

Medical Expert Systems: You Won't Work without Them Once You Know Them

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***Abstract.** Enormous advancements in the field of medical expert systems have taken place in the last few years. Determining the most appropriate system for a given setting has become a time-consuming and complex task for the physician. In order to provide physicians fast and easy access to a specific system, our department developed a web site whose purpose is to serve as a comprehensive source of information for physicians, students, and other healthcare professionals, by providing data about more than 65 medical expert and knowledge-based systems available on a worldwide basis.*

1. Medical Expert Systems: The Physician's Silent Partners

Our web site will be a unique collection of more than 65 state-of-the-art medical expert and knowledge-based systems.

An expert system is an Artificial Intelligence program that uses knowledge to solve problems that would, under normal circumstances, require a human specialist. Expert systems are one of the most successful commercial applications of Artificial Intelligence and are used in several areas. In medicine, expert systems have been developed to assist physicians in a hospital or at the practitioner's office for interpreting medical findings, providing diagnostic support and therapeutic advice, suggesting the prognosis of disease, guiding patient management, and monitoring hospital and patient medical data as well as costs.

Expert systems and knowledge-based systems in medicine help in the manipulation and application of expert medical knowledge. The growing complexity of the fund of knowledge makes the application of such systems indispensable. The quantity of current medical knowledge is such that no physician can access or memorize all the information he needs in daily practice.

Therefore, in an attempt to minimize the frequency of false diagnoses, physicians are looking for expert systems to corroborate their findings and/or highlight anomalies and errors. Provided that

expert systems are used correctly, they also reduce much of the repetitive and specialized mental effort made by treating physicians and enable them to devote time and attention to patient care.

A further reason why decision support technologies are becoming increasingly important in medicine is their benefit in terms of cost reduction. Expert systems permit dissemination of information held by a small number of experts. This makes knowledge available to a larger number of, and less skilled individuals, and also reduces the cost of accessing information.

Additionally, human expertise concerning a specific medical subject is not always available when it is needed. This may be because the knowledge in question is the domain of a small number of medical experts, who may not be in the right place at the right time.

Alternatively, the required knowledge may be inaccessible because it is distributed through a variety of sources and is therefore difficult to assimilate.

2. Medical Expert Systems: Struggling for Acceptance

Increasingly simple access to personal computers (PCs) is partly responsible for the growing interest in medical expert systems. The availability of relatively inexpensive powerful computers and easy-to-use software has made healthcare workers more familiar with machines, and physicians are now ready to accept computers in all areas of their daily life. The World Wide Web (WWW) demystified computers for many new users by providing physicians with relevant, timely, and specific information. As networks have grown and become more robust, academicians and healthcare professionals have learned to appreciate the use of PCs in the process of patient management, teaching, and learning.

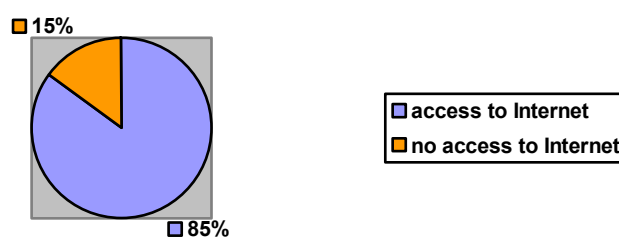


Figure 1: Internet access among physicians in Austria.

The results of a recent study [1] conducted in January 2001 provide concrete figures about the use of PCs and the Internet among general practitioners and internists in Austria. 85% of the surveyed physicians have access to the Internet while 1/3 of the rest are planning to be connected to it in the next six months (Figure 1). Whereas 48% reported that they were properly informed about the possibilities offered by the Internet, nearly the same percentage, 46%, wished to get more information about the Internet and healthcare-related web sites (Figure 2).

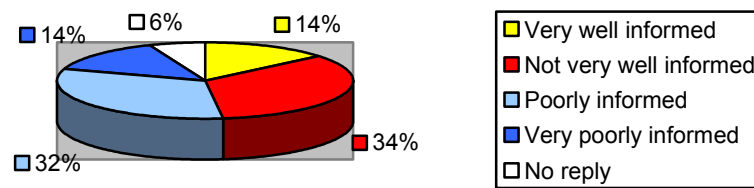


Figure 2: Level of information about the possibilities offered by the Internet.

The study revealed that physicians spend ten hours per month looking for information on the Internet.

Although the use of computers has rapidly increased over the last few years, medical expert systems are not yet in widespread use for the following reasons. In recent years a variety of programs designed to assist the physician in drug dosing, health maintenance, diagnosis, and other clinically relevant decisions have been developed in the medical market. Determining the most appropriate system for a given setting has become a time-consuming and complex task. Physicians in Austria who are interested in the application of computer-based decision support for clinical medicine reported similar problems.

No single search engine covers all of the information available in the Internet; therefore it may be necessary to use more than one. Moreover, most search engines furnish minimum information about a site and its contents, and sometimes prioritize information according to financial remuneration. Therefore it is advisable to try out several search engines. However, in most cases physicians are not familiar with the web and the use of search engines, which makes it nearly impossible for them to determine the appropriate expert system.

For these reasons, the systems in use thus far have failed to gain widespread acceptance among physicians. To cope with their needs, our web page will offer health professionals better access to a fund of information resources and expert systems, and thus enable them to provide more effective patient care.

3. The Purpose of the Web Site “Medical Expert Systems—The Physician’s Silent Partners”

The web site “Medical Expert Systems—The Physician’s Silent Partners” was developed to provide the health professional with a brief overview of a variety of expert and decision support systems and to serve as a guide to accessing the growing number of such programs.

Today the Internet is revolutionizing health care by offering a wealth of information and resources about health, health services, and products. There are currently as many as 25,000 sites online that offer information on health and medical care, and hundreds of thousands of Web pages dedicated to

a wide range of topics. As of July 2001, for instance, there were 683,000 web pages related to general diabetes and 181,000 pages specifically concerned with diabetes mellitus. As a result, consumers with the time and skill to filter through this plethora of information have the opportunity to be as well informed about specific diseases as health professionals.

The purpose of this web site is to serve as a comprehensive source of data for physicians, students, and other healthcare workers by providing information on more than 65 state-of-the-art clinical expert and knowledge-based systems. The web site is a unique collection of expert systems available on a global basis, designed to give physicians the opportunity to obtain fast and easy access to a specific program.

Because of the large number and variety of expert systems, it is important for a healthcare provider to understand that the programs have different purposes and functions, and that some may be more appropriate than others.

Some expert systems focus on a specific disease or therapeutic field:

- The Heart Disease Program (HDP), for example, is a large diagnostic program developed to assist physicians in the diagnosis of heart disease, particularly conditions that lead to hemodynamic dysfunction and heart failure [2].
- IMM/Serve is a computer program that implements clinical guidelines for childhood immunization. Currently it produces recommendations for childhood immunization with regard to seven vaccine series commonly administered to children [3].
- HEPAXpert is a medical expert system for interpretive analysis of hepatitis A and B serology findings. Without additionally consulting the patient's medical history, biochemical, or other clinical data, the program permits the laboratory that carries out the serologic tests to automatically produce a written interpretation, which helps the referring physician to better understand test reports, which are usually rather complex [4].

Other expert systems address various therapeutic fields:

- DiagnosisPro is an interactive decision support software that provides differential diagnosis in the fields of general internal medicine, family practice, pediatrics, geriatrics, and gynecology [5].
- GIDEON is a computer program for diagnosis and reference in tropical and infectious diseases, epidemiology, microbiology, and antimicrobial chemotherapy [6].

Still others are available on various devices (PC, Palmtop):

- One example of this feature is PEPID, which was designed for physicians, residents, interns, and medical students to present the essentials of management for virtually all medical and

drug problems encountered in emergency settings. As PEPID has been developed for use in emergency situations, it has a user-friendly interface. A simple “point-and-click” technique permits rapid assimilation of information. PEPID can be used on a palmtop as well, which makes it immensely flexible for the user. It enables the physician to access the program even in an emergency situation [7].

Some expert systems serve multiple functions and have incorporated applications and methodologies that span nearly the entire range of activities in medical informatics:

- One example of this category is the Health Evaluation through Logical Processes (HELP) System—a comprehensive knowledge-based hospital information system (HIS). It supports the routine application of HIS, including Adverse Drug Therapy (ADT), order entry/charge capture, pharmacy, radiology, nursing documentation, Intensive Care Unit (ICU) monitoring, and is also equipped with robust decision support functions [8,9].

The web site “Medical Expert Systems—The Physician’s Silent Partners” provides physicians with detailed descriptions of programs, links to the online version (if available), availability, pricing, clinical use, information about the developer, and evaluation statistics.

As the web site was primarily designed for physicians, we emphasized medically relevant data and skipped technical details. Special care was taken to provide a logical interface for easy exploration and navigation through the featured expert system. Physicians will have the possibility to choose the program they are interested in by naming it, or may decide on a specific field and choose from a list of relevant programs. Once the physician selects a program he will have further access to a detailed description of it. Information about clinical use and the developer can also be recalled. With the advent of the WWW, an increasing number of programs appeared in the Internet (e.g., HEPAXpert, DxPlain [10], the Heart Disease Program). Therefore, the web site will especially focus on the online/offline availability of the featured expert system. Categorization into the full version, demo version, and Internet version will be given.

The section “Historical Perspective” will present milestones in the development of expert systems and will give a short overview about the first trend-setting systems (MYCIN [11,12], de Dombals System [11,13], HELP [8,9]).

Healthcare professionals will also be given additional background information such as a list of upcoming scientific meetings and events, a link to the Austrian Chamber of Physicians, and links to other useful international medical sites in the Internet.

The web site will be accessible via the homepages <http://www.computer.privateweb.at/judith> and <http://www.akh-wien.ac.at/imc/mes>.

4. Conclusion

Physicians regard the Internet as a source of information about health and medicine. The e-health world still is a highly consumer-conscious environment. Identifying appropriate expert systems is not an easy task for most physicians. The web site described in this report is designed to facilitate the selection process for both, the healthcare provider and the medical researcher.

The Department of Medical Computer Sciences of Vienna, Section on Medical Expert and Knowledge-Based Systems, which has been developing expert systems for more than 25 years, predicts a bright future for the implementation of expert systems in everyday clinical use. To promote the popularity of such expert programs, we decided to include as many programs as possible and to make them jointly available in a single source, which, we believe, will gain wide acceptance among physicians.

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