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# HEALTHCARE INFORMATION SYSTEMS: A REVIEW OF ISSUES TOWARD RESEARCH THEMES AND AGENDAS INTO THE 21<sup>st</sup> CENTURY

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## Abstract

Healthcare information systems encompass a wide range of issues from many disciplines including medicine, computer science, management science, statistics, biomedical engineering and numerous others. In the natural progression toward use of computers in healthcare, researchers in this multidisciplinary field are examining numerous issues ranging from examining the potential of artificial intelligence applications to application of total quality management principles to healthcare. This paper discusses various issues in an attempt toward development of a first cut framework/taxonomy of research themes and agendas for MIS researchers.

## Introduction

Over the past few years, information systems have become increasingly important in healthcare delivery. The use of computers in a wide range of medical applications and healthcare management is one potential alternative to reducing the overall costs of healthcare delivery. Further, the use of sophisticated decision support systems is envisaged to improve quality of clinical decision making. While hospitals and other health organizations have information systems departments to handle and process the continuous flow of information, from patient to insurance data, and universities (particularly medical schools) are attempting to develop curriculum in healthcare information systems, research in design, implementation and use of information systems in healthcare has been somewhat limited to medical schools and healthcare providers. A literature review of mainstream MIS and Management Science journals clearly indicates that healthcare information systems research has not been accepted entirely into the MIS field. Thus, there is a need to identify and develop a framework/taxonomy of potential research themes and agendas in healthcare information systems. This would prove useful to MIS researchers in exploring various issues in this increasingly exciting and complex field. It is hypothesized that Healthcare information systems will increasingly become part of the general discipline of information systems. The framework of research themes and agendas will serve three key purposes:

- (a). provide an organizing scheme for identifying the various state-of-the-art research issues and topics in healthcare information systems that are relevant to the MIS field;
- (b). motivate MIS researchers and practitioners to play a more proactive role in this all important emerging field; and
- (c). identify the reference disciplines and opportunities for collaborative work.

Researchers can then build on each others' work and results to contribute to a cumulative body of research findings. Various research hypotheses can be formulated and tested in both lab and real-world settings. This would continue well into the 21<sup>st</sup> century and beyond.

## Healthcare Information Systems

Numerous books are being published in healthcare information systems and medical informatics to support recently developed curriculum in both areas ( Shortliffe et al., 1990; Tan, 1995). All of these activities are

part of the trend toward use of computers to support a wide range of healthcare related tasks. The rapid development and use of various computer applications by hospitals and other healthcare providers has resulted in many research questions and hypotheses relating to their development and use. This is the next wave of research opportunities for MIS researchers.

The following are some areas with which the field of MIS can associate itself for collaborative research work:

**Medical Informatics:** is the field concerned with..."the cognitive, information processing, and communication tasks of medical practice, education, and research, including the information science and technology to support these tasks (as reported in Greenes and Shortliffe, 1990)." Shortliffe offers yet another view of medical informatics as "the rapidly developing scientific field that deals with biomedical information, data, and knowledge, their storage, retrieval, and optimal use for problem solving and decision making." He further goes on to say..."medical informatics touches on all basic and applied fields in biomedical science and is closely tied to modern information technologies, notably in the areas of computing and communication (Shortliffe et al., 1990)." The core issues in medical informatics include the understanding and modeling of biomedical data and knowledge, their organized storage in data and knowledge bases and the flexible retrieval and inferencing from these. Greenes & Shortliffe (1990) have identified seven key research issues in medical informatics.

**Medical Computer Applications:** Rennels & Shortliffe classify medical computer systems as communication systems and advice systems - the former store, retrieve, and transmit bibliographic material, patient records and other data; examples of these include databases and picture archiving; while the latter participate actively in diagnosis or in management of patient care - these include consultation, monitoring and critiquing systems. There are whole new opportunities for MIS researchers to examine various development issues relating to these systems.

**Nursing Informatics:** according to Hannah et al., (1994), "nursing informatics would include, but not be limited to, the use of artificial intelligence or decision making systems to support the nursing process; the use of a computer-based scheduling package to allocate staff in a health care organization; the use of computers for patient and nursing education...."

**Hospital Information Systems:** modules within a hospital information system include admission/discharge transfer system - scheduling and registration; medical records system; laboratory information system - collection, scheduling, quality assurance & results reporting; pharmacy system - drug monitoring and dosing; and financial management system - reporting and billing ( Perreault & Wiederhold in Shortliffe et al., 1990). The concepts would also apply to community health information networks (CHINs). MIS researchers can play the traditional role and address various issues such as End User Computing, Outsourcing, Systems Development Methodologies, Information Resource Management, Strategic Use of Healthcare Information Systems and so on.

**Electronic Patient Record:** According to the Medical Records Institute, the electronic patient record is a "computer-stored collection of health information about one person linked by a person identifier." The institute further identifies five distinct levels of computerization for patient information systems:

\*Level 1: in this level, health organizations are still depending on paper-based medical records even though 50% of patient information is computer-generated;

\*Level 2: Here, the goal is to digitize the medical record and create an electronically available record; for example, paper-based documents can be scanned into a document imaging system;

\*Level 3: the electronic medical record is the upgraded version of the computerized medical record - the electronic patient record system can provide interactive aiding of the decision making processes by knowledge coupling, providing decision support, and many other functions;

\*Level 4: here, the electronic patient record combines several enterprise-based electronic medical records concerning one patient and assembles a record that goes beyond the enterprise-based retention period; and

\*Level 5: the more comprehensive collection of an individual's health information is the electronic health record.

The Decision Systems Group, a medical informatics and research and development laboratory at Harvard Medical School and Brigham and Women's Hospital focuses on development of software environments and tools that support the work of healthcare professionals (physicians, nurses, and other practitioners), as well as their education and training. Their key areas of interest include distributed component-based software architectures, knowledge representation of medical concepts, multimedia, clinical image manipulation, pen-based computing and structured data entry.

The Applied Informatics program at Columbia is attempting to use the National information Infrastructure to coordinate healthcare for patients across multiple encounters, providers, and settings. The project proposes to link and expand the electronic medical record among the participants, exploit automated clinical protocols, use wireless telecommunications to reach providers in patient's homes, and adhere to appropriate privacy and security measures. MIS research can focus on a variety of issues in wide area networks, clinical data transfer, automated protocols, wireless hand-held computing, patient kiosks and security issues.

The Duke University - University of North Carolina Chapel Hill Medical Informatics program highlights some research topics: development of clinical data and knowledge bases, and the presentation of information from these resources so as to positively affect medical decision making; applications of advanced image processing techniques to diagnosis and treatment planning; studies of the reasoning processes of clinicians and the impact of IT on patient care; and application of advanced IT to education in the basic and clinical sciences.

There are many models and methods in the MIS field that can be applied to healthcare information systems. These include Nolan's stages of growth, Rockart's CSFs, Porter and Millar's value chain concept, the Capability Maturity Model of the SEI and numerous others. The application of many of these classic models will help us understand better the complexities of healthcare information systems and the organizations that use them. Expertise and lessons learnt in client server computing, artificial intelligence and expert systems, and decision supports systems can be applied to analogous situations in healthcare. This would help in the smoother transition to sophisticated information technology.

Other research areas include studying the impact of information technology on the patient/provider relationship, the effect of IT on learning in health care organizations, developing cost-effective models and methods for implementing telemedicine and applied medical informatics projects, examining the potential for emerging technologies in continuing medical and patient education, exploring how IT can help reengineer medicine, the use of the world wide web for representation and retrieval of clinical information, virtual reality applications

## Conclusions

In the future a research framework/taxonomy of research themes and agendas in healthcare information systems for MIS researchers will be developed. Numerous previous articles have presented similar frameworks for research in the MIS field. The significant objective of this paper is to identify the various cutting edge research issues in healthcare information systems. As researchers start to develop models, methodologies and applications, and present hypothesis and results at conferences and in journals, we will find the acceptance of this emerging discipline in mainstream MIS.

References Available Upon Request

