THE STUDY OF HUMAN ORGANISATION AND TECHNOLOGY FACTORS INFLUENCE ON HOSPITAL INFORMATION SYSTEM SATISFACTION IN MALAYSIA

by

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Thesis submitted in fulfilment of the requirements
for the degree of
Master of Arts

July 2013

ACKNOWLEDGEMENT

I would like to take this opportunity to convey my gratitude and thanks to the people whose kindness and assistance had contributed immensely to the successful completion of this thesis. Indeed, the list of those to whom acknowledgement is due cannot be comprehensive, but the following deserve special mention.

First and foremost, I would like to thank my main supervisor, Prof T Ramayah from School of Management, Universiti Sains Malaysia, for his dedication and patients in this research study.

Then, I would like to thank my co-supervisor, Dr Nasriah Zakaria from School of Computer Sciences, Universiti Sains Malaysia, for her advice and guidance throughout this research study.

Also, I would like to thank University Sains Malaysia and also School of Management for giving me the fellowship award and other important resources during my research study.

Special thanks also for CRC Hospital Selayang, CRC Hospital Kepala Batas, CRC Hospital USM, Advanced Medical & Dental Institute, Medical Center USM and others . Thank you so much.

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LIST OF ABBREVIATIONS

AHR	Automated Health Record
AVE	Average Variance Extracted
BHIS	Basic Hospital Information System
BI	Behavior Intention
CBSEM	Covariance Based Structural Equation Modeling
CCU	Cardiac Care Unit
C-HEtS	Caring Hospital Enterprise System
CME	Continue Medical Education
CMR	Computerized Medical Records
CMV	Common Method Variance
CPR	Computer-based Patient Records
CPRE	Computerised Physician Request Entry
CSS	Clinical Support System
DIT	Diffusion of Innovation Theory
EHR	Electronic Health Record
EMR	Electronic Medical Records
EPR	Electronic Patient Records
ERP	Enterprise Resource Planning
ETP	Economic Transformation Program
FHA	Female-focused Health Applications
GOF	Goodness of Fit
GTP	Government Transformation Program
HCI	Human Computer Interaction
HIMSS	Healthcare Information Management and Support Service

HIS	Hospital Information System
HOT	Human Organization Technology fit
IAFC	International Accreditation Federation Council
ICT	Information and Communication Technology
ICU	Intensive Care Unit
IHIS	Intermediate Hospital Information System
IMR	Institute Medical Research
IS	Information System
ISQuA	International Society for Quality in Healthcare
JCI	Joint Commission International
LHP	Lifetime Health Plan
MCPHIE	Mass Customized/Personalized Health information and Education
MOH	Ministry of Health
MRI	Medical Research Institute
MSC	Multimedia Super Corridor
MSQH	Malaysian Society for Quality in Health
NHSE	National Healthy Society Executive
NICU	Neonatal Intensive Care Unit
OLS	Ordinary Least Square
PEU	Perceived Ease of Use
PLHP	Personal Lifetime Health Plan
PLS	Partial Least Square
PU	Perceived Usefulness
RMIIS	Radiology Management Inforamtion & Imaging System
SEM	Structural Equation Model

TAM	Technology Acceptance Model
TC	Teleconsultation Application
THIS	Total Hospital Information System
TOE	Technology Organization Environment Framework
TPB	Theory of Planned behavior
TPC	Technology- to- Performance Chain
TRA	Theory of Reasoned Action
TTF	Task Technology Fit
UTAUT	Unified Theory of Acceptance and Use of Technology
VAF	Variance Accounted For

KAJIAN PENGARUH FAKTOR MANUSIA ORGANISASI DAN TEKNOLOGI TERHADAP KEPUASAN PENGGUNAAN SISTEM MAKLUMAT HOSPITAL

ABSTRAK

Kajian ini adalah bertujuan untuk mengenalpasti isu dan faktor penghalang yang wujud di kalangan pekerja perubatan semasa menerimapakai sistem maklumat hospital. Kajian literatur yang sedia ada amatlah kurang, terutamanya dalam konteks Malaysia. Tambahan pula, kajian yang telah dijalankan lebih menumpukan perhatian pada sesuatu perspektif sahaja, antaranya termasuklah, dari segi perspektif pengguna, organisasi, atau pun teknologi untuk memahami faktor yang mempengaruhi penerimapakaian sistem maklumat hospital dalam industri perubatan. Maka, kajian ini melanjutkan rangka Manusia-Organisasi-Teknologi dengan mengintegrasikan ketiga-tiga perspektif tersebut iaitu dari segi pengguna (keupayaan diri dan pengalaman lampau), organisasi (norma subjektif dan keadaan meransang), dan teknologi (persepsi kebergunaan dan persepsi kesenangan mengguna) dalam memahami proses penerimapakaian sistem maklumat hospital.

Selain itu, penggunaan sesuatu teknologi bergantung kepada dua faktor yang penting iaitu ciri teknologi dan prestasi individu. Prestasi individu dapat ditingkatkan jika ciri teknologi tersebut dapat disesuaikan dengan keperluan tugas pengguan. Oleh itu, kesepadanan teknologi dengan tugas juga dimasukan dalam model kajian ini untuk menyederhanakan hubungan antara sikap dan kepuasan pengguna. Disebabkan kajian penyelidikan ini yang bersifat ramalan, teknik '*Partial Least Square'* digunakan untuk menguji hubungan di antara pembolehubah yang dikaji.

Keputusan ujian hipotesis menunjukkan persepsi kebergunaan, persepsi kesenangan mengguna, keupayaan diri, keadaan meransang, dan norma subjektif

mempunyai hubungkait positif dengan sikap pengguna. Disamping itu, hubungankait positif di antara sikap dan kepusasan juga dikenalpasti. Selain itu, sikap juga berperanan sebagai mediator dalam mengantarakan impak persepsi kebergunaan, persepsi kesenangan mengguna, keupayaan diri, keadaan meransang, dan norma subjektif terhadap kepuasan pengguna. Walaubagaimanapun, hubungkait di antara pengalaman lampau dan sikap didapati tidak bersignifikasi. Tambahan lagi, pembolehubah kesepadanan teknologi dengan tugas didapati berperanan untuk meramal kepuasan pengguna manakala peranannya sebagai penyederhana dalam hubugnan sikap dan kepuasan didapati tidak bersignifikasi.

Implikasi kajian ini menunjukkan penerimapakaian sistem maklumat hospital tidak terhad kepada faktor manusia, organisasi, atau teknologi, sebaliknya ia memerlukan kombinasi setiap pembolehubah tersebut. Kajian ini turut menegaskan kepentingan sikap dalam mempengaruhi kepuasan pengguna yang akhirnya bakal mempengaruhi tahap penggunaan sistem tersebut (diguna dengan minimum, diguna secara purata, diguna secara sepenuhnya). Pihak pengurusan dinasihati untuk menyelidik dalam rantaian nilai sistem maklumat hospital untuk mengenalpasti nilai ekstra yang dapat diperoleh dalam setiap tahap penggunaannya. Mereka juga dinasihati untuk mewujudkan pasukan kerja khas yang terdiri dari perkerja perubatan dan pereka sistem untuk berbincang dengan lebih terperinci dalam isu yang muncul semasa pembangunan sistem maklumat hospital. Pihak pengurusan seharusnya memberikan latihan kepada pekerja perubatan mengikut tahap penguasaan mereka. Akhirnya, mereka harus mewujudkan suasana kerja yang kondusif melalui visi dan ketabahan. Mereka juga harus mementingkan proses pengurusan pengubahan dalam hospital dengan melantik ketua perubahan untuk mempromosikan innovasi dalam praktis kerja melalui sistem maklumat hospital.

THE STUDY OF HUMAN ORGANISATION AND TECHNOLOGY FACTORS INFLUENCE ON HOSPITAL INFORMATION SYSTEM SATISFACTION IN MALAYSIA

ABSTRACT

This study aimed to understand the issues and barriers pertaining to ICT adoption in healthcare in Malaysia. There are very few studies of HIS adoption available in the literature, especially in Malaysia context. In addition, existing studies are mostly focused on a single perspective, either on the user perspective, organisation perspective or the technology itself in order to understand the factors which influence the adoption of information systems in the healthcare industry. Therefore, this study extended the Human-Organization-Technology Fit Framework to examine the HIS adoption in Malaysia by integrating human factors (computer self-efficacy and prior experience), organizing factors (subjective norms and facilitating conditions), and technology factors (perceived usefulness and perceived ease of use).

Other than that, technology usage is depending on two important factors which are technology characteristics and individual performance. Individual performance is improved if the technology attributes are able to fit with the user task requirements. Therefore, task technology fit is also added into the model to moderate the relationship between attitude and user satisfaction. Due to the predicting nature of this research study, partial least square structure equation modelling is used to examine the relationships among variables.

The result from hypothesis testing showed that perceived usefulness, perceived ease of use, computer self-efficacy, facilitating conditions, and subjective

norms were found to have a positive relationship with attitude. At the same time, attitude was found to have a positive relationship with satisfaction. Besides that, attitude was also proven to be a mediator to mediates the impacts of perceived usefulness, perceived ease of use, computer self-efficacy, facilitating conditions, and subjective norms to satisfaction. In spite of that, the relationship betweeen prior experience and attitude was found to be not significant. In addition, task-technology fit was also found to be a good predicator of satisfation rather than to be a moderator that moderates the relationship between attitude and satisfaction.

The implication of this study can be seen where the adoption of HIS is not limited to human, organization, or technology alone, but rather affected by the combination of each of the mentioned variables. In addtion, this study confirmed that attitude has a great impact on medical staff's satisfaction towards the system which indeed affect the level of usage (i.e., underutilized, average utilized, overutilized, or sabotage). Policy makers are advised to investigate into the value chain of HIS to identify how HIS usage can provide extra values in each stage of the process. They are advised to organise a task force which includes medical staff, system designer, to have further discussions into the issues and to develop a HIS, which is user-centric not as a means to an end. They should also provide training for different levels of proficiency in using HIS, for instance beginner, moderate, and expert user. Meanwhile, they should create a conducive environment through a clearer vision statement and determination, in the hospital to promote HIS adoption. Finally, policy makers should emphasize on the change management process in the hospital by appointing a change leader in the hospital to promote the innovation in work practices through HIS.

CHAPTER 1

INTRODUCTION

1.1 Background Study

Today, medical staff and patients face great pressures from the healthcare environment. From the medical staff's perspectives, their frustration is stemming from heavy patient loads, administrative tasks, and losing patient care decision control (Mechanic, 2003), meanwhile, patients complained that more attention should be allocated to them during the medical interaction (Kassirer, 2000). Doctors spend too little time on listening to the patient's problem and interacting with the patient is one of the major cause resulting patient's dissatisfaction. Hence, the demanding nature of patients has called for the transformation of the healthcare industry in their work practices in order to fulfil the expectation. 24/7 access to the medical service especially from the public hospital, effective appointments scheduling system, individual electronic access to personal medical health records, shorten waiting time and prolong interaction time are the main expectation of the patients (Meyers, 2003).

On the other hand, increasing in technology usage and higher education level has made patients today more technology savvy and hence patients tend to replace conventional daily routines to electronically enable mode like using email, and NET Messenger Services. Thus, patients are becoming more demanding on similar electronic services from the medical sector. Unfortunately, the health community is making slow progress in meeting up to these demands. Even in a developed country like the United States of America (USA), only 21% of the American physician used electronic medical records (EMRs) in 2010 (Stone, 2010) compared to the year 2009

whereby only 17% of U.S. hospitals were equipped with computerised physician order entry (CPOE) (Ashish, et al., 2009).

As the prime healthcare provider in the country, the Malaysia government together with the private sector provide a comprehensive range of healthcare services to the people at an affordable price. Unfortunately, factors like changing pattern of death caused by infectious diseases to chronic diseases, population structure, lifestyle, and healthcare service expectation from the people have distorted the status quo. Malaysia's healthcare spending has been increasing every year. According to Economic Intelligence Unit (2009) in the year 2005, Malaysia healthcare spending recorded at RM22 billion (Figure 1.1) with the amount of spending rising each year and recorded at RM30 billion in the year 2009, an increment of 36.4% over the 5 years. The amount is estimated to reach RM42 billion in the year 2014, almost 91% increment in 10 years' time. The government is facing great pressure in reducing the healthcare cost while continuing to improve healthcare quality.

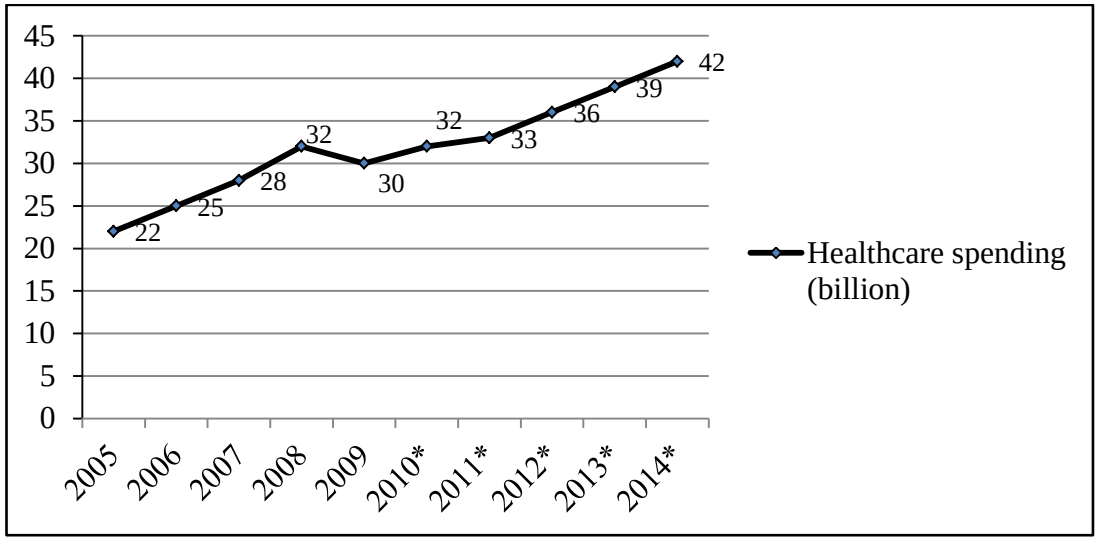

Figure 1.1 Malaysia Healthcare Spending 2005 – 2014 (Economic Intelligent Unit, 2009)
**Year 2010 – 2014 is the forecast from the Economic Intelligent Unit*

Furthermore, the problem of global shortage of medical staff makes the matter worse. In order to provide high quality healthcare service, a large number of

manpower is needed especially skilled workers. According to the World Health Report (2006b), there is a crucial shortfall of medical staff especially in developing countries which represents a total of 2.4 million deficits of medical staff worldwide. In the Malaysian context, the country faces the shortage of medical staff especially nurses. In the year 2010, the number of nurses available in Malaysia was 69110 and the nurse over population ratio equals to 1:410 (Table 1.1). It is estimated that to realize the national vision of 2020, Malaysia requires more nurses in the country in 2020 to reach the target of 1:200 nurse over population ratio, in line with the ratio in neighbouring country like Singapore (Cruez, 2006).

Table 1.1 Total number of nurse/population ratio in Malaysia 2005 -2010 (Ministry of Health Malaysia, 2011)

Year	Total number of nurses	Nurse/Population ratio
2005	44120	1:592
2006	47642	1:559
2007	48916	1:556
2008	54208	1:512
2009	59375	1:477
2010	69110	1:410

The cost and the manpower shortage problems were part of the many problems encountered by the healthcare provider today. Therefore, an effective and economic solution needs to be introduced to solve the problems. One of the solutions is to integrate information and communication technology (ICT) into the healthcare sector. The reason for the increased productivity of service provided in developed countries since early 1990 is being innovated through IT-enabled process redesign (Davenport & Short, 1990). Adoption of ICT in healthcare is able to bring many benefits including reduced medical error rates, increase efficiency, cost effectiveness and increase the involvement of patients in healthcare decision making (Zang, Patel, & Johnson, 2002). Therefore, healthcare service redesign through integrating ICT-

enabled function is in need in order to cater the increasing demands of the society on healthcare services.

The core ICT integrated in the Malaysia healthcare system is called Hospital Information System (HIS). This system provided many benefits; it serves as a repository for valuable data which helps in hospital data management. It allows projections, statistics and record tracing activity to be done more easily and systematically through its automated system. As a result, the hospital does not require extra manpower to do those tasks mentioned because everything is automated. Thus, better allocation of manpower can be achieved where the excess manpower can be assigned to the tasks which are more urgent. Better storage will result better retrieval and subsequently cutting down the waiting time for a patient to receive treatment. On the other hand, patient safety can be enhanced through integrating an information system in healthcare. Patient safety is secured through speedy retrieval of records, immediate availability of result, and reduced treatment error. In addition, using information system in the laboratory will also ensure the correct test is performed and accurate result is collected from a specimen. Thus, it helps in reducing man-made error in the laboratory.

The benefit of adopting ICT in healthcare is even more significant where the Malaysian population growth rate will remain high in the next 20 years comparatively to the slow economic growth resulting Malaysian population young but poor (Lee, 2010). Thus, it can be foreseen that increasing government pressure in providing major healthcare service to the society in the future. Therefore the Malaysia government had taken the initiatives to integrate ICT in the local healthcare sector. The initiatives can be seen through the Seventh Malaysia Plan (1996-2000), the plan stated that around 33 paperless public hospitals will be established within

the plan. A total of 8 hospitals will be using Total Hospital Information System (THIS) while 25 smaller hospitals will be equipped with Hospital Information System (HIS). But until the Ninth Malaysia Plan (2006-2010), only two paperless hospitals were established in the country while other hospitals are still on hold (Sapiah& Rose, 2006). Some of the hospitals are still testing the system and not fully operated.

Therefore, the purpose of this study is to develop a comprehensive theoretical framework stemming from the field of technology and healthcare management to understand the medical staff technology adoption factors in Malaysia, a developing country context.

1.2 The Malaysian Healthcare Service

The history of Malaysian healthcare services began even before the country gained its independence. The hospital was built that time mainly to serve the purpose of providing medical treatment to the workers in the tin mining industry (Castro, 2009). Every of the ore miners were required to pay 50 cents annually as to receive medical treatment from the hospital. In the 19th century, tin ore industry grew rapidly and resulted in more hospitals to be built in Perak, a state in Malaysia which is rich in tin resources. The hospitals were Hospital Taiping, Teluk Intan, Tapah, Sungai Siput, Slim River, Sri Manjung, Selama, Parit Buntar, Kuala Kangsar, Kampar, Ipoh, Grik, Changkat Melintang, Batu Gajah and TanjungRambutan (Chee & Barraclough, 2007).

In 1880, Hospital Taiping the oldest hospital in Malaysia was built and called Hospital YengWah. Hospital Taiping was the first hospital in Malaysia to equip with x-ray facilities (Chee & Barraclough, 2007). In the following years, Institute Medical Research (IMR) was established due to the rampant spread of infectious diseases like

malaria and beriberi (Ministry of Health Malaysia, 2010). The existence of IMR was to explore the potential resolution to the problems and performing research to seek the cause of the problem. Besides that, IMR also served the function to prevent subsequent diseases which were caused by malnutrition, smallpox, and rabies. As a result, in 1928, Entomology Department and Malaria Advisory Board was established in the country (Ministry of Health Malaysia, 2010). Subsequently, Nutrition and Biochemistry department, Bacteria and Pathology department were also established to meet the needs of the country in delivering better healthcare services.

After Malaysia was independent from the British colonization, the government steered the focus towards improving the social-economic status of the rural area. In 1957, there were a total of 65 hospitals in the country. The health department showed great efforts in improving the Malaysian healthcare services. The department emphasized on the development and upgrading of the already existing healthcare services. General hospitals, health centres, midwife houses and clinics were built in correspond to the effort of enhancing local healthcare services (Ministry of Health Malaysia, 2010).

In 1964, Drug and Store Laboratory was established in Petaling Jaya. Parallel with the growth of pharmaceutical field, the Pharmaceutical Service Department established in 1974 to provide better service to the people. National Control of Chemistry Drug Laboratory was developed under the PSD to carry out research on the pharmaceutical product (Ministry of Health Malaysia, 2010).

The Ministry of Health (MOH) continues to grow with additional health facilities every year. MOH has become a role model for other neighbouring countries in cardiology and geriatric (Malaysia Healthcare Travel Council, 2010). Nowadays,

MOH has widened its focus especially on providing easy access, equality and high quality medical service to the people. As a result of globalization and advancement in technology, MOH is striving to improve the quality of the healthcare service according to the trend of development internationally (Ministry of Health Malaysia, 1997).

1.3 Malaysian Healthcare Vision, Mission and Goals

Malaysia has reached a defining moment in its development path. The government has planned a blueprint to move the country towards its next stage of development. The intention is based on four important programmes which are 1Malaysia, Government Transformation Programme (GTP), Economic Transformation Programme (ETP) and the 10th Malaysia Plan. The four programmes are vital in realizing the national vision of 2020 in bringing Malaysia to an advanced and united society where people enjoying high quality of life. As a result, health standard is one of the important pillars in determining national development and ensuring the level of society's well-being.

The Malaysian healthcare vision stated by MOH aimed to develop a nation working together for better health. Leading Malaysians to be a nation of healthy individuals, families and communities, through a health system that is equitable, affordable, efficient, technologically appropriate, environmentally adaptable and consumer-friendly, with emphasis on quality, innovation, health promotion and respect for human dignity and which promotes individual responsibility and community participation towards and enhanced quality of life.

In order to achieve this vision, MOH has embarked on its missions which is dedicated to build a partnership, facilitate and support the people to attain fully their

potential in health, to appreciate health as a valuable asset and take responsibility and positive initiative in maintaining their health. Meanwhile, MOH strives in its mission to ensure high quality health system that is customer centred, equitable, affordable, technology appropriate, efficient, innovative and environment adaptable. This system emphasizes on professionalism, caring and teamwork value while respecting human dignity and community participation.

1.4 Telemedicine in Multimedia Super Corridor (MSC)

In 1996, Multimedia Super Corridor (MSC) was launched by the Malaysian government which intended to nurture the vision 2020. This project clearly defines specific goals and objectives in the development of the country in order to achieve the national vision of 2020. Initially, MSC projects emphasized on several ambitious projects which named as flagship project. This project was launched as to ensure rapid development and deployment throughout the country. The area targeted for intensive development were (1) Electronic government, (2) Multi- purpose card, (3) Smart school, (4) Telemedicine, (5) Research and development (R&D) cluster, (6) Worldwide manufacturing web and (7) borderless marketing.

The prime objective of MSC-based telemedicine is to establish a healthcare system leveraging advanced information and multimedia technology so as to deliver previously unattainable healthcare service at the individual, family and community level (Abidi, Goh, & Yusoff, 1999). The Telemedicine Blueprint of Malaysia, 1997 "Leading Healthcare into information age" is a reference document for the development of telehealth in Malaysia. The blue print states the needs for a transformation in the healthcare system in Malaysia in order to meet the challenges of a changing pattern of disease from infectious disease to lifestyle diseases, rural-

urban migration, increased life expectancy, increased expectation of consumer and rising healthcare cost (Ministry of Health Malaysia, 1997).

The objective of MSC telemedicine is to establish a personal wellness focused system where ensuring people to enjoy a high level of health status throughout their lifetime. There are four key projects in MSC telemedicine in order to achieve this objective which aligned with the vision of MOH. The projects include (1) customised/personalised health information and education, (2) continuing medical education (CME), (3) teleconsultation and (4) lifetime health plan (LHP). The first two projects aimed to provide the services of information and education towards the public and community regarding their health-maintaining issue. Then, Teleconsultation involved the linkages between the public and the healthcare service provider through multimedia connectivity in order to enhance and advance the health searching process performed in the traditional way in the past. Lastly, the LHP focus on developing a healthcare platform to allow primary healthcare provider or the general hospitals to deliver personal lifetime health plans (PLHP) to the public.

LHP is considered as the most complex project under the MSC telemedicine flagship as it involved continuous personalised contact with healthcare providers. The successfulness of the LHP depended on the existence and the ability to control of Electronic Medical Records (EMR) compiled over an individual lifespan (Abidi, Goh, & Yusoff, 1999). The process of transforming medical records from ordinary written style to electronic style may be time consuming to practitioners especially when it involves patients with complex medical history. Meanwhile, a standard method is required to record and integrate new information into the system to allow following appropriate diagnosis to be taken. Therefore it is very important to ensure the accuracy of EMR to medical professionals to guarantee a high quality of

healthcare is delivered. The functionality of LHP projects can be categorized into three broad components which are The Clinical Support System (CSS), The Healthcare Information Management and Support Services (HIMSS) and PLHP.

1.5 Electronic Health Record (EHR) overview

EHR is a platform which composed of a variety of subsystems including clinical data repository, clinical decision support system, controlled medical vocabulary, computerized provider entry and pharmacy and clinical documentation applications to provide the services of documentation, monitoring and managing care delivery within the care delivery organization (Garets & Davis, 2005). Meanwhile, EHR also refers to a computerized health history of an individual that can be viewed as a collection of electronic medical records and other health-related information to be used and viewed primarily by care providers (Tang, Ash, Bates, Overhage, & Sands, 2006).According to World Health Organization (2006a), several terms has been used to describe the movement towards paperless health records management system in healthcare. Some of the terms include Automated Health Records (AHR), Electronic Medical Records (EMR) and Computer-Based Patient Records (CPR).

Automated Health Records (AHR) refer to a collection of traditional health records documents which were scanned into computer and stored as images on optical disks. This approach is used in the early 1990's as to address the access, space, and control problem related to paper based records but did not address data input/output at the patient care level.

Advancement of AHR breeds a new term which is the EMR. EMR encompassed more functions than AHR in the way that EMR allows the practitioner to enhance the patient care level through a systematic way of data management.

EMR is extensively used in patient identification details, medications and prescription generation, laboratory results and healthcare information records.

In 1990's a new term was introduced, the Computer-Based patient Records (CPR). CPR provides a link for patient and health practitioner, focusing on exchanging a collection of health information within the inpatient facilities. Basically CPR serves the function of medical alerts, medication order, patient's registration, financial details and information from pharmacy, laboratory result and nurses records.

Despite a variety of terminology introduced, Electronic Health Records (EHR) is the most widely used nowadays. Although different countries may have variations in defining and extent of coverage, EHR is basically defined as a continuing compilation of a patient's health profile, behavioural and environmental information that foster additional information from multiple providers which will finally evolve into a lifetime record (Amatayakul, 2004).

Although EHR does not have a standard definition, basically it involved a continuous collection of health information accessed in the electronically by health care providers. The records vary according to the kind of information collected ranging from all patient data to certain types of restricted data such as medication list or lab results (Leonard, 2004).

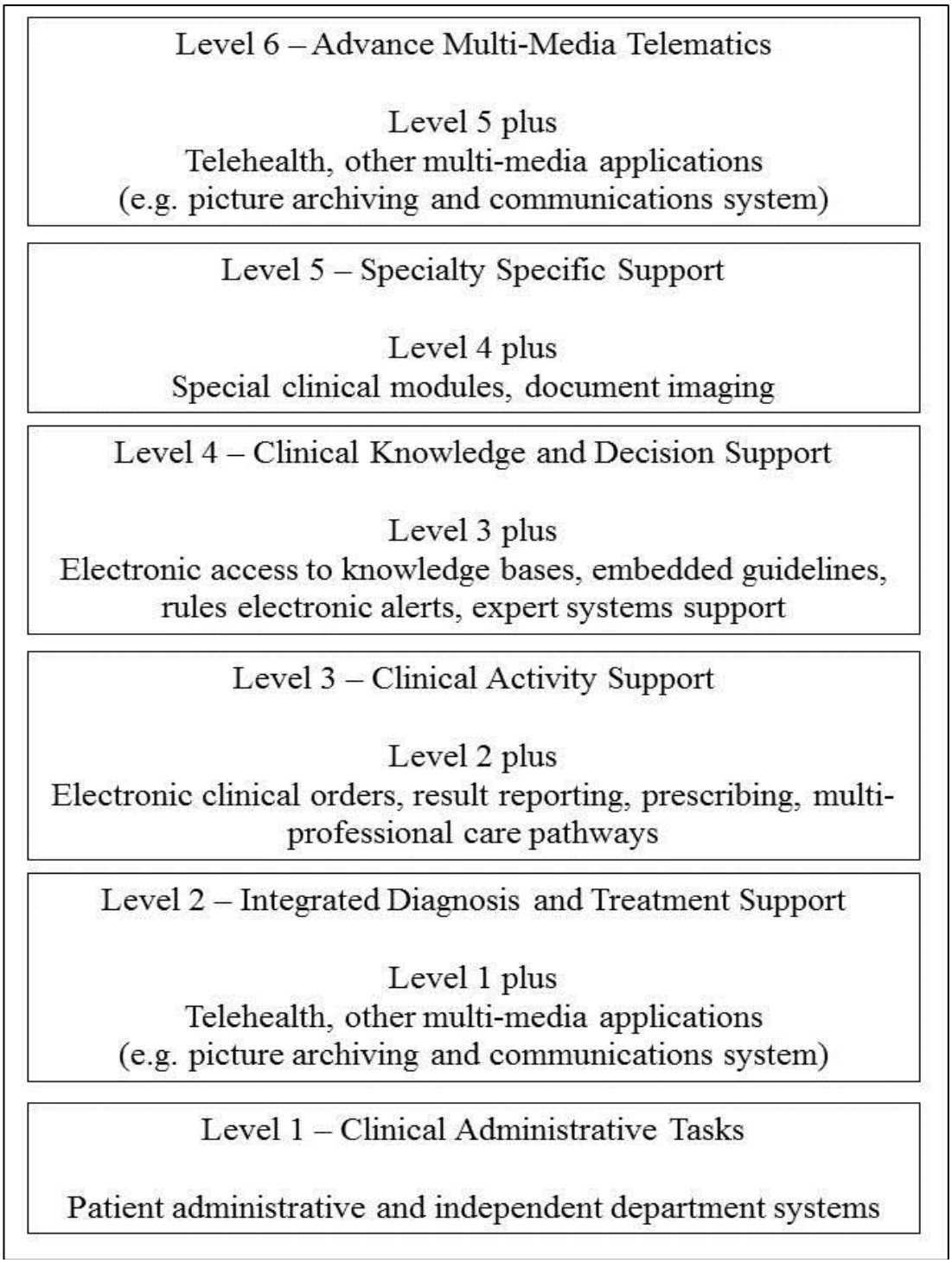

Figure 1.2 Electronic Health Record Level

A six level of Electronic Health Record (EHR) was introduced in the United States of America by the National Healthy Society Executive (NHSE) in the year 1998 (Haslina & Sharifah, 2005). The EHR level demonstrated how electronic health

system is developed based on different functionality. Figure 1.2 illustrated a more complicated function provided by the EHR system.

On the other hand, Medical Record Institute clearly categorizes the evolvement of healthcare information system into five distinct stages (Haslina & Sharifah, 2005). The evolvement is illustrated in Figure 1.3. The initial stage is the Automated Medical Record (AMR). In this stage paper records are still required but some initiatives have been taken to start reducing the use paper in the record management system. Then, the second stage is the Computerized Medical Record (CMR), the computer is widely used in this stage where data is scanned and stored into the computer. The use of paper is eliminated. Following, the third stage is called Electronic Medical Record (EMR), this stage allows users to record the diagnosis process, healthcare plan and placement orders. At this moment EMR is more dedicated for the user to track the information related to the patient. The fourth is the Electronic Patient Record (EPR), this stage involved community, regional, nation and international partnership where interchange of information from EMR is allowed. Lastly, the Electronic Health Record (EHR), at this stage the information system is built more to user oriented where the patients are required to enter all their personal health data.

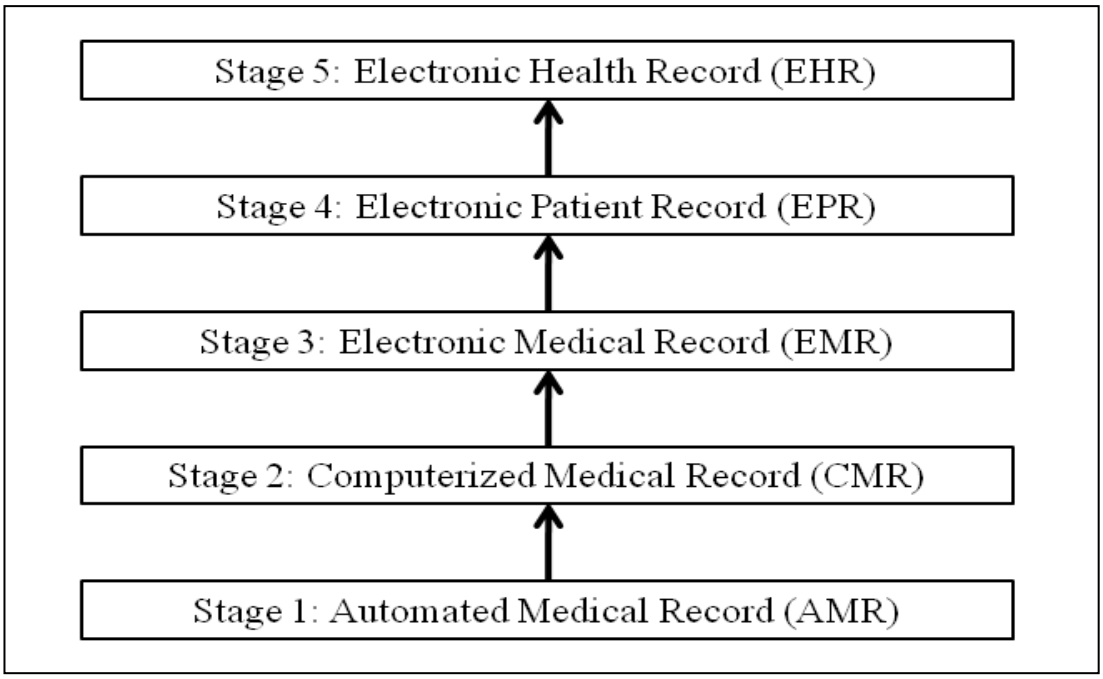

Figure 1.3 Five Stages of Healthcare Information System

1.5.1 Integration of EHR –Hospital Information System (HIS)

Patient records which are stored and demonstrated electronically in the hospital information system are the backbone that allows functions like patient monitoring, administration and care to be performed. Therefore, EHR and other electronic patient healthcare records system are conceptually the subset of the hospital information system. Hospital Information System refers to an information system that performs the function of processing data, information and knowledge in the secondary and tertiary healthcare levels. This system involved several information units such as electronic patient database and communication platforms that allow data access, retrieval, presentation and distribution among different personnel for the purpose of research, education, and teleconsulting (Wilhelm, 2008). There are some important roles to be played by HIS and according to Günther and Thomas (2008) HIS plays the following important roles:

Clinical Order Entry. This is one of the most important functions in any of the healthcare related information system. It involves patient ordering for examination, appointment for physiotherapy or operations, and asking for clinical counselling. This function allows patients to deal with the hospital even before they are admitted into the hospital. Hence it may happen via online system or telemedicine.

Scheduling. HIS serves as a centralised tool that allows all resources and functions arms to be synchronised. This ensures that all procedure and diagnosis and therapeutic sequence are in a timely and semantic manner. Thus achieving the goal of cutting down the waiting time on inpatient-day and provide quality healthcare service.

Electronic patient record. This is a platform where all records created during the interaction between the patients with the hospital are stored in a professional way. Diagnosis report, lab result, administrative records and etc. are stored in a safe an effective way. Authorised users can trace the record easily to better understand their patient or customer needs. Thus creating a patient-oriented environment where patients health is always prioritize.

Structured reporting. HIS allows interactive presentation of data and records on screen replacing the ordinary paper-oriented reports. HIS integrated into its own database and allow the image to be present together with the fact and data.

Process management. The users are offered with the overviews of his/her workload and activity according to his/her role and duty. Meanwhile, clinical pathways can also be shown to identify the activities to be done at every step of getting the patient to receive treatment. HIS can reduce workload by avoiding recurrent activities and alerting the user with a to-do list according to their role.

Hence improving the flow of the treatment process and lighten the burden of healthcare service providers. Figure 1.4 provides a visual representation of the various functions provided by a typical HIS.

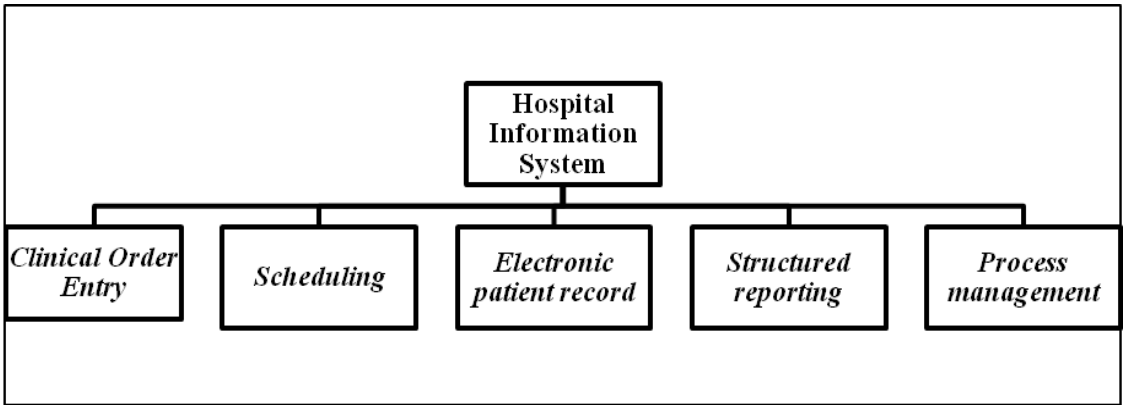

Figure 1.4 General functions provided by an HIS (Günther & Thomas, 2008).

1.5.2 Hospital Information System (HIS) in the Malaysian context.

There are three types of hospital information system introduced under the telehealth project in Malaysia. The hospital information systems introduced are Total Hospital Information System (THIS), Intermediate Hospital Information System (IHIS), and Basic Hospital Information System (BHIS) (Hassan, 2004). The implementation of the type of hospital information system is based on the number of beds that the particular hospital have. Hospitals that have more than 400 beds will be classified as THIS hospital, while hospitals that have a number of beds between 200 and 400 will be classified as IHIS hospital. Lastly BHIS hospital is classed for those hospitals that have less than 200 beds. The scope of different types of HIS in Malaysia is shown in figure 1.5.

BHIS	**IHIS**	**THIS**
Patient Management System + Clinical information System + Order Management and Reporting System + Billing System	Basic HIS + Pharmacy Information System + Laboratory Information System	Intermediate HIS + Radiology InformationSystem + Administration +Financial + Inventory + Personnel +Kitchen + Operating Room Management Systems + Decision Support + Case Mix System
Teleradiology and Teleconsultation Systems, Longitudinal Health Record System and Health Information Management Reporting System linkage to National Smart card system and E-government application and Lifetime Health Record application		

Figure 1.5 Scope of Basic, Intermediate, and Total Hospital Information System (Suleiman, 2008)

Hospital Selayang was the first hospital in the country to integrate THIS in the year of 1999 (Hadis & Hashim, 2004). THIS in Hospital Selayang integrates clinical, administrative and financial management, enabling the seamless flow of information among different departments. The objective of integrating THIS is to provide integrated care delivery system which emphasizes on sharing of information, automation of work processes, improves efficiency and better storage and usage of data. Through THIS, the hospital aims to improve their service delivery by focusing on the patient, enterprise-wide information and management system in order to maximize the efficiency and utilization of their staff (Hameed et al., 2008). Various functions in Hospital Selayang has been computerized, for example appointment and scheduling, registration and discharge, documentation of clinical data, ordering task and tests, ordering drugs and supplies, entering the results of procedures and tests,

viewing results, and referral and communications among medical staff. For appointments and scheduling, the medical staffs share a common scheduling book in the THIS where it can be viewed by all authorised medical staff at anywhere anytime. The patients can call in or walk in to make the appointments with the hospital. All the clinical data recorded will be documented using electronic forms where all the clinical problems and the diagnosis result will be entered into a problem list in the electronic forms while allergy issues will be key in the another list called the allergy list. This type of form also helps doctors not to miss certain important clinical history and finding. The example of structural clerking form for doctors is shown in Figure 1.6.

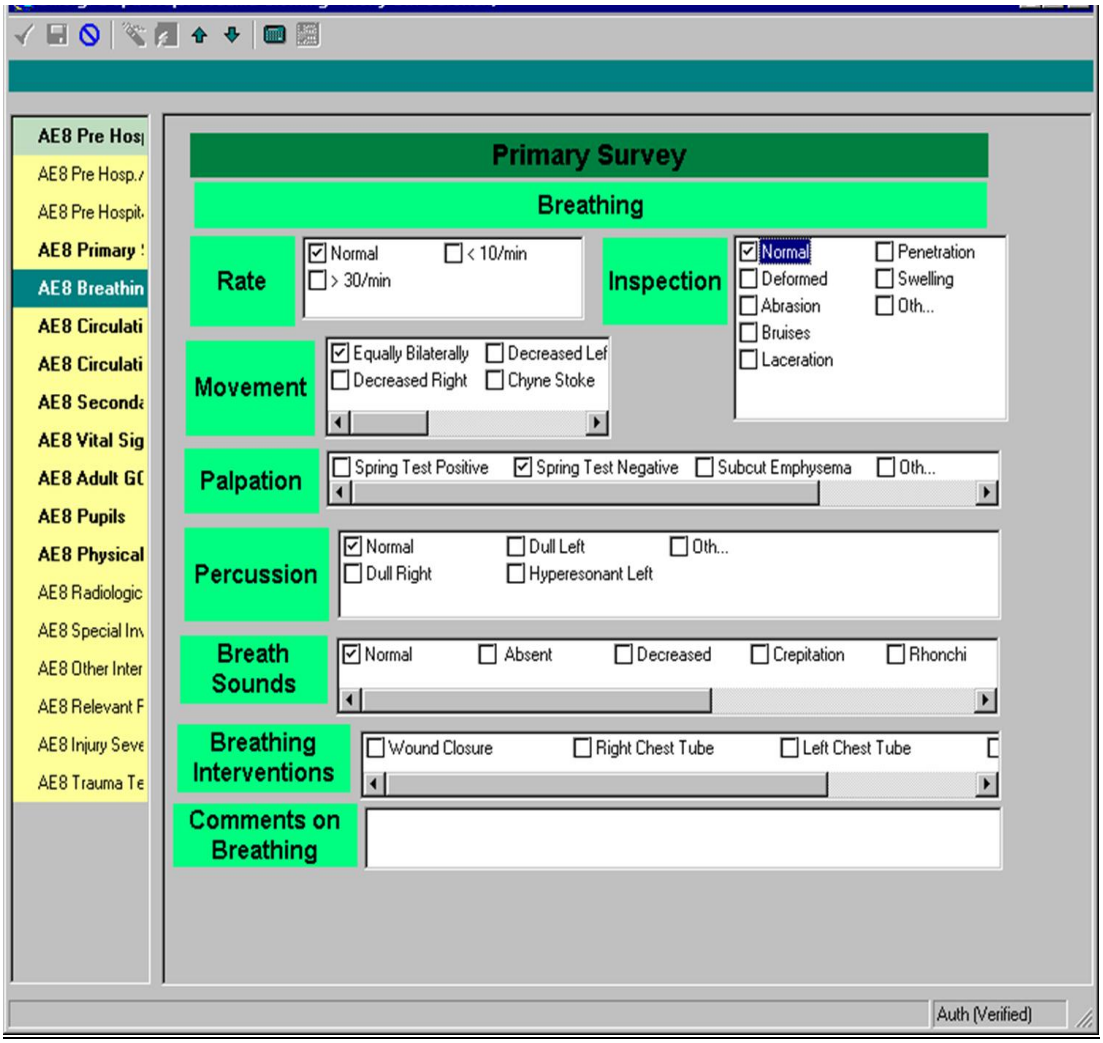

Figure 1.6 Structured Clerking Forms in THIS from Hospital Selayang.

In the ward round, medical staff can retrieve the patient's medical record by using wireless computer to connect to the central hospital database system. Besides, bar code technology will also be used for handling specimens from the patients whereby each of the patients is given a unique identifier. Therefore, the lab assistant will just need to scan the bar code on the specimens and all the patient information will be shown on the system. Subsequently, all the medical treatments and tests done on the patients will be stored in the patient medical records as an object in the database and the cost for each of the treatments will be charged accordingly. The elements involved in THIS are simplified in the system architecture in figure 1.7.

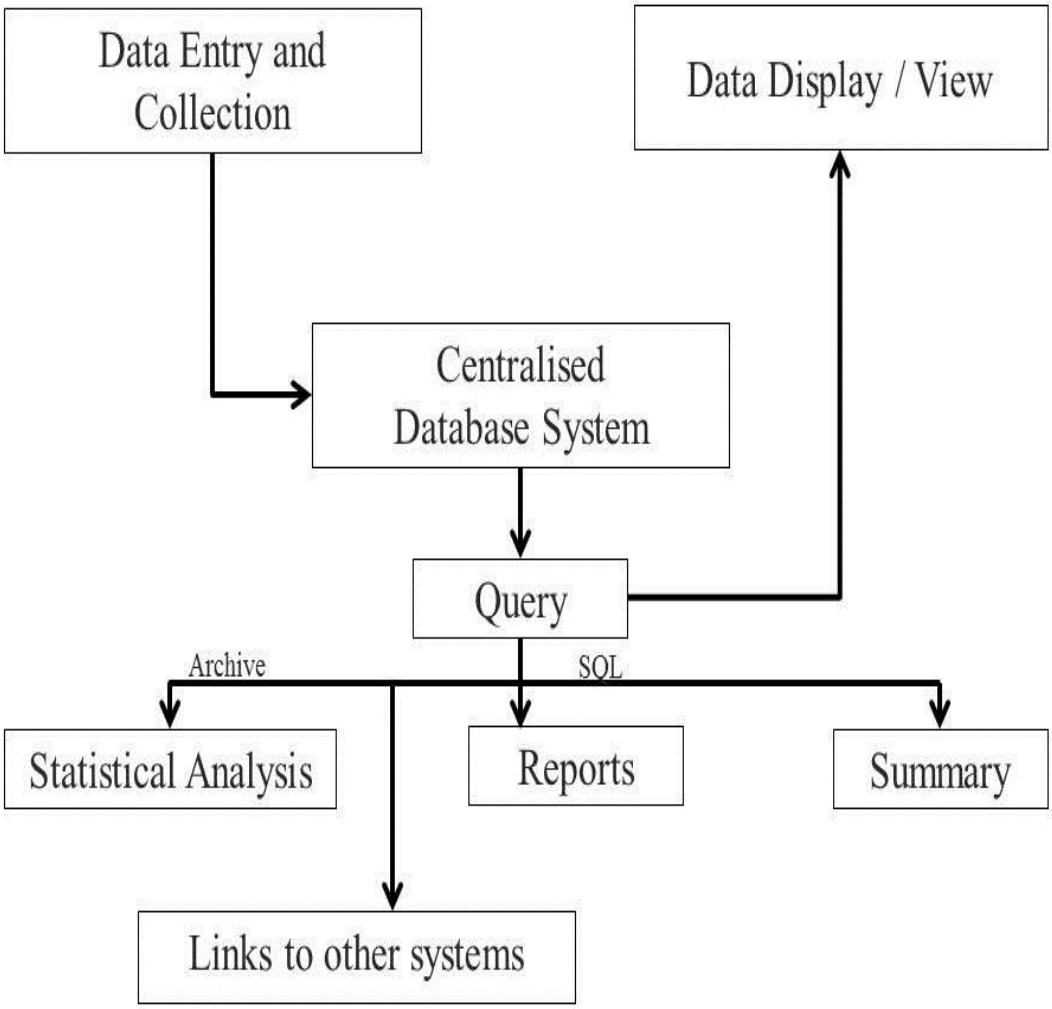

Figure 1.7 THIS System Architecture (Salleh, 2010)

Hospital Putrajaya was the second hospital integrating THIS into the daily operations in the year 2000 (Leong, 2005). THIS application in Hospital Putrajaya contains several modules like EMR, Management System Sterilization Services, Dietary System, Pharmacy Information System, Operating Theatre Management System, Staff Scheduling, Material Management System, and Labour and Delivery System (Ministry of Health, Malaysia, 2012). The integration of THIS reduced the waiting time for patients to receive their medication. In addition the system also improved the efficiency of medicine delivery where medicine or drug can be sent to the ward directly bypassing the hassles of nurses or other clinician to collect the medicine from the pharmacy. The hospital also used online transaction order management system where the medical staff can arrange necessary medical treatment to the patient through an order entry interface. The order-entry interface is shown on figure 1.8.

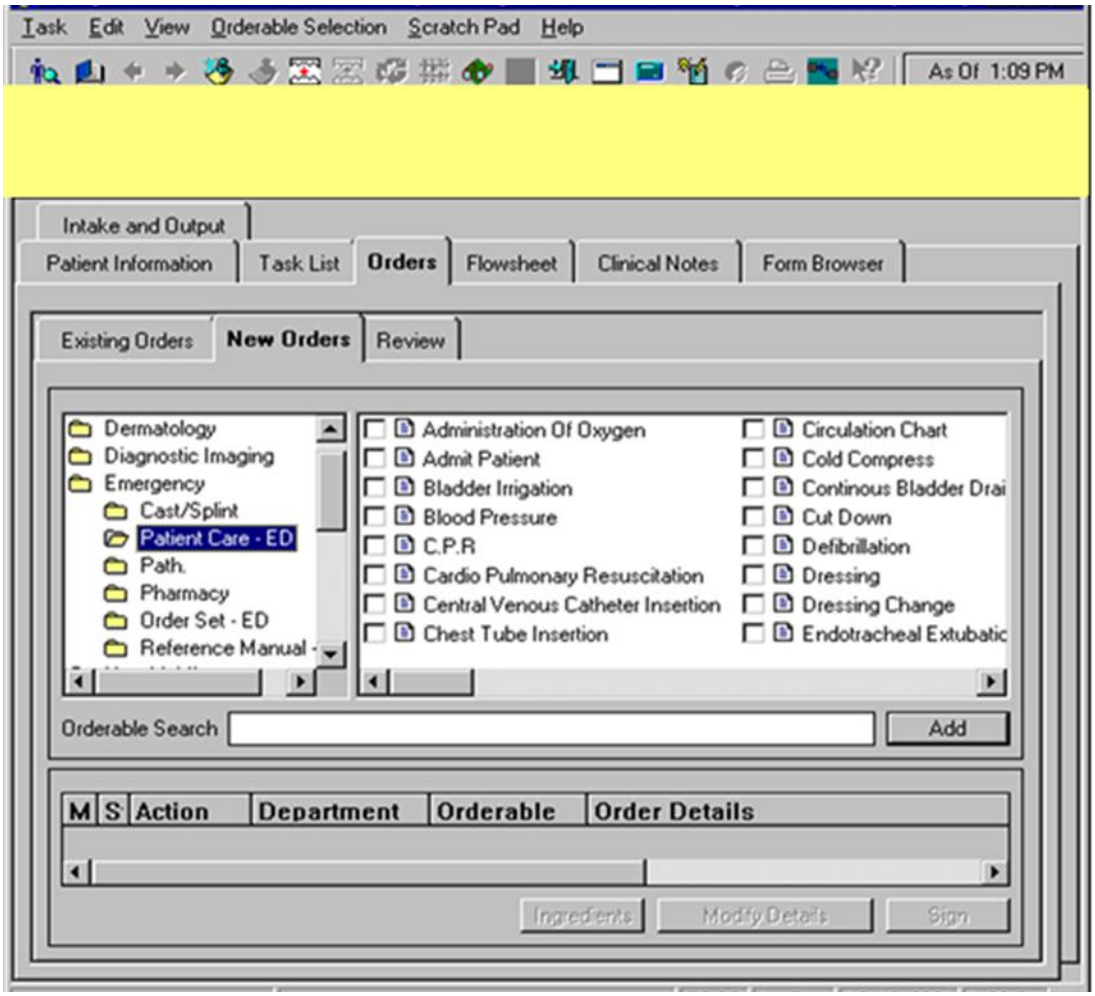

Figure 1.8 The Order Entry Interface

All the orders requested through the THIS will be recorded in the patient medical record in the form of EMR and the finance department may charge the patients accordingly by retrieving the records through the centralized database system.

Universiti Kebangsaan Malaysia Medical Centre (UKMMC) developed its own THIS (Ismail et al., 2010). The THIS developed by UKMMC is called Caring Hospital Enterprise System (C-HEtS), it seems to be cheaper than similar systems available in the market. The system was developed using Oracle Database. C-HEtS implemented patient monitoring system in their special ward for example Intensive Care Unit (ICU), Cardiac Care Unit (CCU), Neonatal Intensive Care Unit (NICU)

and other wards that required constant monitoring. The system works where all data collected for example the blood pressure and oxygen saturation level from the bedside of the patient is linked to a central monitor in front of the clinician desk through Ethernet LAN connection. Therefore, an alarm will be triggered when an abnormal condition is detected from the patient. And thus doctors can respond to the abnormalities immediately. The system architecture in C-HEtS is shown in Figure 1.9.

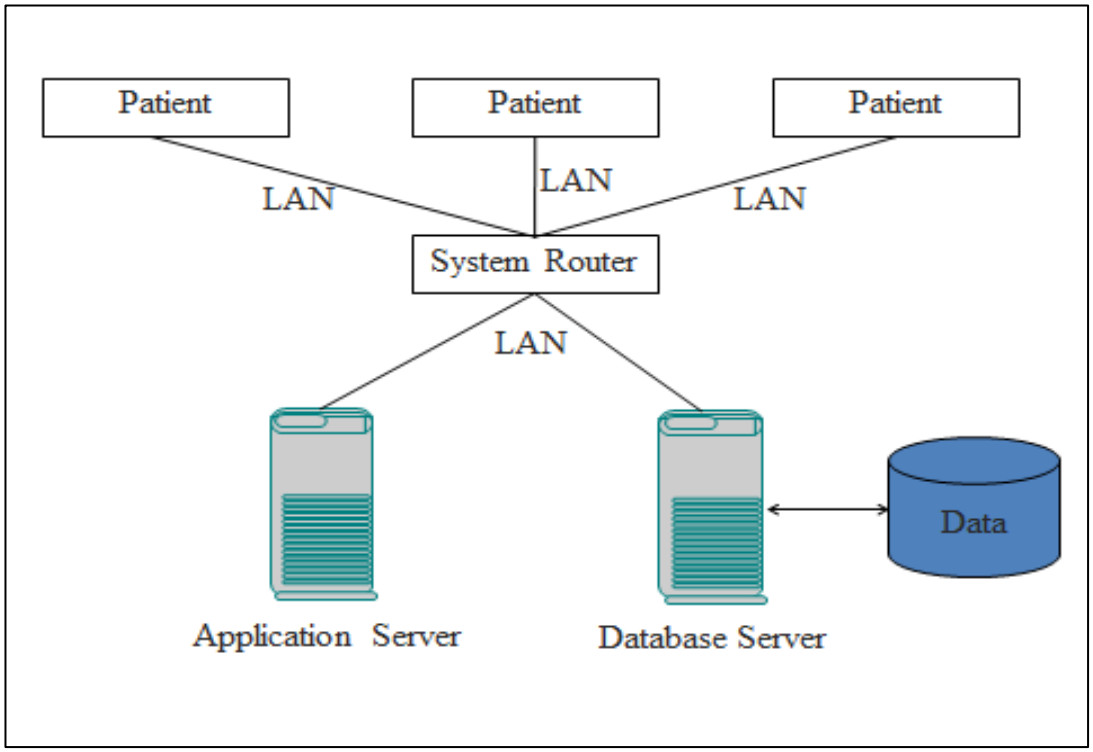

Figure 1.9: C-HEtS System Architecture

In the second phase of implementation of C-HEtS which started since 2008, the system will be emphasizing on expanding the scope to cover the Computerised Physician Request Entry (CPRE), Patient Centric View, Patient Portal, Radiology Management Information & Imaging System (RMIIS) and Research Management. The objective is to replace the existing application of Order Management Systems, integrating different applications which are currently used by different departments, improving the efficiency of medical staff especially in order entry management,

foster the application of research, and provide a portal for patients to reach UKMMC easily (Information Technology Department, UKM). Through the second phase C-HEtS, medical staff is able to make an appointment for all the medical treatment needed by the patient via the system, updating the patient medical records, prepare and verify reports, prescription of drugs, collecting and labelling sample and specimen, payment process, and access to patient portal (Information Technology Department, UKM).

1.6 Problem Statement

Health Information Technology has been identified in many literatures to be the tool to improve healthcare delivery. Hospitals that have a HIS in place are more likely to incur significant efficiencies in improving their productivity (Ford, Huerta, Thompson, & Patry, 2012). Patient- medical staff relationship will be improved and patients will become more educated when hospital information technology is integrated (Hunt, et al., 2009). The study showed that IT-enabled healthcare delivery process will increase about 6% in the value-added in healthcare delivery (Lee, McCullough, & Town, 2012). In spite of that, less than half of the medical staff in developing countries used Electronic Health Record (EHR) and only a fraction of patients have Patient Health Record (PHR) (Rothstein, 2011). Implementing HIS is not just the installation of computer, it required a redesign of work process, job scope and practices and employees' roles and responsibility (Ford, Huerta, Thompson, &Patry, 2012). Successful use of HIT to improve healthcare delivery requires attention to specific implementation issues and strategies (Young, et al., 2007). Therefore, Table 1.2 shows different benefits gained through IT-enabled healthcare delivery.

Table 1.2: Hospital Information System improves healthcare delivery

Study	Objectives	Finding
Patkar et al., (2006)	To determine the effect of Decision Support System (DSS) with and without guidelines for assessment of breast cancer patients	Clinicians made significantly more deviations from guideline without DSS. Opinions of clinicians towards DSS were positive.
Roberts, Ward, Brokel, , Wakefield, Crandall, & Conlon, 2010	Health information technology (HIT) or health information systems (HIS) on the quality of healthcare, focusing on clinician adherence to evidence-based guidelines and the corresponding impact this had on the patient Clinical outcomes.	Hospitals with computerized provider order entry (CPOE) and an advanced Clinical Decision Support System (CDSS) captured significantly more ADE alerts for pharmacist review
Hunt, et al., 2009	To determine the impact of a physician directed multifaceted health information technology (HIT) system on diabetes outcomes.	Significant improvements were observed in all diabetes related outcomes. Mean patient satisfaction remained high, with no significant difference between baseline and follow-up
Boulter, 2009	To determine the effect of innovative automated physical letter system in improving patient communication process	Achieved 20% in cost saving in patient communication process.
Cook & Foster, 2009	To study the Impact of Health Information Technology (IHIT) scale tool to measure the perception of nurses of the impact of HIT to interdisciplinary communication and nurses satisfaction with HIT	HIT changes the central communication role of the nurse, it has the positive benefits of improving access to information to support communication and increased nursing participation in the clinical care planning and decision making process.