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Medical Information Systems Use in China: Organizational and Social Impact Factors

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ABSTRACT

This paper explores the impact factors within societal context in China for medical information systems related to patient health service, the quality of medical information and clinical decision making processes. We investigate the diverse arena of information technology development and use in the Chinese cross-cultural social context. The purpose is to provide a new perspective on medical information systems research by examining the social shaping of IT. Findings reveal the primacy of societal and cultural influences on successful use and development of medical information systems in China.

INTRODUCTION

Medical Information Systems

Patient care has become increasingly complex with the widespread use of advanced technologies in routine care. Healthcare providers must keep track of a staggering amount of information — and their failure to do so can have a detrimental effect on patient care. Medical information systems are a solution to this dilemma. A medical information system is designed to bring the management of patient data into the information age and replace the Medical Records Department of a medical institution, and support the acquisition, storage, manipulation, and distribution of medical information throughout the organization [Christopher, 1998]. The use of medical information systems by physicians significantly improves the management of medical information [Mazzoleni, 2003]. Medical information systems create an electronic patient record that facilitates the reporting, organizing, and locating of patient data.

The importance of system quality, information quality and systems success has been recognized by many researchers as key ingredients in developing a competitive advantage. New scales and measures, along with continued research into organizational/social effectiveness and user satisfaction are needed. Accordingly, documents found have been sorted using a model of IS Success (Figure 1) developed by William H. DeLone and Ephraim R. McLean.

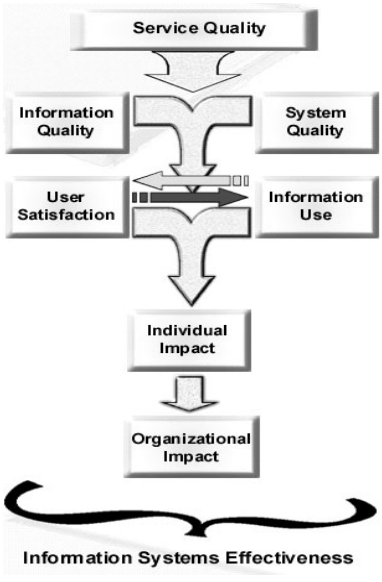
Medical Information Systems in China

China has been undergoing an information technological sea change in the late 1990s, and the effects will be felt far into the new millennium. Even though China currently lags behind many other countries in the Asia/Pacific region, its pace of development is breathtaking. One indication of the growth rate comes from the China Association for Science and Technology. There are approximately seven million PCs in China and over 500,000 internet users in a population of 1.2 billion people [Morgan, 1998]. Another is the rapid flow of Western development money into China. Several major computer companies recently announced to invest billions of U.S. dollars in information technological development in China.

For decades computer-based information systems have been developed and implemented in health care settings in China. A revolution is taking place in the heath care field with information technology playing an increasingly important role in its delivery. The 1990s have witnessed a shift from administrative systems to clinical information systems used by providers in delivering patient care. Further exponential growth is expected as the heath care industry implements electronic medical records, upgrades hospital information systems, sets up intranets for sharing information among related participants, and uses public networks, such as the Internet, to distribute health-related information and provide remote diagnostics via telemedicine.

The demand for IT is fueled by drastic changes in the health care industry and its approach to health care. While it is generally perceived that the health care industry's use of IT is 10-15 years behind sectors such as banking, the airlines and the manufacturing, that perception is rapidly changing. Today's health care providers in China, faced with an

Figure 1: Medical information systems success model.



unprecedented era of competition, are exploring IT opportunities in reducing the overall costs of health care delivery while improving the quality.

This paper aims to contribute to our understanding of the state-of-the-art in the implementation and development of the medical information systems in China. We seek to identify critical factors that influence the implementation and development of medical information systems in China, including the impact of the medical information systems on patient health service, the quality of medical information and clinical decision making process.

In the next section of the paper we review the current state of medical information systems in China. In particular, we examine the socio-cultural influences on the implementation and development of medical information systems in China.

CURRENT STATE OF MEDICAL INFORMATION SYSTEMS IN CHINA

Despite the demonstrated benefits of medical information systems that integrate all areas and functions of a health care delivery system into a network with a common computerized patient record, a recent survey of 360 acute care hospitals in China found only 9% of the hospitals had computerized all areas and functions [Mueller, 1997]. No hospital had integrated these separate computer systems into a network. Computer-based medical information systems have met with limited acceptance among physicians in China. There are numerous factors that potentially lead to poor outcomes and failure in medical information systems. Longitudinal, prospective, primary case studies and multidisciplinary investigation are required to evaluate implementation of medical information systems, quality of health care service, and resource use [Helfrich, 1989].

Societal and Organizational Factors

In the information sector, information infrastructure influences social, political, and cultural factors, as well as the Chinese economy [Tang, 1999]. These factors in turn influence Chinese Internet infrastructure [Tang, 1999]. Different countries adopt vary different policies regarding their information infrastructures. Societal culture — human value and ideology, information system management style, methods of operation and work environmental – is, to a certain extent, unique to each society, and has long been considered in the organizational and societal context within which the information systems are used. Moreover, political and health policy (e.g. privacy law, and health insurance regulations) are being given to societal factors which have influence on the use of the medical information systems.

Social and Financial Structures

Social and financial structures have the influence on the use and development of the medical information systems and providing effective care in China. Political and sociological conditions are causing a revolution in health care, advanced technologies promise to introduce changes even more radical. Heath care has long lagged far behind other industries in adopting information technologies. “The scale of health services has enjoyed rapid expansion.” However, much of the resources are concentrated in urban areas, and China faces several health challenges in this century, such as an aging population and growing medical expenses. The first objective for China is to provide relatively good quality services at a relatively low cost, and to strive to meet the need for basic medical services by the people.

In recognition of the critical importance that medical records play in the delivery of health care, the government called for the development and implementation of computer-based patient records (CPRs). Such a system will perform functions other than the traditional storage of clinical data. In addition, these information systems will be called upon to provide relevant data for review and reimbursement for patient care services, continuing medical education, health services research, technology assessment, and policy analysis.

Information systems are expensive. The decision to install a medical information system necessitates a choice of mechanisms to determine whether the system is need and once implemented, whether it is functioning properly [Ives, 1983]. Theoretically, the determination of information system value is a matter of economics: the costs of system operations and development are subtracted from the actual benefits (in improved organizational and social effectiveness) to obtain the net value of the system to the organization and society. In practice, however, this may not be a simple determination because (1) intangible costs and especially benefits of information systems are difficult to recognize and convert to their monetary equivalent; (2) some clinical decision support systems (e.g. a database supported by a user query facility) are used for disparate. Relatively unstructured, ad hoc decisions: objectively assessing the benefits of such systems may be nearly impossible: (3) data on system success may be determinable but not recorded by the organization, therefore, unavailable for research purposes.

Telecommunications

China’s recent double-digit economic growth has impressed the world, but its telecommunications sector has been growing faster than the economy as a whole, expanding at an annual rate of 30%-50% since 1989 [Mueller, 1997]. The Chinese government has implemented a hierarchy of responsibility on the networks making up the Chinese Internet while allowing a certain degree of competition and decentralized decision making. Chinese government is trying to impose stricter controls on content and access. In January 1996, China’s top civil authority, the State Council, announced regulations to consolidate the administration of all computer network building activities and international interconnections under four government agencies [PRC State Council]. In general, China’s reform-era Internet policy and regulation follow precedents set by its treatment of other media, which can be described as an attempt to balance gradual commercialization and modernization with controls protecting the communist party’s ideological and political dominance. China’s policy toward internet infrastructure is governed by the principles of promoting economic development and maintaining the state’s political and economic control.

China’s early computer networking efforts centered on research and education activities. But with the global internet fever of the mid-1990s, many government organizations have created their own proposals to build national computer networks for internal usage [Muller, 1997]. In large cities such as Beijing, Shanghai and Shenzhen, local groups and entrepreneurs are already taking advantage of dedicated national networks to provide local commercial internet access. The diffusion was encouraged by China’s relaxed regulations. According to the regulations, services can be provided by any qualified Chinese organization after registering with the MPT. Chinese organizations and businesses probably would have followed the model of competitive, decentralized development. But the central government issued two new sets of regulations designed to impose controls on the spread of China Internet.

Information Infrastructure

From a provider perspective, health maintenance organizations, which added millions of members in the past couple of years, need information to analyze the outcomes and costs of different treatment plans. Innovations range from routine hospital information systems to sophisticated AI-based clinical decision support systems [Raghupathi, 1997]. Simultaneously, in today China’s information intensive society, consumers of health care want to be better informed of their health options, and are therefore, demanding easy access to relevant health information. In this context, the Internet is playing a crucial role. The challenge lies in using various forms of IT to organize, store, and present health information in a timely and efficient manner for effective health-related decision-making. That means all health-related parties, including profit and nonprofit health care stakeholders, providers (like hospitals), payers (like insurance companies), employers, practitioners, public health officials, and educators must meet the challenge of addressing these new expectations.

Thus, the computer professional is concerned with the issues of how these changes would affect them as facilitators of IT applications, development and as consumers of health care. In the former, issues of

concern include design and development of applications, acceptance testing, integration with existing technology and standards, while in the latter they include confidentiality, ethics, privacy, security, and user-friendly interfaces.

Health Care Policy and Insurance

The most important aspect of the health care domain is a basic understanding of health policy from governmental, legal, and financial perspectives. Recently, for example, the Health Care Financing Administration issued several pages of guidelines about which medical events require an attending physician to be present, and which events the resident physicians can handle alone. In addition, the increasing amount of litigation has had a pervasive effect on which tests are ordered, referral patterns, and limitations on use of support personnel.

One of the important trends is the move toward a universal electronic patient record. It could be defined as electronically stored health information about one individual uniquely identified by an identifier [Raghupathi, 1997]. This entails capturing, storing, retrieving, transmitting and manipulating patient-specific health care-related data, including clinical, administrative, and biographical data. Its adoption is slow because of practical issues such as complexity, cost, security, confidentiality, and lack of standards. Policy and organizational issues can influence the archival, preservation, and future accessibility of electronic patient records and digital hospital documents. Without broad confidence in medical privacy, we know there are consequences.

Patients may avoid needed health care and physicians may not enter all information into patient records (or may even keep double sets of records). Local and national government have begun to recognize the myriad issues that need to be resolved to implement good practices for long-term access to digital health related information. In a few institutions and hospitals, they are beginning to work with information technologists, who can often help clarify technical issues and help seek promising solutions.

However, the prospective of storing health information in electronic form raises concerns about patient privacy and data security. While IT enables the use of technology to limit access to confidential information, it also introduces some real vulnerability. Unless proper controls and procedures are in place, these kinds of applications also invite unauthorized users to tap into the data. If the concerns are not sufficiently addressed, they can discourage the health care industry from exploiting IT and make health care consumers hesitate to share information. Therefore, IT application, development and use must be done in the midst of maintaining confidentiality, privacy, and security. Ethical issues must also be addressed.

Moreover, the increasing use of computers in medicine and health care, together with the approach of some form of national health insurance, presents an interaction between computers and people, and raises some important issues of interest to legislative and regulatory bodies. While still in the early stages, the dialogue between hospital archivists, electronic patient records managers, and hospital information technologists is beginning to develop across the country.

The application of any administrative or technical intervention to protect information requires an explicit policy defining what the appropriate use of information is and what is not. Such a policy should include as a minimum a statement of institutional philosophy and goals regarding privacy and security: a classification of information assets by type; standards for administering, controlling, and monitoring information system design, implementation, and operation; and a definition of procedures for detecting and handling abuses. Ultimately, security and privacy of health care information depends on ethics and an effective, supervisory and legal structure that provides sanctions against detected misuse.

User Studies

Several articles have explored the nature of cognitive styles and the effects of cognitive style differences on medical information system usage and design [Benbasat, 1978; Taylor, 1978]. In those articles some ideas are presented for clarifying the nature of cognitive styles, and a number of cognitive style models are discussed with are applicable to medical information system design and implementation. The authors suggested incorporate the users' cognitive styles differences (e.g. clinical decision-maker characteristics) into medical information system design and implementation [Benbasat, 1978].

The human decision-maker role in the system should not be neglected. Clinical decision maker characteristics are of importance in the use and implementation of medical information systems. Characteristics represented in the cognitive styles such as intellectual ability, attitudes, demographics (age, education, etc.) and cultural background are expected to figure prominently in the medical information systems usage and design.

The assessment of IT — aimed at the prevention of failures, so common in Health-care is a more and more important problem, particular as regards hospital/clinical information systems [Mazzorleni, 2003]. Spreading the HIS inside the medical centers is of interest. Recent studies on the use and acceptance of the HIS by the users (physicians and nurses) had been established by means of qualitative methodologies regarding to general information such as professional status, previous experience in use of PC, self-reported personal frequency of use of the system), aimed to the inspection of the constructs of perceived usefulness and ease of use of IT. The results indicated those users' characteristics such as learning and becoming skillful and the context such as frequent interaction have particular influence on the use of HIS regardless of age and inexperience [Mazzorleni, 2003].

Culture

Culture has to do with the many ways that people live together. The practice of haling lies at the core of human culture. Designs for the future of medical information systems need to preserve as much traditional culture as possible while also providing a high quality of care.

The slow or lack of acceptance overall by physicians in China may reflect the fact that medical information systems affect the structure and function of health care organizations, the quality of work life of providers within them, and ultimately the cost and quality of the health services provided. When the implementation of medical information systems interferes with traditional practice routines, they are not likely to be accepted by physicians [Anderson, 1997]. In China, physicians may be unwilling to abandon their traditional paper medical record due to the Chinese more cautious and conservative culture.

In the future, Chinese health care providers will need to interact directly with medical information systems in providing patient care in order to take full advantage of the ability of these systems to organize information and to support clinical practice. This will require physicians and other providers to change the ways they have traditionally recorded, retrieved, and utilized clinical data.

Public Health Education

There is a clear and increasing need for faster and more economical access to the world's largest collection of computer technical health related information, making a healthcare digital library available to IT organizations and clinical professional in China and having library made accessible through one or more hospital networks. Computerized information systems are introduced as tools to address the problems of information overload, human error, and roadlocks to evidence-based medical practice.

Organizational and Societal Change

In China, medical information systems provide major benefits in direct support of patient care: they are a vast improvement over the paper record in reporting, organizing, and locating medical information [Anderson, 1997].They can improve physicians' decisions by providing protocols, reminders, and alerts; and they can be designed to coordinate and manage patient care. This paper will examine the impact of medical information systems on the health care service within the societal context in which the information systems exist. Evidence will be explored and provided about the changes in the economy (e.g. standard of living, standard of patients' service), infrastructure (e.g. education, organization structure and workflow), health policy (e.g. human health

status, patients' disease record privacy, confidentiality), which lead to better quality and service to the patients.

The impact that information has on societal performance is difficult to isolate amidst many other factors. My study will investigate relationships between Medical Information Systems and qualitative measures, such as social/organizational structure, change, efficiency, responsiveness, coordination, flexibility, increased quality of decision-making, increased quality of work life, and attempt to measure societal impact by looking at the result of the Medical IS function, such as measuring the quality of patient health service.

Technology itself plays a key role, either leading directly to social change or acting indirectly to facilitate organizational change [Tyne, 1990-1993].These scenarios relate to two opposing approaches to technology and social change long identifiable in the literature. They are both causal and deterministic models based on the idea of thing "impacting" on another to cause change. The principal mechanism in such models is the interactions of groups and individuals acting within the constraints of their current milieu. Medical information systems alter traditional practice patterns.

The implementation of a medical information system affects professional relations between individuals and groups within health care organizations. Their response is shaped by their perceptions of how the computer system will affect these relations and the accomplishment of professional goals [Anderson, 1997]. An approach has been to use opinion leaders among physicians to change practice behavior. Personal contact is one of the most validated strategies in bringing about knowledge transfer and organizational change. In health care, this strategy is based on evidence that communication between physicians and opinion leaders is a key element in translating medical advances into practice. The results of the study suggest a "center-periphery" pattern of diffusion of new ideas and technology among physicians.

A second larger study investigated the role of communication networks among physicians on hospital services in the adoption and utilization of a computer-based medical information system [Anderson, 1987]. The findings of this study confirmed the importance of a central group of opinion leaders in the adoption and utilization of the hospital information system.

The widespread implementation of medical information systems will also alter the social organization of health care organizations. Most of these organizations are relatively decentralized, with individual departments and practitioners making decisions regarding patient care.

Health and Social Service

Colleges and universities, government agencies, and other organizations become increasingly create and use health related information resources in the digital environment in China. There is today a vast array of information available to those seeking answers to medical questions and health related information. Consumer-oriented health web sites, electronic medical record systems, and clinical databases offer unprecedented access to medical knowledge. The importance of accurate medical information continues to increase. In today's competitive environment, Health care enterprises must excel in user/patient satisfaction, quality management, outcomes analysis, clinical decision making and solution provision that enable healthcare organizations to maximize the potential of their healthcare information.

Telemedicine

Telemedicine can be broadly defined as the use of telecommunications technologies to provide medical information and services [Perednia, 1995].. Telemedicine especially benefits rural regions in China. For example, Chinese Medical Foundation developed a joint telemedicine program which allows local small hospitals (there has always been a paucity of health-care providers, especially specialists, in rural areas) connect with special hospitals in big cities such as Beijing and Shanghai for accessible and low-cost health care. Such small hospitals may not survive the chaos unless they align themselves with larger care centers in a community health-information network, a telemedicine network, or some other type of partnership. Therefore, it improves the quality and availability of care to patients in remote areas in China.

DISCUSSION

Today, medical information systems still face challenges. The U.S. is the largest developed country, and China the largest developing country. There are similarities in the pattern of disease in both countries, and there are differences as well. The two systems have radically different structures. The Chinese system is highly centralized, with the government overseeing all aspects of healthcare delivery, while the U.S. system is very diffuse. Yet both countries face similar demographic changes, such as increasingly aging population that must be cared for. And both nations face changing health care burdens. As medicine controls infectious disease, chronic non-communicable diseases like heart disease and diabetes become increasing problems.

The U.S. can learn form China's policy emphasizing prevention, which is a key strategy in controlling the growing health problems caused by smoking, poor diet, and sedentary lifestyles. "The payment system here pays for treatment, it does not pay for prevention.", even though prevention efforts can be more cost-effective than treating disease later on. In the U.S., the lack of comprehensive insurance leaves many people uninsured, and disparities in care exist across socioeconomic, racial, and geographic lines. For China, one of the main challenges is reaching its significant rural population, which has less access to care than those in urban areas. China can learn from the U.S. experience. "Some times it is good to be a few steps behind to wait to see the adverse effects or benefits."

China has made progress in medical information services from having practically none about fifty years ago. But the prevalence of various issues has also been rising rapidly, and much needs to be done to address the problems. We still have a very severe shortage of professionals (especially the combinations who have the knowledge in clinic expertise and medial information technology as well).

Substantially, China public policy, privacy laws and legislative issues must soon be addressed that will define the standards and safeguards that are to be applied to all health care information, not just that in digital form. They allow uncontrolled access to and exploitation of patient-identified health care information in parts of a developing health information services industry.

In the future, integrated medical information systems will be essential for the support of health care. Current trends in China will lead to accelerated growth of large heath care systems.

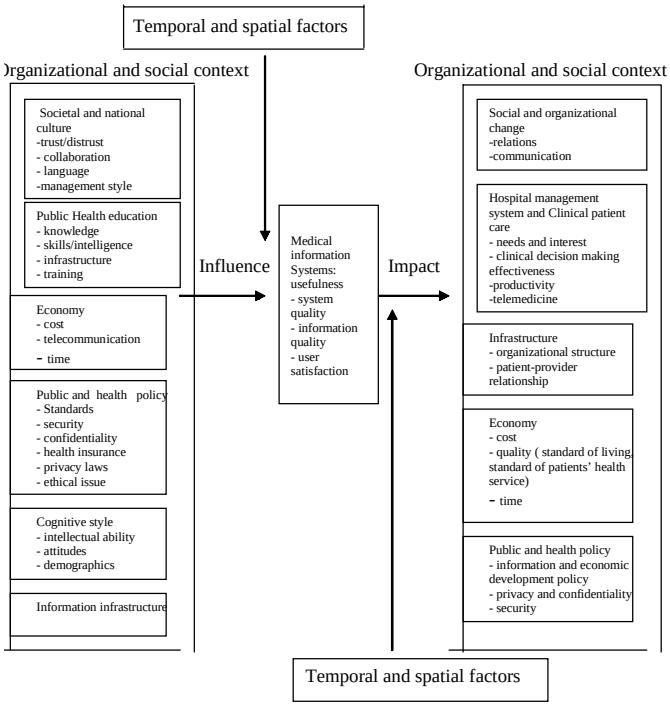
The successful implementation of information systems depends heavily upon integrating these systems into complex, organizational setting. Past experience suggests that efforts to introduce medical information systems into practice settings will result in failures and unanticipated consequences if their technical aspects are emphasized and their social and organization factors are overlooked. Information systems do more than enhance our ability to deliver health care. They also affect practice patterns and professional relations of individuals and groups within health care organizations. The experience with computer-based information systems make it clear the critical issues in the implementation of these systems are social and organizational, not sole technical.

One thing we can learn from a general perspective is that technology certainly has the potential to provide some solutions for the major challenges facing the business of health-care delivery and service. Whether or not technology will drive these changes is not the question. What is important is that how the technology can help facilitate the changes and how obstacles can be removed in the deployment of the technology.

FURTHER RESEARCH

Case studies of medical information systems use and development are needed to illustrate the influence of organizational and social context on medical information system development and the impact of medical information system on organizational and social context in China. Many existing information science challenges still exist. For instance, many hospital, clinics, and private offices in China do not have internet access or even local area networks because they have not yet found compelling reasons to invest money and personnel in these technologies. However, as the utility of resources such as the electronic medical

Figure 2. Influence/impact model of human, information and technology interaction



record and network-based information increases, medical institutions will likely increase investment in the needed network infrastructure.

There is exciting potential to improve the medical information systems in China to practitioners by the careful application of digital content, information science methods, and technology. The hope is that improved medical information systems will ultimately boost the quality of medical care delivered to patients in China. Progress in the use and implementation of the medical information systems is likely if professionals with medical and information science expertise work collaboratively on these challenges.

CONCLUSION

China has undergoing an information technological sea change in the late 1990s, and the effects will be felt far into the new millennium. The development and integration of medical information systems into modern China health care society is absolutely essential and inevitable for optimal health care, medical research, public health, and the operation of modern heath care enterprises.

As we move toward the era of computerized medical information systems, we must design the systems from the start to accommodate evolving policies and health care management technologies, and develop standards to integrate and administer computerized health information systems prudently.

These are exciting times for the health care organizations/ industry and IT. The integration of the two disciplines will revolutionize health care delivery in the decades ahead. It also opens up new areas for applications and research. I hope a broad spectrum of cutting-edge applications and research issues in medical information systems will stimulate further thinking and the exchange of ideas on this subject.

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