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Commentary

A Comment on the Help-System: A Program for Medical Decision Making from the Early 1970s

Reflections on H.Warner et al.'s paper:
HELP – A Program for Medical Decision-Making

Introduction

Reading an early scientific paper in medical informatics as the one by Warner, Olmsted and Rutherford [1] is both thrilling and useful when trying to understand the historical development of the relatively new scientific area of medical informatics. The formation of the area of biomedical computing started in the 1960s [2] and still important aspects of the characteristics of medical informatics as a scientific discipline and its relations to other subject areas, such as biomedical engineering and computer science, are still being discussed [3]. When thinking of lessons learned over the past 30 years of biomedical computing, the HELP system is probably a very good choice of study material, since the HELP system has incorporated applications and methods that span nearly the full range of activities in medical informatics [4,5]: biosignal processing, patient monitoring, computer-based patient records, decision logic and decision support, medical terminology, system integration, evaluation and assessment, etc.

Obviously, the article mirrors the technology of the early 1970s in the way that the method and result parts are "bits and bytes oriented", reflecting the desire to report low-level details of program implementation. But more interesting is, of course, the underlying problem which the developers of the HELP system tried to solve; time seems to have had little impact on its relevance. On the contrary, the introduction and parts of the discussion of the paper still seem highly relevant, which at the same time raises a number of questions: why do we still have the same basic problems to solve, what has happened since the early 1970s, were the expectations at that time set too high, which problem areas were underestimated, and which sub-problems have been solved?

In this commentary we will try to identify some problem areas which we believe are fundamental both to the HELP system and to the medical informatics community as a whole. We don't claim that the problem list is in any way exhaustive, nor that our comments take all relevant aspects into consederation, but we do make some comments from our own experience about what we think is still today a highly relevant piece of work.

Problem Areas

Information and Decision Support in the Clinical Setting

"The rapid growth in useful medical knowledge has made it increasingly difficult for a physician to stay abreast of improvements in diagnosis and management of patients..." [1]. This statement concerning the information supply problem was true in 1971 and may be even more true today. The world of medicine has changed radically since the early 1970s. The scientific domain is expanding rapidly with a doubling time of 19 years [6,7]; this implies that the total amount of biomedical knowledge has tripled since the publication of the HELP paper. In 1971, about 217,000 articles were added to the MEDLINE database; in 1997, the number of articles per year had reached over 400,000. ICD-8, the classification of diseases, used in the early 1970s, contained about 4,000 codes; today, ICD-10 contains over 10,000 codes. SNOP, the coding system used to code discharge diagnoses in the HELP system, had four axes and contained approximately 10,000 codes. The first version of SNOMED, the predecessor of SNOP published in 1977, had six axes and contained about 39,000 codes; today, SNOMED 3.5 has 12 axes and contains over 150,000 codes.

Throughout the years, one of the primary goals of the medical informatics community has been to provide tools and methods for supporting healthcare providers in their quest for infor-

mation. Areas dealing with questions concerning information supply include decision support and expert systems, where the HELP system was one of the first of its kind, and also information retrieval, literature databases, and electronic medical record systems. Others within medical informatics have tried to focus on describing the information need [8,9] and the context in which the information need arises [10].

The information needed by health-care providers, ranges from patient data and scientific medical knowledge to logistic and social information [8], whereas most efforts have solely dealt with patient data or general medical knowledge. The sources used by health-care providers include journal articles and on-line retrieval systems, textbooks both on paper and CD-ROM and continuing medical education (CME) programs [7]. Journal articles are often considered hard to use for solving practice-related problems, due to high specialization, leading to low relevance for most patient care. Textbooks, although easy to use, quickly become dated and many widely used CME methods show little impact on physician performance [11]. Health-care providers claim that they have a hard time trying to find the information they need due to numerous problems, including sorting out relevant pieces of information and finding time to look for information [12]. The impact of the Internet as a source of information for health-care practice has yet to be determined, but will likely be significant.

Realization of Medical Decision-Support Systems

One of the major features of the HELP System is its data-driven decision-support capability. HELP was from the very start based on the view that "this system can only be effective when integrated with a patient-oriented computer-based medical record" [1]. That view then led to the construct of small and independent logical modules with triggering criteria, which each held a piece of medical decision logic with the capability of generating warnings and alerts with respect to specific patient cases with specific data characteristics. The logic modules' triggering criteria were expressed in terms of patient data entered into the system, e.g., the storage of specific symptoms in combination with a specific medical history. The intentions of the system developers were to make available both current patient data and up-to-date medical knowledge for the diagnosis and management of patients for a wide variety of medical problems. The challenge was at least threefold: (1) formalization and maintenance of a comprehensive knowledge base together with the realization of a problem solving or inference mechanism, (2) structuring of patient data allowing for automated processing, and (3) integration of various system components into an effective solution within the clinical setting.

The challenge of establishing a comprehensive medical knowledge base, covering in principle every clinical domain, has been shown to be much more problematic than the early papers from the 1970s indicate, due to the complexity of the medical domain and the wide variety of information needs by different health-care professionals of different specialties [13,14]. Over the years, much effort has been invested in the search for a standardized knowledge-representation format, allowing sharing and reuse of knowledge. The experience with the HELP logic modules was one of the key factors behind the development of the Arden Syntax for Medical Logic Modules [15]. Our own group has been working with Arden Syntax in several application areas and reported on its usability, strengths and shortcomings [16-18]. One major obstacle when realizing data-driven decision support is the database and knowledge-base integration [19,20], which still awaits a standardized solution. In the HELP system, a centralized hospital information system, the data structures of the patient record, the monitoring systems in the intensive care units, and those within the decision-logic frames were developed uniformly. The problems of integrating knowledge-based systems or expert systems with the databases in the hospital information systems is one of the major reasons for the "failure of AI" in clinical applications [13,14]. Too many AI-systems were developed that left the issues of data integration aside, leading to incomplete solutions in the clinical setting, despite powerful knowledge-representation formalisms and inference engines. In the USA attempts are made to improve knowledge and data sharing through co-operation between Arden Syntax and HL7 projects [21], but the terminological problems concerning the formal, communicable description of medical data still remain to be solved.

Electronic Patient Records and Medical Terminology

A key area in the history of medical informatics is the move from a paper-based to a computer-based patient record. A 1998 held IMIA conference on the Electronic Patient Record in Medical Practice (EPRiMP) [22] highlighted that fundamental research issues still exist. The HELP system is one of the most comprehensive electronic medical records (EMRs). The data in HELP are drawn from different hospital departments and cover a wide range of functional types [4]. Almost all data in the HELP system are encoded in PTXT, a strictly hierarchical medical terminology developed within the LDS hospital [23]. Although of fundamental importance for the success of the HELP system within the LDS hospital, PTXT has not gained widespread acceptance outside the different HELP installations. The limitations of strict hierarchical terminolo

gies as abstracting systems for medical record keeping is well documented in the literature [23]. Traditional hierarchical classification systems have been developed with a specific purpose in mind and are not well suited for re-use, which becomes a necessity if the EMR should be used not only for direct patient care, but should support seamless care, overcoming health-care organizational barriers, provide health statistics reporting, and facilitate follow-up and medical audit. Advanced terminological systems, such as the GALEN terminology server [24], based on formal description of medical concepts and their relations, with support for sanctioning mechanisms for composition of complex medical statements from atomic ones, promise solutions to the problem of abstracting systems in the form of traditional classifications. However, unsolved questions remain regarding the degree of structure of the patient record, models for unambiguous representation of patient data, and how to facilitate structured data entry, based on a common terminology server [25-27].

Discussion

Initially, we asked some questions regarding the development of the field of medical informatics. The fact that we are still dealing with the same research questions as those described in the 1971 HELP paper may be due to many reasons. One could be developments within the domain of medicine. A rapidly expanding biomedical knowledge base resulting in a high degree of specialization, places new demands on the methods and information systems that we try to develop in the field of medical informatics. These demands are more complex than those formulated 30 years ago. The developments in the field of information technology and the new possibilities this brings, also increase the demands on the medical systems.

Another reason may be an underestimation of the complexity of medicine, together with the initial optimistic beliefs about artificial intelligence and computer science as well as early successes in other fields such as administration and finance.

Even though not many problems have not been completely solved, several steps into the direction of better information management in health-care organization have been made. Our understanding of medical information management from a technical, organizational and practical point of view has increased together with understanding of the cognitive processes behind medical decisions, and the social context in which health care is being practiced.

In systems development, there has been a trend from centralized towards decentralized systems and now, perhaps, back towards a more centralized view, based on the middleware paradigm. The centralized systems were considered too rigid and unable to suit the specific needs of each specialty. The decentralized systems developed more recently have posed other problems, especially in the communicating of information between systems.

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