

ORIGINAL ARTICLE

THE IMPLEMENTATION OF HOSPITAL INFORMATION SYSTEM (HIS) IN TERTIARY HOSPITALS IN MALAYSIA: A QUALITATIVE STUDY

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ABSTRACT

Hospital Information System (HIS) is a comprehensive, integrated information system designed to manage the administrative, financial and clinical aspects of a hospital. This study is to describe those aspects of the implementation of hospital information system in three tertiary hospitals in Klang Valley; Serdang Hospital, Selayang Hospital and University Kebangsaan Malaysia Medical Centre (UKMMC). A qualitative study was conducted to obtain views on information system development and implementation in the hospitals mentioned above. In-depth interviews with personnel representing both the system providers and the end-users were done guided by a questionnaire. The results of the interviews were categorized into few themes namely the system development, human resource, scope of implementation, support system, user-friendly, training, hardware and security. There were differences in hospital information system development and implementation in the three hospitals. Each system has its own strengths and weaknesses that make it unique. In developing HIS, its important to ensure the system can work effectively and efficiently. Quality human resource, good support system, user-friendly and adequate training of the end-user will determine the success of implementation of HIS. Upgrading of hardware and software as needed is the basis to keep up with the pace of technology advancement and increasing number of patients. It is hoped that HIS will be implemented in all other hospitals with effective integration and networking.

Key words: Hospital information system, Serdang Hospital, Selayang Hospital, UKM Medical Centre, qualitative study

INTRODUCTION

Introduction of Information & Communication Technology (ICT) is an important step taken by the Ministry of Health toward establishing of the future health care system. Under the MOH-MS Telehealth Flagship Applications, the Ministry has embarked on introducing the electronic Hospital Information Systems (HIS) in several public hospitals including Serdang Hospital, Selayang Hospital and University Kebangsaan Malaysia Medical Centre (UKMMC) under the Ministry of Higher Education (MOHE).

A Hospital Information System (HIS) is a comprehensive, integrated information system designed to manage the administrative, financial and clinical aspects of a hospital. As an area of medical informatics, the aim of hospital information system is to achieve the best possible support of patient care and administration by electronic data processing.

Information technology has made a significant positive impact on the healthcare sector. The past decade has witnessed the foray of numerous information systems and their resultant products into the hospital scenario. The capital invested in electronic management facilities and types of hospital systems has increased substantially to replace previous paper medical records which are cumbersome in nature, bulky to use and difficult to manage, with digital records that much easier to handle and improve the workflow efficiency by integrating various tasks¹.

Hospital information system (HIS) provides the required information to each level of the management at the right time, in the right form, and in the right place, so that the decisions to be made effectively and efficiently. HIS plays a vital role in planning, initiating, organizing and controlling the operations of the subsystems of the hospital and thus provides a synergistic organization in the process. HIS improves patient

care by assessing data and making recommendations for care and enables a hospital to move from retrospective to a concurrent review quality and appropriateness of care.

In the Asia-Pacific region, numerous HIS implementations have taken place in various hospitals across Australia, Japan, South Korea, Singapore and Malaysia. In Malaysia, the Ministry of Health (MOH) is the leading agency and the main provider of health care services. The government subsidizes approximately 98% of all public medical expenses. Increasing awareness and rising demand for better healthcare facilities are the driving force on application and implementation of advanced facilities and management systems in public and private hospitals in Malaysia, and Hospital Information Systems (HIS) has been the top priority wherein.

In Seventh Malaysian Plan (1996-2000), it was stated that there will be 33 paperless public hospitals in Malaysia. Eight hospitals to be operated with Total Hospital Information System (THIS) covering their total day to day administration demand, and in other 25 smaller hospitals, Hospital information System (HIS) to be implemented. But due to the economic crisis in 1998, those projects were put on hold and are expected to be implemented during the eighth Malaysian Plan³.

Over the period of executing the Ninth Malaysia Plan (9MP, 2006 - 2010), the government consolidated health care services, enhanced human resource development and optimized resource utilization. Delivery systems have been improved with greater involvement of the private sector and Non-Government Organizations (NGOs). Computerization and networking have brought Malaysia a long way in monitoring, analyzing, and disseminating information on local health data. However, despite above admirable accomplishments, increasing demand for health tourism, the need for hospitals to upgrade their healthcare services to meet international standards, the increasing pressure exerted upon government to develop the healthcare industry and today's tech-savvy consumers demand for better healthcare and customer services have been remaining driving force in adopting automation in the healthcare industry².

The leading vendors in the healthcare industry tend to fall into two categories. The first category is the larger multinational IT vendors, such as Microsoft,

IBM, HP, Oracle, SAP, Accenture, EDS and Intel. The second category is comprised of vendors focused on providing healthcare solutions, which increasingly leveraging technology as part of these solutions. Local independent solution vendors and system integrators are also quite prominent. They compete and partner with the multinational companies. For instance, Selayang Hospital is using Cerner system, while Hospital Serdang, Sungai Buloh and Ampang are using India's Medicom and Putrajaya Hospital uses Kompakar².

Selayang Hospital, the first paperless hospital, operates on a Total Hospital Information System (THIS), which integrates clinical, administrative and financial management, enabling seamless data flow between separate areas. Cerner was given the responsibility to operate the system. THIS has also been implemented at Putrajaya Hospital and Pantai Medical Centre by Kompakar eHealth Tech Sdn Bhd, part of System Kompakar Sdn Bhd. Basic and intermediate information systems were implemented at Kepala Batas Hospital, Penang and Hospital Lahad Datu, Sabah respectively. THIS implementation is for tertiary hospitals with over 400 beds. Challenges on above application are tailoring above management systems according to the hospital size, varying work cultures, clinical procedures and services provided as well as operation workflow².

University Kebangsaan Malaysia Medical Centre (UKMMC) has developed its own Total Hospital Information System (THIS), the first by a government hospital in Malaysia and possibly in Asia. THIS developed in UKMMC, called Caring Hospital Enterprise System (C-HEtS), is expected to be cheaper than similar systems available in the market. The huge savings was a result of UKMMC itself holding the copyright for C-HEtS (created 100 percent in-house) and the system was developed using Oracle Database bought from US-based software firm Oracle Corp⁴.

Experiences from other countries which have implemented THIS proved to be challenging. In Pakistan, they face barriers such as lack of commitment, inability to provide extensive information technology (IT) infrastructure, difficulty to obtain a suitable software and hardware and lack of skilled IT personnel⁹. A study conducted in Nigeria and Tanzania revealed that proper planning, good managerial skills, top management commitment, leadership styles and end-user consideration were among the

prerequisites to ensure the success of THIS implementation⁹. Lack of government appreciation of the IT value in healthcare was another reason of failure in THIS especially among developing countries⁹.

The main objective of the study is to describe the implementation of hospital information system (HIS) and its user perspective in Serdang Hospital, Selayang Hospital and University Kebangsaan Malaysia Medical Centre (UKMMC). The sub-objectives are to assess the establishment and development of hospital information system at University Kebangsaan Malaysia Medical Centre, Serdang Hospital and Selayang Hospital, to analyze the functionality of the information system available in these three tertiary hospitals and to assess the application and impact of hospital information system on health provider and user.

METHODS

A qualitative study was conducted through an in-depth face-to-face interview with a total of 25 samples comprising of 4 hospital personals representing both the system providers (Information Technology Manager) and the end-users (doctors, nurses, allied health personnel) from each of the three hospitals. The three hospitals were selected in view of easy accessibility and logistic feasibility as they are all located within the Klang Valley and tertiary referral. In addition, Information Technology Systems applied in above named hospitals are at different stages of development and differs from one another. Therefore, the description on their hospital information system is based on the stage of implementation and its functionalities.

The interviews were conducted in September 2009. A purposive sampling was used to select the samples among the hospital staff that are directly involving with the information system in the hospital. Once the identified sample verbally consented for the interview, an in-depth face-to-face interview was performed in their respective hospitals. The samples were introduced to the interviewer and were briefed about the study purpose. The interview was conducted using an identical guide questions to ensure similarity of interviewing method and flow of discussion.

The data obtained was sorted according to various categories based on content analysis. Data analysis was carried out by studying and mapping according to emerging themes.

RESULTS

The findings from the interviews were categorised into six main themes and 3 sub-themes. The main themes identified are system development and maintenance, human resource, scope of implementation, support system, user-friendliness and administrative. The administrative theme is further divided into three sub-themes which are training, hardware and security.

System development and maintenance

In terms of system development, a few issues were brought up by the Information Technology Department. Two hospitals mentioned that their information technology (IT) systems were developed simultaneously with the hospital construction.

"The IT system in the hospital is the turnkey project."

"The IT system came as a package together with the building construction."

"The software and the whole system have been pre-determined by the headquarters."

However, a person from one hospital briefed about their in-house IT system.

*"Our IT system is developed from scratch."
"We developed our own system."*

Human resource

In terms of human resources required to run the IT system in the hospital, various responds were voiced out. One hospital needs many IT staff but the others need not.

"In order to develop and run the IT system in this hospital, we need to have many IT experts."

"We only have five officers in this department, myself, the IT officer and three computer programmers."

"We don't need much manpower to run the system. Our task is only to co-ordinate the system."

"The system is maintained by the vendors; therefore the majority come from their organization."

Scope of implementation

Regarding the scope of implementation, all three hospitals implemented Total Hospital Information System (THIS).

"Most of the major departments in this hospital are linked with this system except for dental and haemodialysis unit which have an independent system."

"This is the first IT hospital in Malaysia. The system is available in all departments within this hospital."

"We started the IT system with the core functions such as patient registration, admission and discharge, and emergency department. Then, we expanded the system to other functions within few years."

Support system

As far as support system is concerned, all hospitals are capable to provide prompt assistance to users but one hospital requires backup support.

"We encountered one major breakdown in 2006. However, with good support system, we managed to overcome this problem."

"The IT support system is maintained by the vendors 24 hours a day, 7 days a week. We have call centres to entertain any queries and complaints from the user."

"We even provide services during public holidays. We have our officers who are on-call to provide assistance."

"We were provided with good support system to assist with any problems we encounter."

"There are no backup system and no hardcopy, therefore if something happens; there is no data on the patient."

User-friendliness

In terms of user-friendly, users gave differing views about the system.

"It is troublesome to use different passwords to access pharmacy system and to do other things."

"Anyone can use the system due to the simplicity of the system."

"There are lots of clicking to navigate and to get from one menu to another it takes sometimes up to ten clicks!."

"Personally, I think Selayang has the most user-friendly system."

"Those who have worked in various hospitals with IT system will agree that Selayang's system is the most user-friendly."

Administrative

The administrative theme was subdivided into 3 sub themes namely the training components, the hardware installed and the system security.

Training: All staff in the three hospitals were given training and guidance on how to use the system.

"All of our new staff will be given hands-on training on the system usage before they can start their work."

"We train our new staffs by batches and when it is needed."

Hardware: In view of different stages of implementation, different hospitals require different types of upgrading.

"The system is already 10 years old, but we are still using a Pentium II computer."

*"Upgrading of the system is beyond our control."
"Our system is running well with the computers."*

Security: All the systems provide their own level of security and data protection is given utmost priority.

"We can trace those who use the system using Audit Trail."

“Each staff will have different IDs and passwords for pharmacy and others. They are encouraged to use different passwords.”

“The system is backed up on a daily basis, and ideally the data is stored off-site. However in this

hospital we store the backup data in different floor.” The data collected analyzed and summarized into the table below (Table 1).

Table 1. Characteristics of hospital information system

RESEARCH VARIABLE	SERDANG HOSPITAL	SELAYANG HOSPITAL	UKMMC
System used	IBA Health	Cerner	C-Hets
Country of origin	U.K	U.S.A	Malaysia
No. of hospital beds	630	960	1050
Staffing- manpower	1900	2600	3500
Development	2005 Turnkey Project RM 80 million	1999 Turnkey Project RM 64 million	2004 Dev. in phases. In-house product RM 6.3 million
Human Resource	IT Department - 1 IT Manager - 4 IT Programmer	IT Department - 1 IT Manager - 6 support staffs	IT Department - Head of IT Unit - 40 technical staffs - 40 domain expert
Scope	THIS for all the departments. The dental and hemodialysis unit are using independent IT system	THIS covering all the departments	Moving towards THIS - implemented in stages
Support System	24 hours by - Helpdesk support - On-site support team - Central support team	24 hours by - Helpdesk support - On-site support team - Central support team	24 hours by - Hotline - Operation room - Helpdesk support - On-call staffs
User Friendly	- Convenient - Multiple workstations available - Easy navigation - Certain action requires multiple windows	- Convenient - Multiple workstation available - Easy navigation - Multiple action can be done in similar windows	- Convenient - Designated workstations - Basic and simple navigation
Administrative Training	- Conducted in batches as needed	- Conducted on ad-hoc basis, regardless no. of staff attending the session - Untrained personnel not allowed to commence their work	- Road show to each and every departments - Trained all staff
Hardware	- High configuration computer hardware	- Computer hardware using Pentium II - Due for upgrading	- Using hardware cope with the needs
Security	- Audit trail - Individual login ID and password - Data backup on daily basis	- Audit trail - Individual login ID and password - Data backup on daily basis	- Audit trail - Separate ID and password for clinical and pharmacy - Data backup on daily basis

DISCUSSION

The success and failure of implementing ICT projects are extensively analyzed and elaborated in literature published by Kotter⁵ (1996) and Collins and Bicknell⁶ (1998). Their famous papers entitled "Leading Change"⁵ and "Crash"⁶ listed several factors influencing the outcome of an ICT project. Kotter lists the sense of urgency, powerful coalition, creating a vision, communicating the vision, empowering others, planning for short-term wins, consolidating improvements and institutionalizing new approaches as key factors leading to successful implementation⁵. Collins and Bicknell on the other hand focus on failure factors and identify over ambition, complacency, over-rating computer technology, over reliance on ICT professionals and ICT consultants, undue confidence in the power of the contract to penalize an underperforming ICT company and trust in costly custom built software as key factors⁶.

The principle determining factor of the success and sustainability of an Hospital Information System is a well-planned and extensive coverage of the system^{7,8}. Detailed planning and management will ensure a smooth implementation, institutionalization and acceptance of a system^{9,10}. In this study, two hospitals, Serdang and Selayang - are newly built hospitals had their IT system developed together with the building construction (Turnkey Project). Thus, this will ensure a proper implementation of the system itself in that hospital.

The intention of the Ministry of Health (MOH) on implementing Total Hospital Information System (THIS) in tertiary hospitals above 400 beds is proven to be beneficial³. Even though, the task could be risky but the overall advantage of having extensive system as mentioned in this study is priceless¹¹.

In view of the manpower or human resource needed to maintain the IT system, the study showed that Serdang and Selayang Hospital (the Turnkey Project) require minimal number of support staff, whereas the UKMMC who have developed own system requires a substantial amount of staff. The cost-efficiency analysis of these two variants needs to be further explored. However, all the three hospital have their own IT Department headed by an IT expert. This indeed is

another crucial factor to ensure sustainability and smooth running of the system^{11,12}.

Since Hospital Information System is still new to our local healthcare industry, its implementation requires continuous support and assistance from experts in this field. Some literature mentioned that failure of an IT system is due to inadequate electrical supply, lack or unsustainable funding, lack of computer supply and educational level of technical and support staffs^{13,14}. In this study, we found that the IT system was maintained by appointed vendors or in-house IT experts. Technical assistance was also provided on a 24-hour basis.

This study is supported by the analysis by Kuhn and Guise (2001), whereby they summarized the main challenges including integration and standardization (of the systems, technology etc.), human-computer interaction and the structure of data/information/knowledge (such as the interface, user-friendliness, coding and languages), socio-technical and organizational issues (including perception towards the use of technology and adaptation towards common health practices) and processes in health care (which in many cases, are not as straightforward as workflows in other fields)¹⁵.

The systems in all hospitals in this study are user-friendly. Multiple workstations were being provided with convenience of access from anywhere within the hospital building. The design applied was easy for navigation. A study by Lucas (2008), Heeks (2006) and Khyllback and Sutter (2007) showed that the system will fail if there are lack of clarity on the system functionality and poor user-interface design¹⁶⁻¹⁸.

To avoid failure or underutilization of the system, continuous training is indispensable. In this study, training is compulsory for all users, which reduces technical problems resulted from misuse. Ball (2003) mentioned that raising users understanding of the system requirements and benefits are important to ensure success^{19,20}.

Ensuring the security of the data stored in the system is very crucial. Many of the data stored in the system are confidential and valuable. In this study, all the hospitals have back-ups for each and every patient information. They also have audit trails where they can monitor the data usage and access. The use of log-in identification code with password is another level of security. Unsecured data can be violated and abused^{21, 22}.

Efficiently handling electronic information of patients and the secrecy of the information are also amongst the key issues in HIS. Therefore, an ethical framework such as one suggested by Sapiah and Rose (2006) should be in place for maintaining the integrity of the hospital record system and at the same time improving the efficiency of HIS².

Based on the result of this study, the following recommendations are made with the hope of future Hospital Information System development will incorporate these suggestion for a better performance. The recommendations are oriented to develop in-house hospital information system in order to reduce cost, developing hospital information system in accordance and customized to user's requirement and needs, regular upgrading of hardware and software on needed basis to keep up with the pace of technology advancement and increasing number of patients, development of hospital information system to be flexible as to readily accommodate changes and advances of technology.

CONCLUSION

The Hospital Information System in each hospital has its strengths and weaknesses. For example, the information system developed in-house doesn't need a very high cost to develop but demands expertise and more number of technically trained personnel to operate. The development of the system as per the con-current demand and availability of various resources is important to ensure the system operates effectively and efficiently. Apart from that, investment in human resource, good support system, user friendliness and adequate training to the end user will also determine whether the implementation of a system would go smoothly or not. The purpose of implementing these systems is not to compete with each other but serves to facilitate and improve the quality of patient care. There is no one system which is superior from the other but they have their own uniqueness. However, there is a need to synchronize these systems so that the system can communicate with other outside systems to ensure the maintenance and continuity of care. It is also hoped that HIS will be implemented in all other hospitals with effective integration and networking.

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REFERENCES

1. Ovretveit J, Scott T. Implementation of electronic medical records in hospitals: two case studies. *Health Policy* 2007; **84**: 181-190.
2. Sapiah S, Rose AA. Information ethics in Malaysia paperless hospital. Postgraduate Annual Research Seminar 2006. Faculty of Computer Science & Information systems UTM. Available from: eprints.utm.my/.../Information_Ethics_in_Malaysia_Paperless_Hospital.pdf (accessed 3 October 2009).
3. Ahmad N. Malaysia: health care information technology. US Commercial Service. USA Department of Commerce 2008. Available from: www.buyusa.gov/.../malaysiahealthcareit.pdf (accessed 4 October 2009).
4. Daud MA. HUKM develops own total HMIS. *Bernama* 2007. Available from: http://www.bernama.com.my/bernama/v3/news_lite.php?id=305217 (accessed 4 October 2009).
5. Kotter JP. *Leading change*. Harvard Business School Press: Boston, 1996.
6. Collins T, Bicknell D. *Crash: learning from the world's worst computer disasters*. Simon & Schuster Intl: New York, 1998.
7. Frame J, Watson J. Deploying a culture change programme management approach in support of information and communication technology developments in Greater Glasgow NHS Board. *Health Informatics Journal* 2008; **14**(2): 125-139.
8. iHealthBeat. 2007. EHRs and PHRs. IT executives offer advice for adopting electronic records. Available from: <http://www.ihealthbeat.org/Articles/2007/5/>

- 21/ IT-Executives-Offer-Advice-for-Adopting-Electronic-Records.aspx (accessed 4 October 2009).
9. Malik MA, Khan HR. Understanding the implementation of an electronic hospital information system in a developing country: a case study from Pakistan. In: Warren JR. (eds). Proc. Third Australasian Workshop on Health Informatics and Knowledge Management (HIKM 2009). Wellington, New Zealand. *CRPIT* 2009; **97**.
 10. Ovretveit J, Scott T. Improving quality through effective implementation of information technology in healthcare. *International Journal for Quality in Health Care* 2007; **19**(5): 259-266.
 11. Kensing F, Sigurdardottir H. MUST - a participatory method for designing sustainable health IT. *Studies in Health Technology & Informatics* 2007; **129**(2): 1204-1208.
 12. Berg M, Aarts J. ICT in health care: sociotechnical approaches. *Methods of Information in Medicine* 2007; **42**: 297-301.
 13. Chandrasekhar CP, Ghosh J. Information and communication technologies and health in low income countries: the potential and the constraints. *Bulletin of the World Health Organization* 2007; **79**(9): 850-855.
 14. Gordon AN, Hinson RE. Towards a sustainable framework for computer based health information systems (CHIS) for least developed countries (LDCs). *International Journal of Health Care Quality Assurance* 2007; **20**(6): 532-544.
 15. Kuhn KA, Giuse DA. From hospital information systems to health information systems: problems, challenges, perspectives. *Methods in Information Medicine* 2001; **40**: 275-287.
 16. Heeks R. Health information systems: failure, success and improvisation. *International Journal of Medical Informatics* 2007; **75**: 125-137.
 17. Kyhlback H, Sutter B. What does it take to replace an old functioning information system with a new one? A case study. *International Journal of Medical Informatics* 2007; **76S**: S149-S158.
 18. Lucas H. Information and communications technology for future health systems in developing countries. *Social Science & Medicine* 2007; **66**: 2122-2132.
 19. Ball MJ. Hospital information systems: perspectives on problems and prospects, 1979 and 2002. *International Journal of Medical Informatics* 2003; **69**: 83-89.
 20. Idowu PD, Cornford ST. Health informatics deployment in Nigeria. *Journal of Health Informatics in Developing Countries* 2008. Available from: <http://www.jhidc.org/index.php/jhidc/issue/view/4> (accessed 6 October 2009).
 21. Barber B, Garwood D, Skerman P. Security in hospital information system. *International Journal of Bio-Medical Computing* 1995; **39**(1): 133-138.
 22. Clifford GD, Blaya JA. Medical information systems: a foundation for healthcare technologies in developing countries. *BioMedical Engineering OnLine* 2008; **7**(18): 1-8.