Digital Libraries and Recent Medical Informatics Research

Findings from the IMIA Yearbook of Medical Informatics 2001

1. Background and significance of digital libraries

For centuries, libraries have played an important role in collecting and communicating knowledge. Originally, libraries collected hand-written or printed media. During the digital revolution, information technology became an important component of library work. First, the main emphasis was placed on cataloging the available media. Now, as electronic media become increasingly widespread, the vision of a "digital library" is beginning to emerge. This term includes the idea that the human knowledge, stored in electronic form, can be accessed quickly and easily from any point of the world at any time.

In the medical and health sciences, digital libraries offer completely new ways of exchanging up-to-date information about patients and medical knowledge to support patient care, patient information, and education. Outstanding examples of medical digital libraries are: the image databases of the Visible Human Project, the genomic databases of the Human Genome Projects, and the medical reference libraries of the National Library of Medicine. Those digital libraries have changed dramatically and will continue to change the way we work with medical knowledge.

2. The IMIA Yearbook of Medical Informatics 2001

The IMIA Yearbook has been published annually since 1992, by the International Medical Informatics Association (IMIA) and contains a selection of recent excellent papers on medical informatics research. The special topic of the just published Yearbook 2001 is "Digital Libraries and Medicine". Digital libraries have changed dramatically and will continue to change the way we work with medical knowledge. The selected papers present recent research and new results on digital libraries. As usual, the Yearbook 2001 also contains a variety of papers on other subjects relevant to medical informatics, such as Electronic Patient Records, Health Information Systems, Health and Clinical Management, Decision Support Systems, Education, as well as Image and Signal Processing. This paper will briefly introduce the contributions covering digital libraries and will show how medical informatics research contributes to this important topic.

Keywords: Medical Informatics, International Medical Informatics Association, IMIA, Digital Library, Yearbook
by Donald Lindberg, who is director of the National Library of Medicine in Bethesda, MD, USA, represents the perspectives of a leading developer of medical digital libraries and its contents. After briefly introducing the concept of a “digital library”, D. Lindberg discusses some of the most important challenges facing digital libraries. In his opinion, these challenges include, establishing methods and tools for acquisition, organization, storage and dissemination of digital information, using the Internet as a new means of sharing information, and considering new audiences for medical digital libraries such as patients and their relatives. He also sees important challenges in the sheer volume of biomedical digital data and the need to ensure its permanence.

Yu-Chuan Li has written a review on digital libraries in medicine. He identifies three main trends: the aggregation of digital data into useful collections of information, the virtualization of digital library services, and the two-way integration of digital libraries and electronic health records. In his opinion, the future challenges are not only technical, but also social and political in nature, such as standardization and copyright issues.

The special section on digital libraries contains six papers, introduced through a synopsis by Branko Cesnik. He begins with a historical overview of libraries from the traditional to the modern, digital libraries which now allow great savings in space and inexpensive storage of multimedia information. In his opinion, neither storage nor speed will be the limiting factors for digital libraries. In contrast to the conventional archiving of information, digital libraries have the potential to develop into a dynamic, changing and growing resource, which can help the clinical user access and use vast amounts of knowledge to support concrete tasks. In his opinion, digital libraries will play an important role in patient care in the future.

In summary, the most important challenges facing digital libraries, as discussed by D. Lindberg and B. Cesnik, are:

1. Digital libraries comprise a vast amount of partly unstructured information which must not only be collected, but also analyzed.
2. In digital libraries, certain terminological standards must be used when recording information in order to allow understanding and exchanging of information.
3. Information in digital libraries must be presented in a way which matches the needs of the users.
4. The quality and reliability of information in digital libraries must be guaranteed.
5. Digital libraries make it possible to address new target groups and to evaluate new forms of use.

To address these challenges seems an important precondition for the broader use of digital libraries. We next consider all papers of the Yearbook 2001 which deal in certain ways with digital libraries and will discuss how they contribute solutions to the above challenges.

### 3.1 Analyzing massive amounts of partly unstructured information

In his article, JA Goldman presents a technique for data mining text databases. This supports the automatic search for specific patterns or distributions in texts (“knowledge discovery”) and therefore supports the analysis of unstructured or partly structured texts.

The article by SB Johnson discusses an approach for representing semantic information about words and phrases extracted from existing UMLS sources. This approach taken by natural language processing programs can support the analysis of medical narratives.

### 3.2 Terminological standards

NF de Keizer presents a framework for the description of terminology systems. With the help of this framework, five clinical terminologies are described. The detailed understanding of the structure of terminologies is a precondition for constructing, comparing and evaluating clinical terminologies.

AL Rector analyses the most important problems facing clinical reference terminologies in his article. He presents ten reasons why standardized clinical terminologies are still not in broad use. For example, the conflict between standardization on the one hand, and

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Fig. 1 Sections and main authors of the 41 papers contained in the different sections of the IMIA Yearbook 2001 (including the special section on Digital Libraries). Papers contributing to research pertaining to digital libraries are set in italics.
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WT Goossen presents the development of a Nursing Minimum Data Set (NMDSN) for the Netherlands. In his opinion, those minimum data sets are a precondition for the systematic collection of patient-related care data, which case, reporting concepts are linked to external vocabularies, such as the UMLS. He promotes the use of open standards, such as SGML, as an important step towards universally comprehensible structured reports.

patient-centered individual documentation as the other are mentioned. He stresses the necessity of validating reference terminologies in routine use.

CE Kahn describes the use of SGML to encode medical observations, in which case, reporting concepts are linked to external vocabularies, such as the UMLS. He promotes the use of open standards, such as SGML, as an important step towards universally comprehensible structured reports.
### Table 1: Continuation.


3.3 Presentation of information in a user-dependent way

R Pagesy presents an approach to support finding relevant information from the diffuse data in the Internet and to return that information according to the specific needs of a user. He demonstrates his approach by presenting an adaptive hypertext system for knowledge navigation.

R Jones examines the usefulness of a personalized computer based information system for cancer patients. In addition to general information, this system also offers, personalized information which directly refers to information taken from the medical record of the user. System evaluation results show a high acceptance of personalized information.

LA Lenert describes an Internet-based approach to patient decision support which has been developed for patients with benign prostatic hypertrophy. This service does not only present general information, but also calculates the probability of the success of certain therapies, depending on patient specific data. He promotes his approach as an important step to integrate patients in the medical decision support process.

3.4 Guarantee the quality and reliability of information

C Pandolfini examines the quality of free medical information in the Internet. He uses a checklist to compare websites related to the home management of cough in children with current sources of medical knowledge. He finds incomplete and even wrong information and therefore demands strategies for the validation of online medical information.
J.-A. Choi presents an evaluation of the quality of prescription drug information of six consumer drug information databases. He finds significant differences between the available databases, both with regard to content and quality. He proposes to make health care professionals aware of the quality of information provided.

3.5 Address new target groups and new usage forms

PJ Murray analyzes available nursing e-journals in the Internet using a taxonomy of nursing e-journal models. He advocates the development of innovative and interactive nursing e-journal technology and their further specialization on specific topics.

In the article by DH Gustafson, the impact of an Internet-based information resource for HIV patients on the patients’ quality of life and on self-care is presented. The results show that such a tool can improve the quality of life of the patients and allows a more efficient use of available health care resources.

P Golland presents an anatomy browser which allows the visualization of three-dimensional surface models. The browser offers the user rich interaction possibilities. The tool has explicitly been developed so that it can be used on normally equipped client computers and, therefore, is well-suited to be used for medical education.

4. Discussion

The two most important factors influencing the usefulness of digital libraries will be:
- the quality of information stored in the digital library and
- the quality of access to this information.

The content of the IMIA Yearbook 2001 demonstrates that medical informatics research can contribute in a variety of ways to reach the necessary quality. Major results can be expected from research on medical terminology, knowledge processing, as well as methods and tools for the Internet. The broad availability of the Internet is an ideal platform for providing access to digital libraries. Due to the large amount of medical knowledge and the diversity of various user groups, developing effective digital libraries in medicine is particularly challenging. Especially, since the user groups have very different levels of medical knowledge and skills. Therefore, it can be expected that medical informatics research will contribute considerably to the development of digital libraries in general quite beyond its medical horizons.

In addition to this exciting topic, the IMIA Yearbook 2001 impressively represents the considerable versatility and quality of current medical informatics research. Evaluations of medical informatics tools and methods can be found in all of the other sections: health and clinical management, computer-based patient records, information systems, image and signal processing, knowledge processing and decision support, and education. The variety of topics reaches from speech recognition to automated anatomic labeling and clinical practice guidelines. A detailed list of all papers is provided in Table 1.

Outlook

The next IMIA Yearbook, 2002, will appear in March, 2002. Its special topic will be “Medical Imaging Informatics”. For the first time the main sections will be completed by a new main section on “bioinformatics”. The preface will be written by Nicholas A. Yache (France). International researchers have already agreed to write reviews about dedicated topics such as organizational issues, standardization issues, and brain imaging informatics. Up-to-date information about the current and future issues of the IMIA Yearbook 2002 is available at http://www.med.uni-heidelberg.de/mi/yearbook/index.htm.

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