometry, and Epidemiology

Chair of Medical Informatics

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Research Focus
• Process support through health information systems
• Medical ontologies and medical knowledge processing
• Evaluation of health information systems
• Analysis, assessment, and visualization of medical data
• IT-infrastructure applications for medical research
• Translational cancer research

Structure of the Division

The endowed Chair of Medical Informatics and the Chair of Medical Biometry and Epidemiology together constitute the Institute of Medical Informatics, Biometry, and Epidemiology within the Faculty of Medicine of the FAU. Furthermore, the Chair of Medical Informatics has a secondary affiliation within the Faculty of Engineering, the research group Medicine. The Chair of Medical Informatics has 20 staff members, with 15 of them being funded by research grants.

The research projects comprise the design and implementation of electronic medical records, the integration of clinical decision support functions into hospital information systems, the modeling and optimization of clinical workflows, data warehouse and data mining applications, concepts and architectures for intersectoral health networks, the evaluation of electronic information systems, the use of mobile technologies in medicine, and the design of IT infrastructures for clinical and translational research, especially the reuse of routine data for translational research.

Prof. Dr. H.-U. Prokosch who holds the Chair of Medical Informatics is (as Chief Information Officer of the UK Erlangen) also responsible for the university hospital’s routine operative business and its strategic information processing development.

Research

Process support through health information systems

One of the major challenges in the design, establishment, and management of Hospital Information Systems (HIS) is the intersectoral interoperability which is important to optimize the cooperation of the various health service providers across institutional boundaries in outpatient and inpatient care in order to deliver the best patient care. For an additional reduction of patient risks we integrate clinical decision support functionalities into health information systems. In its final consequence clinical information flow and communication functionalities shall also support the shared decision making paradigm and self-responsible patients.

The challenge of shared decision making processes and digital patient guidance has been especially tackled in the EU-project eHealth Monitor where innovative information and knowledge management technologies synergize to bring the most adequate information to physicians, patients, and their relatives.

In addition to such grant funded projects, the Chair of Medical Informatics also pursues and supports several innovative pilot projects embedded in the SOARIAN® hospital information system environment of UK Erlangen (e.g. a complete clinical cancer documentation embedded in a comprehensive clinical data reuse concept and the introduction of a nursing care information system).

Medical ontologies and medical knowledge processing

In our projects, providing knowledge processing systems in medicine always comprises knowledge modeling and the implementation of standardized knowledge modules for example to support drug therapy and drug prescription or to reduce patient risks within intensive care units (ICU).

In the BMBF project “Personalized Pharmacotherapy in Psychiatry”, the chemical structure and physicochemical properties of drug substances are included in the knowledge model. Based on this, a data- and model-driven software prototype for individualized, optimized psychiatric pharmacotherapy is designed, developed, and evaluated.

Within the patient data management system of an ICU, a CDSS (clinical decision support system) has been integrated to monitor dangerously low blood glucose levels with direct feedback as text messages on the DECT telephone for the calculation and trending of scores and for quality assurance measures supporting the DRG-based billing in complex ICU patients.

Evaluation of health information systems

When introducing new information technologies, it is essential to evaluate their effect on user satisfaction, work processes, and process costs to avoid adverse effects of these technologies on medical care. Successful use of IT in medicine may be hindered by negative user attitudes, user-unfriendly interfaces, and insufficient usability in general.

In numerous evaluation studies, we have applied methods, such as questionnaires, observations, thinking aloud, and cognitive walkthrough, to evaluate the acceptance and usability of different kinds of IT artefacts. When introduced early in the design and planning process, major success factors and barriers can be identified and properly dealt with.

Finally, within the project Prospective Health Technology Assessment (ProHTA), part of the cluster of excellence initiative, simulation tools to forecast the potential impact of future technologies and their potential return on invest even before development have been conceptually designed, implemented, and evaluated.

Analysis, assessment, and visualization of medical data

An increasing amount of data is documented electronically in clinical IT systems during routine patient care. To avoid information overload or overlooking of essential facts, appropriate and flexible visualization methods are required. Further, we start creating a learning health system by reusing such data for research projects. In cooperation with Harvard University Medical Center, the i2b2 (informatics for integrating biology and the bedside) platform has been integrated with the UK Erlangen Clinical Data Warehouse and enhanced with semantic ontology annotations as well as timeline-based visualization methods. It has been established as a research integration platform for several projects at UK Erlangen, but also within national collaborations.

Within the project “cloud4health”, we have developed a complex architecture with an integrated de-identification workbench for leveraging narrative text findings through cloud-based natural language processing, text mining, and
text annotation mechanisms and thus enriched our research data warehouse with information also drawn from unstructured text documents. In this context, I. Leb received the TELEMED 2013 award for her contribution "Secondary usage of structured and free-text data via cloud architecture conforming to data protection requirements" at the annual German Telemedicine Conference.

In the BMWF-funded IDRT project (Integrated Data Repository Toolkit), a suite of sustainable tools for the optimized extraction and querying of biomedical data was developed.

**IT-infrastructure applications for medical research**

Today, medical research is often pursued within networked multicenter structures which require efficient and safe IT-infrastructures. The Chair of Medical Informatics has designed and provided such web-based electronic data capture systems for many medical multicenter research projects, such as the Polyprobe Study, the nation-wide registry for chronic kidney diseases (GCKD), and the CONKO-O07 study on radiochemotherapy for pancreatic cancer. Current activities further comprise IT infrastructures to support biobanking and single source reuse of patient data for clinical research. The Chair of Medical Informatics is member and active partner in many projects and working groups of the TMF (German technology and methods platform for networked medical research) and leads the GMDS working group "Reusing electronic patient records for clinical research".

The architecture and HIS-integrated modules designed and implemented within the BMWF-funded project “EHR-based patient recruitment for clinical trials” have been applied in several clinical trials of the Faculty of Medicine and have shown to improve patient recruitment processes significantly.

Within the EFPIA-funded Innovative Medicine Initiative, we are partner in the EHR4CR project developing adaptable, reusable, and scalable solutions for reusing data from electronic health record systems for clinical research. The solutions are validated for different scenarios (e.g. patient identification and recruitment, clinical trial execution, adverse event reporting), across different therapeutic areas, and across several European countries.

**Translational cancer research**

A special research focus for the reuse of clinical data in research as well as for quality management purposes is the efficient IT support in the context of cancer care and translational cancer research. We have designed and established a comprehensive single source framework of IT components supporting tissue banking, multicenter cancer trials, cancer registration, and routine cancer care documentation. While interfacing the new cancer registry database of UK Erlangen’s Comprehensive Cancer Center with our EHR system, we designed a reference model for cancer documentation comprising a set of elementary documentation packages, related processes within patient care, quality assurance and research, respective information systems as well as interfaces to be established.

**Teaching**

The Chair of Medical Informatics is teaching medical students in the cross-sectional subject medical informatics, biometry, and epidemiology. It further offers medical informatics courses for computer science students of the Faculty of Engineering and has a considerable teaching part in the Master degree program Medical Process Management of the Faculty of Medicine as well as the Bachelor and Master degree program Medical Devices Technology of the Faculty of Engineering.

In this context, the Chair of Medical Informatics has mentored six bachelor theses, eight master and diploma theses as well as four doctoral theses in the years 2013/2014.

**Selected Publications**


**International Cooperations**

Prof. Dr. K.-P. Adlassnig, Medical University of Vienna, Vienna: Austria

Prof. Dr. E. Ammenwerth, UMIT-University for Health Sciences, Hall: Austria

Prof. Dr. P. Déguolet, Hôpital Étudiant George Pompidou, Paris: France

Prof. I. Kohane, MD, Ph.D., i2b2 National Center for Biomedical Computing, Boston: USA