EVALUATING THE EXISTING INFORMATION-BASED HEALTHCARE SYSTEMS (A CASE STUDY)

R. A. Bhutto
General Manager, Consumer Sales; Pakistan Telecommunication Authority

K. R. Khoumbati
*Institute of Information and Communication Technology,
University of Sindh, Jamshoro, Pakistan*

M. S. Kalhoro
Institute of Physics, University of Sindh, Jamshoro, Pakistan

Abstract

Improving healthcare and staying healthy is one of the most discussed and important issues in our society. The adoption of Informatics systems in healthcare sector have very strong and successful endeavor for the provision of better healthcare services. Thus the focus of this study is to develop a deeper understanding of how, in an information-rich environment information systems can help to provide better healthcare services. The results of the study suggests that a consistent guidelines be developed and agreed across the board regarding the processing of health data, with specific clarifications regarding diagnostic notes, which emphasize and guarantee its protection and confidentiality, as well as unrestricted access by the patients to their own data. In addition to that potential technical knowledge difficulties can be overcome by ensuring that the application is both technically feasible and clinically acceptable. Further, all stakeholders (citizens, healthcare professionals and policy makers) must accept the introduction of healthcare information systems. The findings of this research may help the policy makers while taking the decision for implementation of information systems in healthcare sector.
Keywords: Evaluation, Information, Health informatics and Case Study

Introduction

There has been an explosion in knowledge and information management activity, particularly in healthcare sector over the past few years. Typically, hospitals and medical schools have started employing doctors having computer and automation skills. These institutions have also acquired sophisticated information systems to store and retrieve accumulated knowledge. Health informatics includes several components such as telemedicine, tele-education, telematics for healthcare services management and research (Khoumbati *et al.,* 2007). There are four areas where health informatics is playing an increasing role in healthcare development: a) administrative, b) education and training, c) quality improvement and d) the improvement of efficiency of health care services.

The world has progressed a lot in the field of healthcare by making extensive use of information-base systems (Anonymous, 2000). This has not only made the whole healthcare system (learning and curing) but has benefited tremendously

the doctors and patients to mutually enhance the performance of healthcare management (Southard, 2000). Throughout the world, healthcare professionals often lack knowledge of the possibilities and limitations of systematically processing data, information and knowledge for resulting impact on quality decision-making. They are often asked to use information technologies of which they have limited appreciation, in order to enhance their practices through better use of information resources (Alshawi *et al*., 2003).

However, for systematically processing data, information and knowledge in medicine and in healthcare, healthcare professionals who are well-trained in health informatics are needed (Austin and Boxerman, 2002). Unfortunately the public hospitals and medical colleges/ schools in Pakistan not have the overall focus and seem to be badly lacking to develop a deeper understanding of how, in an information-rich environment can bring a revolutionary change and bring a radical betterment in whole system (Bemmel, 1999). The management of these institutions is either slow in defining policies or loose vision to study both technological and organizational/managerial challenges associated with introducing health informatics into the enterprises. 'Health informatics' is now tending to replace the previously commoner term 'medical informatics', reflecting a widespread concern to define an information agenda for healthcare services which recognizes the role of citizens as agents in their own care, as well as the major information-handling roles of the non-medical healthcare professions (Irani *et al*., 2008). The aim of this independent study is to examine and measure the current views, awareness, and management strategies for the implementation of information systems in the one of the top universities in medical sciences and its affiliated hospital. This paper now proceeds to provide a brief discussion on the theoretical basis for this research is provided in Section 2. Section 3 provides a brief discussion about the research methods. In section 4 the two case studies are presented. In moving forward the data is analyzed in the section 5. The findings are presented in Section 6. Finally, conclusions are presented in section 7 following the implication of this research provided in section 8.

Research Model

Medical informatics has both an applied and a theoretical dimension. These two aspects of the discipline have expanded dramatically during the last decade, and will continue to do so in the years to come. We are witnessing a radical change as technologies that primarily support administrative processes are augmented with systems that address the core of medicine: patient care in emergency, indoor setting, disease prevention and health promotion, rehabilitation, and home care. Computer-based patient records and electronic communication will be the most visible developments in the years ahead. Therefore the attempt is to asses the

current use and adoption readiness for health informatics, to identify the true barriers, and to analyze the sources for the targeted investment.

The preliminary questions to be tested in context of contemporary applications of techniques and recommendations conceded with particular reference to "Telemedicine 2010" vision which is taken as reference model in this study. The "Telemedicine 2010" is found to be a comprehensive model which gives an overall action plan by covering all important parts of informatics systems in healthcare. The salient features of "Telemedicine 2010" vision are (Anonymous, 2004):

- Empower citizens and patients (e.g. choices based on knowledge, interactivity, and participation in decision-making processes).
- Improve and support equal access to care (e.g. continuity of care, deinstitutionalization, tele-home care, second opinion, specialized care).
- Build capacity for health professionals (e.g. access to knowledge databases, second opinions, education and training).
- Increase quality and cost/efficiency (e.g. shorter waiting lists, safer prescription, diagnostics and treatment, shorter stays in healthcare institutions).
- Reduce burden of travel for patients (e.g. remote monitoring, second opinions, and referrals).
- Support decision-making by improving information systems and surveillance (epidemiology, access to databases).
- Keep pace with and make use of the infrastructures that will be provided by other sectors, i.e. eGovernment, eBusiness, and eLearning. Otherwise, expensive duplication, loss of time and missed opportunities to improve health services may be the result.
- Overcome substantial barriers of a political, professional or economic nature. Health requires a different and more modern approach to healthcare provision, with new roles for the professionals and greater empowerment of the individual citizen.
- Promote and foster the worldwide standardization and interoperability of applications and systems.

Research Methodology

The research methodology of this study is designed simply and precise to cover explicit aspects related to importance and use of information as a capital asset employed for ensuing best practices, efficiency enhancement and ultimately developing an enterprise integrated system in which all data and processes are put into unified system. In a qualitative research, popular data collection techniques include: surveys, literature review, content analysis, interviews/

discussion sessions and participant observation techniques. In terms of data collection, conducting interviews is being considered as a primary process, as interviews provide in-depth information about particular questions. It has been described as verbal confirmation or disconfirmation of observation or any formal informal or causal answers to a question constituting an interview.

The overall focus of this study is to develop a deeper understanding of how, in an information-rich environment, policy workers assess whether they have enough vision and information to cater the needs of modern medical informatics which envisage efficient way for learning and well organized resourceful way of healthcare. Understanding such situation is a critical element that in fact is backbone of this whole exercise. This developed an impetus and motivation for adopting "constructivism" method in this study. For producing a good piece of work, a broad procedure is adopted keeping focused direction for precise aspects of investigation with the aim to achieve the best outcome from the research work.

For data collection multi-methods approach is followed containing interviews, observation, and documents (books, journals, records, annual reports, news and publications) because it is necessary to see the things from different perspectives. Primary data were derived from in-depth, open, structured and semi-structured interviews. In the initial interviews, questions were asked relating to the role of individuals, backgrounds of hospital and general facts about hospital that were not found through other channels (e.g. website material). These questions were open-ended, to acquire as much information as possible and not restricting the respondent in any way. Semi-structured interviews were carried out using the interview agenda.

The analysis is mainly aimed on qualitative issues.

The data in this study is collected through different means which includes:

1) A review of literature on medical informatics and importance of knowledge management in healthcare sector.
2) Empirical research is based on a convenience sampling. The samples were mostly chased at their work places; the data is collected through discussion sessions at five different times & personal face-to-face interview with Vice Chancellor and Medical Superintendent of Dow University of Health Sciences and Civil Hospital Karachi respectively.
3) The population is professors and senior faculty members of Dow University of Health Sciences and Civil Hospital Karachi. The number of participants in this study among population was 28.
4) Analytical Framework for the study is aimed at getting an insight and to arrive at conclusion.

In order to improve the quality of the collected data, data triangulation is used to maintain the reliability and validity of findings. Thus, the authors have applied multiple data sources as data and methodological triangulation within each case study to maintain the reliability and validity of the research findings. Thus, the multiple levels of interviewees were conducted, within the same case study such as from senior mangers, middle and low level management.

Case Study Organizations

1) Overview of Dow University of Health Sciences (DUHS)

Dow Medical College is very old medical of sindh province. The college is affiliated with two hospitals of Karachi. These are Civil Hospital and Sindh Government Lyari General Hospital. This college, rapidly improving facilities, besides welfare facilities viz. up gradation of for auditorium, library, recreation rooms and sports facilities all basic science departments have been extensively renovated with tutorial rooms, museum and well equipped laboratories. The department of anatomy has one of the best plastic museums in the country. Currently major project of modernization of the college is in progress. Dow Medical College is a constituent college of the Dow University of Health Sciences, established on 29th December 2003.

Dow University of Health Sciences was established in December 2003, through an ordinance, which was validated by the Provincial Assembly of Sindh in April 2004. At inception, it has three constituent institutions, namely Dow Medical College, Sindh Medical College and the Ojha Institute of Tuberculosis and Chest Diseases. Within two and half years, DUHS has established ten other institutional entities, for continuing medical education, faculty development, training in information technology, teachers training programs, essential clinical and interpersonal skill development. The Dow University of Health Sciences, in addition to medical education provides training for Dentistry, Nursing Education and training in Bio-Medical Technology. University imparts undergraduate and post graduate medical education to more than 2000 students in Medicine, Dentistry, Nursing and Medical Technology, by a faculty of 55 Professors, 52 Associate Professors, 120 Assistant Professors and 110 Lecturers. The affiliated hospitals of university have total bed strength of 4400, which makes this institution the largest medical university in Pakistan.

The educational programs in University are augmented by library resources, high speed Internet and a digital library with subscriptions to over 13000 journals. University also plans to create Wide Area Network (WAN) among three campuses and with other institutes for video conferencing and interactive

teaching sessions. DUHS also intends to open Dow International Medical College for overseas Pakistani's and students from all Muslim countries.

University also emphasis on clinical skill trainings, research procedures, problem-based learning, and has improved elective & forensic teaching. The Digital Network Library provides the facility for the on-line resources access. This may enable students and the faculty members to update knowledge by having access books and journals through Pakistan Education & Research Network (PERN), a project initiated by Higher Education Commission (HEC) Pakistan.

2) Civil Hospital Karachi (CHK)

Civil Hospital Karachi is one of the oldest hospitals in country; it was established as 200-bed district hospital in 1896. At that time the population of Karachi city was only 0.2 million people. Now after 110 years the hospital is extended to 2000 bed teaching hospital affiliated with Dow University of Health Sciences, whereas the population of city has risen to 15 million souls. The hospital when established had only four departments, which have been increased to 68 departments now.

Approximately 4~5 thousand external patients visit daily in Out Door Patient Department (OPD) of hospital that means 1.1 million patients registered and examined annually at OPD in hospital. About 0.35 million patients get x-rays in Radiology Department annually, 0.25 different clinical tests are conducted in hospital's labs and approximately 26000 surgeries are performed in hospital annually. More than 800 emergency cases are brought into Causality section daily, which include critical accident cases, firearm injuries, acute strokes, acute shock and those going through acute myocardial infarction; it is assumed that the CHK emergency centre is the life line for many. But if one were to visit the existing casualty ward, or rather the four 'rooms' [hovels, more like], it would baffle the most imaginative mind as to how patients could be treated in a place which functions out of four dilapidated rooms that are a thoroughfare for all even while critical procedures are taking place. The Causality is planned to be renovated and enhanced to 55-bed from existing 40-bed capacity. Civil Hospital, Karachi is a tertiary care public hospital that imparts both undergraduate and postgraduate teaching and training. It is one of the teaching hospitals affiliated with Dow University of Health Sciences. Civil Hospital, Karachi attracts patients not only from Karachi but also from the rural areas of Sindh and Balochistan province.

Data Analysis and Findings
The data is collected on the basis of framework designed prior to holding discussion sessions with samples in this study. The framework was determined

after detailed literature review and pursuing various models discovering therein the fundamental components essentially required for complete health informatics system. Since this discipline is concerned with the development, use, application and influence of information systems therefore it inheirently exists in layered form containing different components knitted together contrary to a single unit form. The whole subject is divided into ten parts/areas. The data obtained during discussion sessions is therefore sorted out on the basis of variables compatible to relevant part of the whole informatics system and subsequently results have been derived.

1) Concept Level
On the basis of views shared with samples related to fundamentals of informatics systems in healthcare sector it is assessed that more than 70% samples does not visualize the core concept of informatics and do not realize that as to how information and knowledge management can play a critical role in health care for elevating the overall performance. Half of the samples conceive misconception regarding informatics and presume it with usage of computers only.

2) Vision
There were two aspects; first it was heartening to revealed that majority of the samples were fascinated and wish to have this system functional in university and hospital, but the darker facet of the perception measured was that more than 50% samples were either considered themselves not instrumental, found shifting responsibility on government (Health Department) and having no hope or confidence in leadership.

3) Enabling Environment
There appears to be no serious activity or immediate comprehensive plan or consideration before management that reflects the priority and importance to medical informatics. Contrary to nitty-gritty of system few steps have been taken viz. university has provided two branded personal computers along with a printer, multimedia, and a slide projector in all departments of hospital. These are being used only as word processors and a little work on MS office applications. There is no networking, intranet, on-line sharing of info among different departments. The medical students and doctors lack ICT knowledge and computer usage skills and require training. It is noticed pleasantly that few professors out of 68 departments in hospital have put in place indigenous kind of network from funds raised through personal efforts from NGOs and donor agencies and maintain computerized records. The Surgical Unit-VI, Pediatrics Unit-III, and Surgical Unit-I are among those who have stepped forward and initiated few interventions.

DUHS has hired a Project IT Director for last 2~3 years but there appears no solid ground work carried out for the enterprise informatics resource planning. University has however, started imparting computer trainings to students, doctors, and para medic staff which is quite constructive move.

4) Building Infrastructure
The needed infrastructure for an efficient medical informatics system is not available. The main cause again discovered here is unavailability of funds and no forecast or planning for future needs.

5) Creating Health Content System
Almost all processes in university and hospital are birthright paper-based and highly mismanaged. None of the departments in hospital maintain proper electronic medical records. The various tools (i.e. Electronic Health Record (HER), Patient Information Systems (PIS), Hospital Information Systems (HIS), National Electronics Registries, Pharmacy/Drug registries and inventories, Decision Support Systems (DSS), and Nursing Care System etc.) are absolutely unavailable. The record keeping in these institutions is of same primitive style. The appointments, registration, admission, discharge and patient administration is completely manual, thus render no benefit to any stakeholder. The most painful situation observed is that despite presence of highly efficient and expert doctors in various fields large numbers of patients either die or get no proper and urgent treatment in absence of efficient inter-departmental referral system.

6) Education & Learning
The informatics systems play a vital role in education today; especially in this context broadly there are two major areas:

i)   As a supporting tool
ii) Representing users and platforms at a strategic level

During course of investigation it is revealed that university continued to follow old ways of teaching. The faculty only uses multimedia for lectures delivery on power point. There is no on-line archive, distant collaboration for learning sessions through video/ audio conferencing, any simulation programs/ software's, nor is any arrangement for share of information with different national health institutions / agencies are at place when advanced countries are using grid computing systems for this purpose. University is contented on meager bandwidth provided by Higher Education Commission (HEC) under Pakistan Education & Research Network (PERN) project. The university has however established digital library with about 100 workstations. The information regarding medical sciences is available on CDs in library. The Civil Hospital Karachi is one of the major hospitals affiliated with College of Physicians & Surgeons Pakistan (CPSP) and provides training to postgraduate students; DUHS

also offers postgraduate programs on its own. The research is not conducted (in terms of intellectual assets—both explicit (recorded) and tacit (personal know-how) the way civil hospital is receiving cases of distinctive nature which otherwise would have been preserved and used for learning in case of availability of proper information & knowledge system. The radiology department has no resources available to record images in soft form in result training on medical imaging, image processing and analysis is almost zero. There are many health institutions associated with DUHS and CHK but the provision of telemedicine is yet not implemented fully. The telemedicine promotes consistency through consulting with other special groups, dispensaries, labs. and bring healthcare professionals at single platform.

7) Parallel Transformation from Old to New Informatics System
The management envisages no immediate stipulation of informatics system thus has no contingent program. The transformation process at the moment is at snail's pace and it's not likely to gain momentum in near future. At the intangible side either the staff is yet not prepared both skillfully and mentally prepared for the change/ paradigm shift. Building ICT knowledge and skills in the sector is most critical issue and obviously take long time being a consistent process.

8) Other Relevant Links
Individual case management is based on paper files and often creates problems for patients and physicians. Majority of samples also agreed that it causes duplication and repetition of work which ultimately devour time which otherwise would have been spent on more patients.

- For the learning purpose faculty members have not been able create online professional health group and produce proficient communication system with students.
- More than 65% samples agreed that manual record can never be helpful for efficient forecast and accurate analysis of diseases statistically.
- More than half samples admitted that preventive health education and health-enquiry services are not resourcefully available.
- Precisely 65% samples also agreed directly or indirectly that prevailing manual system is incapable of acceptable public-health and reporting source of notifiable/ infectious diseases. The statistical analysis and management of health consequences of natural/ man-made disasters are difficult to evaluate on existing record keeping and maintenance process.
- The senior management of DUHS and CHK has the same opinion that under prevailing system required patient care satisfaction is difficult to achieve and cause suffering to patients and serving doctors in shape of serious wastage of consumables, inventory loss and proper accountability.

9) The Key Delay Factors for Change

Table 1: Evaluation of Key Factors

S.#	Key Factor	Remarks	% of opinion appraised
1.	Government's Priority	Not serious as required.	95%
2.	Funds/ Budget Allocation	Consider informatics system as advance when basic amenities are denied/ are not available	95%
3.	Awareness/ Vision/ Preparedness	Workload, personal preferences, limited approach	80%
4.	Capacity Building	No systematic move	75%
5.	Future Plan	Uncertain	60%
6.	Responsibility	Shifted	90%
7.	Human Resource	No tendency except limited individuals	70%

Although one third majority of samples conceived the importance of informatics system but unfortunately bears no clear vision for implementation and considers it impossible in near future. The professors and senior faculty members realize no active role at their part despite fact they want to add few parts of system in their units/ departments but have no agreed enterprise solution. More than 70% samples showed their inability to express their views explicitly that how such system can be developed rapidly. When explained benchmarks of "Telemedicine 2010" determined by the European Commission (EC) for creating vision for a personal healthcare network (which is ahead/ advance expansion of usual healthcare informatics) by the year 2010, one third of samples showed inability to accomplish even basic informatics system by year 2010 in twin institutions.

Findings Compared with "Telemedicine 2010", Reference Model in this Study

The essential variables extracted from the data and ensuing findings elucidated in the Table 2 have been compared with "Telemedicine 2010" a model for "Visions for Personal Medical Networks", to derive out a literal standing of DUHS and CHK. This also entails for developing a model, which is presented in next part of this section suggesting therein a complete project cycle for carrying forward the objective of building a fundamental but a comprehensive informatics system in these institutions by 2010.

Table 2: Comparison: Studied Institutions with Telemedicine 2010

Factors		Status
Defined in "Telemedicine 2010"	**Discerned at "DUHS & CHK"**	
Vision: A Citizen-Centered eHealth System	Not specifically prevails in informatics context.	Blurred
	No ground work for electronic	Immature

Factors		Status
Defined in "Telemedicine 2010"	**Discerned at "DUHS & CHK"**	
Key Issues: divided into eCare, eLearning, eSurveillance and eAdministration	working and processes	
Fundamental Components: Electronic Medical Records, Online professional health groups, Access to evidence-based medicine, Public-health and reporting, Real-time epidemiological analysis, Research and electronic statistical health analysis, Patients Administration Management, reporting of administrative data, including quality/performance, clinical outcomes.	Prevails and carried-out on legacy systems that grants no effective and fruitful results	Old and outdated
Technical & Financial: Roadmap and Resources	No professionally designed plans nor adequate funds allocation	Perplexed
Driving Forces: Population, Quality of Care, Cost, Technology, and Consumerism	No proper forecasting in light of growing population, declination of quality, limited technological assessment, patients needs not met with.	Chaotic
Rollout Actions: Awareness, Systematic Change, Legal Framework, Interoperability, CIT Events.	Awareness not yet developed no contingent plan for legal & legislation issues, SOPs, and technical issues.	Turbulent
Impediments: Cost, Lack of Infrastructure, non adherence to adequate standards, fear of change.	Happened to be true	Quo
Commitment	Volubly yes, practically no	Little

Conclusion

The government and top management in healthcare sector and especially in these twin institutions must seize the momentum to accord priority and realize the importance of information and knowledge for future growth and survival. Year 2010 may be declared as the year of health informatics to create awareness for the most competitive and dynamic knowledge-base healthcare founded on strong medical informatics system. The Vision has to be disseminated to the multiple healthcare decision makers in country. Enhanced cooperation is a must among different role players within and outside these institutions as citizens/patients have ever greater expectations from their healthcare systems.

The survey results portray certain wretched results, from leisured response of samples it appears that senior leadership is not proactive despite unanimous agreement that informatics system in healthcare is inevitable for survival and it must succeed and should be encouraged. From prevailing situation it is concluded that deficiency of conceptual approach and absence of proper model or project in such big and important healthcare institutions is detrimental for their future for country as well. In absence of unmanaged records these institutions can not produce best doctors with IT skills, promote research and development and whole healthcare system (learning and curing) more efficient which could have benefited tremendously the doctors and patients to mutually enhance the performance of health management. On the threshold of the new millennium the world health community faces exceptional challenges and opportunities in a rapidly changing world, with the "double burden" of old and new diseases falling most heavily on the developing countries, without arrangement of efficient medical informatics systems it would be difficult rather impossible to handle situation and take control of rapidly spreading diseases.

Implication of the research

This research has various implications. The first implication of this research is the generalization of findings of the research finding. Therefore, the generalization of this study required collecting data from across the Pakistan. The second implication of this research is about the collection of data. As the required data was collected in a very short period of time, thus it just provide an overview of the results. This can, however, for the purpose of longitudinal view the data can be further expended for a longer period of time. This may help to produce the missing bits of this research.

References

Alshawi, S., Missi, F. and Elbadi, T. (2003) 'Healthcare Information Management: the Integration of Patients' Data', Logistic Information Management, 16(2-3): pp. 286-295.

Andrew H. Gold, Arvind Malhotra, Albert H. Segars. (2001) 'Knowledge Management: An Organizational Capabilities Perspective' Journal of Management Information Systems, 18 (1), p 185

Anonymous (2000), 'Recommendations of the International Medical Informatics Association (IMIA) on Education in Health and Medical Informatics', Methods of Information in Medicine 39(2000), pp. 267-277.

Anonymous (2004), Telemedicine 2010, 'Visions for Personal Medical Networks', The TM Alliance Report July 2004.

Bemmel V (1999). 'Handbook of Medical Informatics' M.A Musen, Stanford University, Stanford USA, 1999, pp.I-III.

Irani, Z., Khoumbati, K., Mantzana, V. and Themistocleous, M. (2008) 'Factors and Actors Affecting the EAI Adoption in the Healthcare Sector', Communication of the Association of the Information Systems, 22(6): pp.103-116

Khoumbati, K. Uqaili, M .A and Kalhoro, M.S. (2007) 'Evaluating the adoption of Enterprise Application Integration in Healthcare Organizations: An Exploratory Case Study' Meharn University Research Journal of Engineering & Technology 26 (2): pp. 117-132.

Southard, P., H. Soongoo, and S. Keng. 'Information Technology in the Healthcare Industry A Primer,' 33rd Hawaii International Conference on Systems Sciences, (CD- Proceedings), 2000.