DEVELOPMENT OF IMPLEMENTATION MODELS FOR
HOSPITAL INFORMATION SYSTEM (HIS) IN MALAYSIAN
PUBLIC HOSPITALS

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DEVELOPMENT OF IMPLEMENTATION MODELS FOR HOSPITAL INFORMATION SYSTEM (HIS) IN MALAYSIAN PUBLIC HOSPITALS

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A thesis submitted in
fulfilment of the requirement for the award of the
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DEDICATION

I dedicated my work to my beloved husband, Wazli..

My beloved mother, Norrisah..

My beloved grandmother, Hajah Fatimah..

My brother, Faizul, and all my families,

Without them, I would not go this far.

Thanks for your love, caring, understanding and huge support.

I love you all till ‘Jannah’.
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ABSTRACT

Studies have shown that Hospital Information System (HIS) implementation improve hospital’s management and activities in terms of cost and time reductions. However, there are only 15.2% out of 138 Malaysian Public Hospitals implemented HIS. Literatures have further highlighted various issues and challenges with regards to its implementation. Therefore, this study aimed to explore the implementation of THIS, IHIS and BHIS’s hospitals as well as factors affecting them. This study employed a mixed methods approach to answer the research objectives. In the first phase of this study, semi-structured interviews were conducted with nine participants consisted of the hospital directors, Information Technology officers and HIS users. It is found that THIS’s hospital implementation phases differed from IHIS and BHIS’s hospitals, while IHIS and BHIS’s hospitals have similar phases based on Business Interaction Phases of Business Action Theory. Human context was discovered to play important roles in the HIS implementation. A survey was conducted in the second phase of this study among HIS users at different categories of HIS’s hospitals. Two hundred and twenty-nine questionnaires were returned to yield a response rate of 45.8%. Based on ANOVA findings, factors affecting THIS implementation were significantly different from those in IHIS and BHIS’s hospitals. There was no significance different between IHIS and BHIS’s hospitals. There are three major contributions of this study: 1) Distinctive implementation phases for THIS hospital and IHIS-BHIS hospital were discovered for HIS implementation. 2) New models of HIS implementation which highlight the Human context were proposed, and 3) Different factors were found to affect HIS implementation at different types of HIS’s hospitals.
ABSTRAK

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<td>$\eta^2$</td>
<td>Eta-Squared</td>
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<td>BCS</td>
<td>Business Continuity System</td>
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<td>HIS</td>
<td>Hospital Information System</td>
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<td>Basic Hospital Information System</td>
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<td>National Medical Research Register</td>
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CHAPTER 1

INTRODUCTION

1.0 Introduction

This chapter begins with a general overview on healthcare sector in Malaysia. It includes a problem statement, research questions, research objectives, significance of study, scope of study and operational definitions. The structure of the thesis is also presented at the end of this chapter.

In this study, Hospital Information System (HIS) is seen as an important national agenda in the Malaysian healthcare system. Thus, an implementable model of HIS needs to be developed to ensure that the HIS can be successfully executed in the near future. Accordingly, this study focuses on the development of an implementation model for HIS in Malaysian public hospitals.

1.1 Healthcare Background in Malaysia

Healthcare sector remains a significant indicator of quality of life of a nation. Therefore, each country continuously striving to improve their healthcare sector by enhancing the healthcare management, services and treatments.
In Malaysia, the healthcare sector is divided into three (3) categories which are public healthcare, Non-Governmental Organisation (NGO) healthcare and private healthcare (Ministry of Health, 2011; Rasiah, 2011). Under each category, there are hospitals and clinics. Public hospitals and clinics are administered by Malaysian Ministry of Health (MOH) to serve the public, while the NGO hospitals such as Hospital Universiti Kebangsaan Malaysia and Hospital Universiti Sains Malaysia are administered by universities to serve the university students and staff. The private hospitals and clinics, however, are administered by private bodies such as Pantai Holdings Berhad. Evidently, the public healthcare is the most important healthcare category in Malaysia because it has the largest number of hospitals and patients.

Improving national healthcare has been always a priority agenda since 6th Malaysian Plan (MP) but only in the 10th MP, the Malaysian Government launched several initiatives under Ministry of Health (MOH) to enhance Information Technology (IT) applications in public hospitals. Such initiatives are to ensure that public hospital services become faster, manageable and efficient, for example by implementing Hospital Information System (HIS) in Malaysian public hospitals. Therefore, this study focused on issues related to HIS implementation among public HIS’s hospitals.

1.2 Problem Statement

Even though the Malaysian Government has played an important role to support the Public Healthcare especially the public hospitals, there are several pressing issues. Most of these issues are about the services provided by the hospitals.

According to Saari (2007) and Wee & Jomo (2007), the government hospital services are slow and inefficient where the patients need to wait for a long time to get their medical treatments. Pillay et al. (2011) claimed that the average waiting time from registration to getting the prescription slip is more than two hours in his study at Malaysian public hospitals.

Moreover, according to Ministry of Health (2012), the average negligence cases reported by the medical staffs are between five to eight cases a month and the number of negligence cases which reportedly in public hospitals in year 2000 to 2008 has increased.
to 144 cases with 61.9% from the total cases are bought to court (Ministry of Health, 2012). In addition, public hospitals faced with increasing cost of healthcare expense every year in Malaysia (Ahmadi et al., 2015). For example, RM 6,348,632.28 was spent on compensation cost for medical negligence cases from year 2000 to May 2009 (Bernama, 2009). Root cause of these cases often arised from large numbers of patients to be nursed at once and administrative tasks. The implementation of HIS is aimed to reduce these common management problems in public hospitals. Therefore, Malaysian Government has enhanced the healthcare quality and reduce the cost (Lee & Ramayah, 2012).

However, HIS implementation is not encouraging in where level of adoption of HIS is only 60% to 78% worldwide (Hsiao & Hing, 2012, Artmann et al., 2010). This might caused by different phases of HIS implementation in different categories of Hospital (Houser, 1984; Rossi et al., 2009). According to Malaysian Ministry of Health (2012), only 21 out of 138 or 15.2% of Malaysian Public Hospitals has implemented HIS. From 21 public hospitals that had implemented HIS, 7.8% is categorized as THIS, 1.4% as IHIS and 7.2% as BHIS. Conversely, several factors have been claimed to influence HIS implementation for example high initial cost (Boonstra & Broekhuis, 2010; Smelcer et al., 2009), high initial physician time (Smelcer et al., 2009; Ganesh & Al-Mujaini, 2009), technology and technical matters (Boonstra & Broekhuis, 2010), lack of skills (Boonstra & Broekhuis, 2010) and ethical issues (Boonstra & Broekhuis, 2010; McKenzie & Kelly, 2002).

Similarly, Ahmadi et al. (2015) and Sulaiman & Wickramasighe (2014) found various factors affecting HIS implementation which could be delineated under the contexts of Technology, Organisation and Environment as proposed by TOE Framework (Tornatzky & Fleischer, 1990). Majority of these studies focused on THIS hospitals alone whereby existence of other factors unique to different categories of HIS could not be unearthed. In addition, most of these studies are quantitative in nature.

Moreover, there are limited empirical studies on HIS in Malaysia. Most of these empirical studies only focused on implementation of THIS alone (Abdul Hamid, 2010; Ibrahim, 2007; Ismail et al., 2010; Abdullah, 2012; Mohd. Yusof et al., 2008; Hassan,
2012; Fadhil et al., 2012; Ismail & Ali, 2013; Mohd Amin et al., 2011; Mohamad Yunus et al., 2013), while others focused on Electronic Medical Records (EMR) since it was synonym with the HIS (Mohd & Syed Mohamad, 2005; Syed Mohamad et al., 2008; Nik Ariffin et al., 2010). None has studied the implementation of HIS in different categories of HIS in public hospitals. Lack of such study would limit our understanding on how to encourage HIS implementation in Malaysian Public Hospitals. This is because, most studies discuss HIS for one specific HIS category without integration and combination other categories of HIS.

1.3 Research Questions

The above of problem statements have led to three research questions as follows:

(i) RQ1: How is HIS being implemented at THIS, IHIS and BHIS’s hospitals?
(ii) RQ2: What are factors affecting the HIS implementation at THIS, IHIS and BHIS’s hospitals?
(iii) RQ3: Is HIS implementation model similar across different categories of HIS’s hospitals?

1.4 Research Objectives

Based on the research questions above, three research objectives have been formulated as follows:

(i) RO1: To explore HIS implementation at THIS, IHIS and BHIS’s hospitals.
(ii) RO2: To explore factors affecting HIS implementation at THIS, IHIS and BHIS’s hospitals.
(iii) RO3: To test HIS implementation model across different categories of HIS’s hospitals.
1.5 Significance of Study

This study contribute to the body of knowledge and fill in the existing literatures gap on HIS implementation of HIS at different categories of HIS’s hospitals using mixed methods approach based on limited qualitative studies of HIS and limited empirical studies in IHIS and BHIS’s hospitals in Malaysia.

The HIS implementation model incorporating its implementation phases and factors affecting it might be used as a guide to refine, improve and enhance the HIS implementation at different categories of HIS’s hospitals in future.

Consequently, this study provides empirical data of HIS implementation to give an in-depth understanding to Ministry of Health (MOH), healthcare sectors, HIS users and HIS vendors on implementation of different categories of HIS in Malaysian Public Hospitals. In addition, this study is significant to the hospitals to overcome their services especially the longer waiting time and negligence cases towards the patients.

1.6 Scope of the Study

This study focuses on the implementation of Hospital Information System (HIS) in Malaysian Public Hospitals at Total Hospital Information System (THIS), Intermediate Hospital Information System (IHIS) and Basic Hospital Information System (BHIS). This is because, Abdul Hamid (2010), Ismail et al. (2010), Mohd. & Syed Mohamad (2005) and Syed Mohamad (2008) have categorised HIS into three categories: THIS, IHIS and BHIS. Thus, this study included hospitals in each category to provide deeper insight.

This study used two models which are Business Interaction of BAT (Goldkulh, 1998) to provide framework for understanding HIS implementation phases, and the TOE framework (Tornatzky & Fleischer, 1990) to understand factors affecting the HIS implementation at different categories of HIS’s hospitals. The participants for qualitative phase were chosen among the hospital directors, Physicians, Information Technology (IT) officers and HIS users. While, quantitative phase was conducted
among HIS users to determine factors affecting the HIS implementation at different categories of HIS’s hospitals.

1.7 Operational Definition

Operational definition remains important in giving clear definitions of major terminologies, especially to avoid an uncertainty in understanding the information contains along the study, as follows:

**Development** – The process of starting to experience of creating something over a period of time.

**Implementation** - Implementation is efforts, including the phases and stages which are applied to be develop a new innovation to accomplish an objective in an Organisation.

**Model** - A structure of ideas or facts that provide support as an example to follow or imitate.

**Information Technology** - Technologies, techniques and equipments of computers and electronic devices used by people to acquire, store, retrieve, evaluate, distribute and exchange the data and information in Organisations.

**Information System** - Information System (IS) is a system designed to work with electronic devices like computers to collect, record, process, store, retrieve and display information and to attain an objective by an Organisation.

**Hospital Information System (HIS)** - HIS refered to an integrated electronic systems that collect, store, retrieve and display overall patients’ data and information such as history of patients’ information, results of laboratory test, diagnoses, billing and others related hospital’s procedures which are used in several departments within the hospitals.
Public Hospitals - Public Hospitals refered to the hospitals administered by Malaysian Government under Malaysian Ministry of Health.

Total Hospital Information System - Total Hospital Information System is an integrated systems under the HIS which is brings a complete Information System to be linked or connected in every departments within the hospitals to achieve paperless hospitals.

Intermediate Hospital Information System - Intermediate Hospital Information System is an integrated system under the HIS which is brings half or intermediate set of integrated systems of what the THIS have to be linked or connected in several departments within the hospitals.

Basic Hospital Information System - Basic Hospital Information System is an integrated system under the HIS which is brings a basic or least set of integrated systems of what the IHIS have to be linked or connected in several departments within the hospitals.

1.8 Structure of the Thesis

This study has seven chapters. Each chapter has its own contents which relates to the implementation of HIS in Malaysian Public Hospitals. Thus, the contents had been identified as follows: Introduction, Literature Review, Research Methodology, Data Analysis, Qualitative Findings, Quantitative Findings and Conclusion.

Chapter 1 introduces the overall study. It includes the general introduction, background of problem, problem statement, research questions, research objectives, significance of study, limitation of study, operational definitions and structure of the thesis.

Chapter 2 discusses the literature review. It provides background of healthcare in Malaysia, HIS in Malaysia, acceptance theories of IS and previous HIS study in Malaysia. It provides an understanding of the HIS implementation based on previous
conceptual and empirical HIS studies. In addition, a theoretical framework was developed as interview guide for data collection process.

**Chapter 3** explains the research methodology. This chapter had been divided into two phases which are qualitative and quantitative research, as this study employed mixed methods. Both phases are includes the research method and data collection techniques used in this study.

**Chapter 4** describes the qualitative findings. These findings are divided into three case study as follows: Case Study 1: Total Hospital Information system (THIS), Case study 2: Intermediate Hospital Information system (IHIS) and Case Study 3: Basic Hospital Information System (BHIS). These findings have meets the research objectives number 1, 2 and 3 based on interview data.

**Chapter 5** describes the qualitative findings. These findings were analysed to test and confirm the qualitative findings. These findings have meets the research objectives number 4 based on survey data.

**Chapter 6** describes discussions. It provides the discussions of both qualitative and quantitative findings, as well as research contribution based on this study.

**Chapter 7** describes conclusion and recommendation. It provides the conclusion on HIS implementation in Malaysian public hospitals, as well as recommendations or suggestions.
CHAPTER 2

LITERATURE REVIEW: IMPLEMENTATION OF HOSPITAL INFORMATION SYSTEM (HIS) IN MALAYSIAN PUBLIC HOSPITALS

2.0 Introduction

Literature review is an important part in conducting a research. Its main purposes are to develop a deeper understanding of a research topic and to widen a researcher’s knowledge base of the study. This chapter presents a literature review of the implementation of Hospital Information System (HIS). This review is important to compare and critique the available information, which will provide guidance and support for the current research; the sources of these relevant data are related articles, research papers, conference papers, seminar papers, seminar handouts, journals and books from all over the world.

Discussions of this chapter centre around three important areas essential to this section. The first area introduces healthcare in Malaysia, and healthcare transformation which encompasses history, implementation as well as associated issues and challenges in Malaysia and abroad. The second area explains the nature and characteristics of HIS and its components, development and implementation phases. The third area discusses related theories and previous studies.
2.1 Healthcare in Malaysia

All sectors of the healthcare system are pivotal and beneficial to the welfare of the Malaysian citizens. The overall healthcare system provides them with medical treatments for a better quality of life. According to the Department of Statistics, Malaysia (2015), there are 30.73 million of Malaysian population, in year of 2015. The population growth is 81.40 percent compared to last year.

This statistics clearly indicated that more than 30 millions of Malaysian citizens might be using healthcare services. Healthcare services are offered by both public hospitals, private hospitals and NGO’s hospitals (Ministry of Health, 2014). Table 2.1 shows the numbers of patients admission in different categories of hospitals. The total number of admissions in the public hospitals is 2,110,628 patients compared with 1,020,397 patients in private hospitals. These statistics show huge numbers of patient admissions in Malaysian public hospitals. Clearly, public hospitals have the largest numbers of patients admission. Table 2.1 proves that the public healthcare sector is the citizens’ priority to seek medical treatments.

Table 2.1 Total Number of Patient Admissions (Adapted from Ministry of Health Malaysia, 2015)

<table>
<thead>
<tr>
<th>State</th>
<th>Public Sector</th>
<th>Private Sector</th>
<th>Total Admission</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Hospital</td>
<td>Special Medical Institution</td>
<td>Non-MOH</td>
</tr>
<tr>
<td>Perlis</td>
<td>33,618</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Kedah</td>
<td>194,799</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Pulau Pinang</td>
<td>129,432</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Perak</td>
<td>229,990</td>
<td>2,405</td>
<td>3,633</td>
</tr>
<tr>
<td>Selangor</td>
<td>355,803</td>
<td>78</td>
<td>-</td>
</tr>
<tr>
<td>W.P. Kuala Lumpur</td>
<td>128,595</td>
<td>3,628</td>
<td>100,501</td>
</tr>
<tr>
<td>W.P. Putrajaya</td>
<td>n.a</td>
<td>2,929</td>
<td>-</td>
</tr>
<tr>
<td>W.P. Labuan</td>
<td>7,432</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Negeri Sembilan</td>
<td>112,215</td>
<td>-</td>
<td>337</td>
</tr>
<tr>
<td>Melaka</td>
<td>83,885</td>
<td>-</td>
<td>3,354</td>
</tr>
<tr>
<td>Johor</td>
<td>318,154</td>
<td>1,315</td>
<td>-</td>
</tr>
<tr>
<td>Pahang</td>
<td>152,039</td>
<td>0</td>
<td>-</td>
</tr>
<tr>
<td>Terengganu</td>
<td>132,894</td>
<td>0</td>
<td>-</td>
</tr>
<tr>
<td>Kelantan</td>
<td>137,664</td>
<td>0</td>
<td>40,420</td>
</tr>
<tr>
<td>Sabah</td>
<td>196,502</td>
<td>47,412</td>
<td>205</td>
</tr>
<tr>
<td>Sarawak</td>
<td>194,100</td>
<td>573</td>
<td>-</td>
</tr>
<tr>
<td>Malaysia</td>
<td>2,407,122</td>
<td>58,040</td>
<td>148,450</td>
</tr>
</tbody>
</table>
According to the Ministry of Health Malaysia (2015), there were 35,318 beds in the 138 public hospitals in Malaysia. The number was higher compared to the 13,038 beds in 184 private hospitals in Malaysia. The Bed Occupancy Rate (BOR) and Total Patient Days (TOD) has increased from 2011 to 2012 in all types of public hospitals except the medical institutions.

Table 2.2: Bed Occupancy Rate (BOR) and Total Patient Days (TOD) (Adapted from Ministry of Health Malaysia, 2012)

<table>
<thead>
<tr>
<th>Type of Hospital by Functional Classification</th>
<th>Bed Occupancy Rate (BOR) %</th>
<th>Average Length of Stay (ALOS) Days</th>
<th>Turn Over Internal (TOI)</th>
<th>Total Patient Days (TOD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hospital Kuala Lumpur and State Hospital</td>
<td>79.71</td>
<td>81.28</td>
<td>4.40</td>
<td>4.3</td>
</tr>
<tr>
<td>Major Specialist Hospital</td>
<td>75.61</td>
<td>76.16</td>
<td>2.41</td>
<td>3.79</td>
</tr>
<tr>
<td>Minor Specialist Hospital</td>
<td>53.00</td>
<td>57.71</td>
<td>3.10</td>
<td>3.13</td>
</tr>
<tr>
<td>Non-Specialist Hospital</td>
<td>47.30</td>
<td>46.98</td>
<td>2.77</td>
<td>2.73</td>
</tr>
<tr>
<td>Specialist Medical Institution</td>
<td>66.08</td>
<td>78.62</td>
<td>204.1</td>
<td>23.9</td>
</tr>
</tbody>
</table>

All these statistics show that the numbers of patients increases every year, especially in public hospitals. This increasing demand for medical services has exerted pressure on the public hospitals. Consequently, there are several issues faced by the Malaysian public hospitals related to their care and services. These includes inequity in access to health services, inappropriate interventions and treatments as demanded by patients or induced by providers, varying quality and standards of care and costs insufficient number of experienced specialists, limited or imbalanced medical facilities and workload complexity due to the increasing number of patients (Ministry of Health, 2012).

The above statistics and information indicate that the public healthcare sector plays a more prominent role compared to the private healthcare. The public healthcare
sector appears to become more complex since be serves patients twenty four hours a day.

2.1.1 Malaysian Public Hospitals

The increasing numbers of patients seeking treatments from public hospitals caused more public hospitals to be built from year to year. For example, there are 135 Malaysian public hospitals in 2010 (Ministry of Health Malaysia, 2012). However, as to June 2015, there are 138 public hospitals in Malaysia (Ministry of Health, 2015). The hospitals are located in every state and city within the country as shown in Table 2.3. These public hospitals are divided into two categories: (1) Specialist Hospital and Institutions and (2) Non-specialist Hospitals.
### Table 2.3: Categories and Lists of Malaysian Public Hospitals (Adapted from Ministry of Health Malaysia, 2015)

<table>
<thead>
<tr>
<th>State Hospitals</th>
<th>Major Specialist Hospitals</th>
<th>Minor Specialist Hospitals</th>
<th>Special Medical Institutions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Hospital Kuala Lumpur</td>
<td>1. Hospital Putrajaya</td>
<td>1. Hospital Labuan</td>
<td>1. Institut Perubatan Respiratori, Kuala Lumpur</td>
</tr>
<tr>
<td>5. Hospital Raja Permaisuri Bainun, Ipoh</td>
<td>5. Hospital Taiping</td>
<td>5. Hospital Sri Manjung</td>
<td>5. Hospital Permai, Johor Bahru</td>
</tr>
<tr>
<td></td>
<td>15. Hospital Sultanah Nora Ismail, Batu Pahat</td>
<td>15. Hospital Pekan</td>
<td></td>
</tr>
<tr>
<td></td>
<td>16. Hospital Segamat</td>
<td>16. Hospital Kapit</td>
<td></td>
</tr>
<tr>
<td></td>
<td>17. Hospital Sultan Haji Ahmad Shah, Temerloh</td>
<td>17. Hospital Limbang</td>
<td></td>
</tr>
<tr>
<td></td>
<td>18. Hospital Kemaman</td>
<td>18. Hospital Sarikaei</td>
<td></td>
</tr>
<tr>
<td></td>
<td>19. Hospital Kuala Krai</td>
<td>19. Hospital Sri Aman</td>
<td></td>
</tr>
<tr>
<td></td>
<td>20. Hospital Sibu</td>
<td>20. Hospital Datin Seri Endon Lahad Datu</td>
<td></td>
</tr>
<tr>
<td></td>
<td>21. Hospital Miri</td>
<td>21. Hospital Keningau</td>
<td></td>
</tr>
<tr>
<td></td>
<td>22. Hospital Bintulu</td>
<td>22. Hospital Beaufort</td>
<td></td>
</tr>
<tr>
<td></td>
<td>23. Hospital Duchess of Kent, Sandakan</td>
<td>23. Hospital Kota Marudu</td>
<td></td>
</tr>
<tr>
<td></td>
<td>24. Hospital Tawau</td>
<td>24. Hospital Wanita dan Kanak-Kanak Likas</td>
<td></td>
</tr>
<tr>
<td></td>
<td>25. Hospital Queen Elizabeth II, Kota Kinabalu</td>
<td>25. Hospital Dungun</td>
<td></td>
</tr>
<tr>
<td></td>
<td>26. Hospital Tanah Merah</td>
<td>26. Hospital Tampin</td>
<td></td>
</tr>
<tr>
<td></td>
<td>27. Hospital Mukah</td>
<td>27. Hospital Mukah</td>
<td></td>
</tr>
</tbody>
</table>
The Specialist Hospitals and Institutions are further categorised as follows: State Hospitals, Major Specialist Hospitals, Minor Specialist Hospitals, and Special Medical Institutions. In total, there are 71 specialist hospitals and institutions in the Malaysian public healthcare system (Ministry of Health, 2015).

<table>
<thead>
<tr>
<th>Non-Specialist Hospitals</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Kedah</td>
</tr>
<tr>
<td>a. Hospital Baling</td>
</tr>
<tr>
<td>b. Hospital Jitra</td>
</tr>
<tr>
<td>c. Hospital Kuala Nerang</td>
</tr>
<tr>
<td>d. Hospital Sik</td>
</tr>
<tr>
<td>e. Hospital Yan</td>
</tr>
<tr>
<td>f. Pulau Pinang</td>
</tr>
<tr>
<td>g. Hospital Balik Pulau</td>
</tr>
<tr>
<td>h. Hospital Sungai Bakap</td>
</tr>
<tr>
<td>i. Perak</td>
</tr>
<tr>
<td>j. Hospital Batu Gajah</td>
</tr>
<tr>
<td>k. Hospital Changkat Melintang</td>
</tr>
<tr>
<td>l. Hospital Kampar</td>
</tr>
<tr>
<td>m. Hospital Parit Buntar</td>
</tr>
<tr>
<td>n. Hospital Selama</td>
</tr>
<tr>
<td>o. Hospital Sungai Siput</td>
</tr>
<tr>
<td>p. Hospital Tapah</td>
</tr>
<tr>
<td>q. Selangor</td>
</tr>
<tr>
<td>r. Hospital Kuala Kajang</td>
</tr>
<tr>
<td>s. Hospital Tanjung Karang</td>
</tr>
<tr>
<td>t. Hospital Tengku Ampuan Jemahun, Sabak Bernam</td>
</tr>
<tr>
<td>2. Negeri Sembilan</td>
</tr>
<tr>
<td>a. Hospital Jelebu</td>
</tr>
<tr>
<td>b. Hospital Jempol</td>
</tr>
<tr>
<td>c. Hospital Tampin</td>
</tr>
<tr>
<td>3. Melaka</td>
</tr>
<tr>
<td>a. Hospital Alor Gajah</td>
</tr>
<tr>
<td>b. Hospital Jasin</td>
</tr>
<tr>
<td>4. Johor</td>
</tr>
<tr>
<td>a. Hospital Mersing</td>
</tr>
<tr>
<td>b. Hospital Pontian</td>
</tr>
<tr>
<td>c. Hospital Tangkak</td>
</tr>
<tr>
<td>d. Hospital Temenggong Sri Maharaja Tun Ibrahim, Kulai</td>
</tr>
<tr>
<td>5. Pahang</td>
</tr>
<tr>
<td>a. Hospital Jengka</td>
</tr>
<tr>
<td>b. Hospital Jerantut</td>
</tr>
<tr>
<td>c. Hospital Muadzam Shah</td>
</tr>
<tr>
<td>d. Hospital Raub</td>
</tr>
<tr>
<td>e. Hospital Sultanah Hajjah Kalsom, Cameron Highlands</td>
</tr>
<tr>
<td>6. Terengganu</td>
</tr>
<tr>
<td>a. Hospital Besut</td>
</tr>
<tr>
<td>b. Hospital Dungun</td>
</tr>
<tr>
<td>c. Hospital Hulu Terengganu</td>
</tr>
<tr>
<td>d. Hospital Setiu</td>
</tr>
<tr>
<td>7. Sarawak</td>
</tr>
<tr>
<td>a. Hospital Bau</td>
</tr>
<tr>
<td>b. Hospital Betong</td>
</tr>
<tr>
<td>c. Hospital Daro</td>
</tr>
<tr>
<td>d. Hospital Dalat</td>
</tr>
<tr>
<td>e. Hospital Kanowit</td>
</tr>
<tr>
<td>f. Hospital Lawas</td>
</tr>
<tr>
<td>g. Hospital Lundu</td>
</tr>
<tr>
<td>h. Hospital Marudi</td>
</tr>
<tr>
<td>i. Hospital Rajah Charles Brooke Memorial, Kuching</td>
</tr>
<tr>
<td>j. Hospital Saratok</td>
</tr>
<tr>
<td>k. Hospital Serian</td>
</tr>
<tr>
<td>l. Hospital Simunjan</td>
</tr>
<tr>
<td>8. Kelantan</td>
</tr>
<tr>
<td>a. Hospital Gua Musang</td>
</tr>
<tr>
<td>b. Hospital Jeli</td>
</tr>
<tr>
<td>c. Hospital Machang</td>
</tr>
<tr>
<td>d. Hospital Pasir Mas</td>
</tr>
<tr>
<td>e. Hospital Tengku Anis, Pasir Puteh</td>
</tr>
<tr>
<td>f. Hospital Tumpat</td>
</tr>
<tr>
<td>9. Sabah</td>
</tr>
<tr>
<td>a. Hospital Beluran</td>
</tr>
<tr>
<td>b. Hospital Kinabatangan</td>
</tr>
<tr>
<td>c. Hospital Kota Belud</td>
</tr>
<tr>
<td>d. Hospital Kuala Penyu</td>
</tr>
<tr>
<td>e. Hospital Kudat</td>
</tr>
<tr>
<td>f. Hospital Kunak</td>
</tr>
<tr>
<td>g. Hospital Papar</td>
</tr>
<tr>
<td>h. Hospital Pitas</td>
</tr>
<tr>
<td>i. Hospital Ranau</td>
</tr>
<tr>
<td>j. Hospital Semporna</td>
</tr>
<tr>
<td>k. Hospital Sipitang</td>
</tr>
<tr>
<td>l. Hospital Tambunan</td>
</tr>
<tr>
<td>m. Hospital Tenom</td>
</tr>
<tr>
<td>n. Hospital Tuaran</td>
</tr>
</tbody>
</table>
2.2 Healthcare Services and Transformation in Malaysia

Vision 2020 is to gear Malaysia to become a developed country not only in terms of economic but also political, social, spiritual, psychological and cultural (Ministry of Health Malaysia, 2012). It is expected to form a national unity and social cohesion in terms of economy, social justice, political stability, system of government, quality of life, social and spiritual values, national pride and confidence (Ministry of Health Malaysia, 2012). Four pillars of National Transformation have been developed to guide the nation to achieve its Vision 2020 (National Economic Advisory Council, 2010). These pillars are:

(i) 1Malaysia
(ii) Government Transformation Programme (GTP)
(iii) Economic Transformation Programme (ETP)
(iv) Tenth Malaysia Plan

Figure 2.1: Four Pillars of National Transformation (Adapted from National Economic Advisory Council, 2010)
According to Prime Minister Office (2011), Economic Transformation Programme (ETP) Plan which is in tandem in New Economic Model (NEM) is driven by eight Strategic Reform Initiatives (SRIs) to strengthen twelve areas of National Key Economic Areas (NKEAs) as shown in Table 2.4.

Table 2.4: Strategic Reform Initiatives (SRIs) and National Key Economic Areas (NKEAs) (Adapted from Prime Minister Office, 2011)

<table>
<thead>
<tr>
<th>SRIs</th>
<th>NKEA</th>
</tr>
</thead>
<tbody>
<tr>
<td>i) Re-energising the private sector</td>
<td>i) Oil, gas and energy</td>
</tr>
<tr>
<td>ii) Developing quality workforce</td>
<td>ii) Palm oil and rubber</td>
</tr>
<tr>
<td>iii) Competitive domestic economy</td>
<td>iii) Financial services</td>
</tr>
<tr>
<td>iv) Strengthen the public sector</td>
<td>iv) Tourism</td>
</tr>
<tr>
<td>v) Transparent and Market-friendly</td>
<td>v) Business services</td>
</tr>
<tr>
<td>Affirmative Action</td>
<td>vi) Electronics and electrical</td>
</tr>
<tr>
<td>vi) Building knowledge based information</td>
<td>vii) Wholesale and retail</td>
</tr>
<tr>
<td>vii) Enhance sources of growth</td>
<td>viii) Education</td>
</tr>
<tr>
<td>viii) Ensuring sustainability of growth</td>
<td>ix) Healthcare</td>
</tr>
<tr>
<td></td>
<td>x) Communications content and</td>
</tr>
<tr>
<td></td>
<td>infrastructure</td>
</tr>
<tr>
<td></td>
<td>xi) Agriculture</td>
</tr>
<tr>
<td></td>
<td>xii) Greater Kuala Lumpur/Klang Valley</td>
</tr>
</tbody>
</table>

As shown in the Table 2.4, healthcare has been identified as one of National Key Economic Areas (NKEAs) among the twelve sectors. All these NKEAs are to propel Malaysia’s future growth by executing Strategic Reform Initiatives (SRIs).

Healthcare as one of NKEAs has been prioritize in the development of Malaysian Plans, particularly in the Tenth Malaysia Plan (MP). The Tenth MP signifies the beginning of healthcare transformation in Malaysia in the context of integrating healthcare information system.

According to Prime Minister Office (2010), there are four key areas under the healthcare sector in the Tenth MP which are: (1) transforming delivery of the healthcare system, (2) increasing quality, capacity and coverage of the healthcare infrastructure, (3) shifting towards wellness and disease prevention rather than treatment, and (4) increasing the quality of human resource in terms of health. In addition, six National Strategic Directions have been formulated identified to support the Tenth Malaysian Plan (Prime Minister Office, 2010) as follows:
Quality of Life of an Advanced Nation is further delineated into Quality Healthcare and Active Healthy Lifestyle with their subsequent strategies as shown in Figure 2.2.

Figure 2.2: Strategies to Quality Healthcare and Active Healthy Lifestyle

(Adapted from Ministry of Health, 2013)

According to the Ministry of Health Malaysia (2013) in Health Country Plan: Tenth Malaysia Plan, three KRAs for the health sector have been identified from these strategies, namely Health Sector Transformation towards a More Efficient and Effective Health System in Ensuring Universal Access to Healthcare (KRA 1), Health Awareness and Healthy Lifestyle (KRA 2), and Empowerment of Individual and Community to be responsible for their health (KRA 3) as shown displayed in Table 2.5.
Table 2.5: Key Research Areas (KRAs) for Health Sector (Adapted from Ministry of Health Malaysia, 2013)

<table>
<thead>
<tr>
<th>Health Sector Transformation Towards A More Efficient &amp; Effective Health System in Ensuring Universal Access to Healthcare (KRA 1)</th>
<th>Health Awareness &amp; Healthy Lifestyle (KRA 2)</th>
<th>Empowerment of Individual and Community to be responsible for their health (KRA 3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(i) Streamline/realign healthcare delivery system</td>
<td>(i) Increase access to health knowledge</td>
<td>(i) Strategies to increase health literacy</td>
</tr>
<tr>
<td>(ii) Unified healthcare financing system</td>
<td>(ii) Motivate individuals, family and community to acquire knowledge and skill</td>
<td>(ii) Provision of health information, including cost of care and governance policies</td>
</tr>
<tr>
<td>(iii) Common quality and standard of care</td>
<td>(iii) Increase opportunities to practice healthy lifestyle at workplace, schools, home etc.</td>
<td>(iii) Providing avenues for effective complaints or enquiries regarding health providers</td>
</tr>
<tr>
<td>(iv) Adequate and competent workforce</td>
<td>(iv) Formulate and enforce public policy towards healthy lifestyle</td>
<td>(iv) Mobilize civil society (NGOs, support groups, community leaders)</td>
</tr>
<tr>
<td>(v) Strengthening healthcare legislation and enforcement</td>
<td>(v) ICT as enabler</td>
<td></td>
</tr>
<tr>
<td>(vi) Strengthening implementation, monitoring and evaluation system</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(vii) ICT as enabler</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

As shown in table 2.5, KRA 1 highlighted ICT as enabler, which are further translated into several initiatives including introduction of HIS in Malaysian public hospitals.

2.3 Hospital Information System (HIS)

Hyung-Joon et al. (2004) defined HIS as a system focusing on the integration of clinical applications collectively with financial and administrative functions to increase service efficiency. Winter & Haux (1995) and Fang et al. (2007) defines HIS as all the information processing activities within a certain hospital, including the information processing tools used to contribute to high-quality patient care and medical research. Ibrahim (2007), claimed that HIS is a systematic integrated system within the hospital that enable patient registration, medical charting and review, appointment handling management, drug prescribing and dispensing, X-ray images storage and management, automatic bill changing, laboratory ordering and reporting, inventory and store management, and other routine processes and workflow. Fang et al. (2007) claim that the system is supported with information sharing between hospitals, doctors, patients
and administrations. All these definitions implied that HIS must be integrated within the hospital and have several components to improve hospital efficiency. In Malaysia, HIS is defined as an integrated system or components uses within the hospital (Suleiman, 2008).

2.3.1 Components of Hospital Information System (HIS)

Biomedical Informatics Ltd. (2006) reported that HIS consists of two or more of these components: Clinical Information System (CIS), Financial Information System (FIS), Laboratory Information System (LIS), Nursing Information System (NIS), Pharmacy Information System (PIS), Picture Archiving Communication System (PACS) and Radiology Information System (RIS) as shown in Figure 2.3.

![Figure 2.3: Components in Hospital Information System (HIS) (adapted from Biomedical Informatics Ltd., 2006).]
These components of HIS are differentiated by their core functions, departments that used them and type of users as shown on Table 2.6.

### Table 2.6: Differences of HIS Components

<table>
<thead>
<tr>
<th>HIS component</th>
<th>Core Functions</th>
<th>Differences</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clinical Information System (CIS)</td>
<td>A computer-based system designed for collecting, storing, manipulating, and making clinical information accessible to the healthcare delivery process. It is also defined as computer-supported applications with a relatively large and long-term database containing clinical data that are used to assist in the management of patient care (Blum, 1986). A CIS may be limited in extent to a single area (e.g. laboratory systems and ECG management systems) or it may be more widespread and include virtually all aspects of clinical information (e.g. electronic medical records). Used by doctors and nurses in a clinical department.</td>
<td>Clinical</td>
</tr>
<tr>
<td>Financial Information System (FIS)</td>
<td>A computer system that manages the business aspects of a hospital such as payroll, patient accounting, accounts payable, accounts receivable, general ledger, fixed asset management, claims management and contract management. It used by accountants of finance departments in hospitals.</td>
<td>Financial</td>
</tr>
<tr>
<td>Laboratory Information System (LIS)</td>
<td>A computer information system that manages laboratory information for all the laboratory disciplines such as clinical chemistry, haematology, and microbiology. It provides modules for sending laboratory test order to the instruments through its multiple instrument interfaces tracks those orders and then captures the results as soon as they become available. The results can then be analysed and a report is generated. It used in a laboratory by laboratory officers.</td>
<td>Laboratory</td>
</tr>
<tr>
<td>Nursing Information System (NIS)</td>
<td>A computer systems that manage clinical data from a variety of healthcare environments, which are then available in a timely and orderly to aid nurses in improving patient care at wards.</td>
<td>Ward, clinics</td>
</tr>
<tr>
<td>Pharmacy Information System (PIS)</td>
<td>It consists of complex computer systems that are designed to meet the needs of a pharmacy department. Through the use of such system, pharmacists can supervise and store inputs on how medication is used in a hospital. It assists in providing patient care by monitoring drug interactions, drug allergies and other possible medication-related complications. It used by the pharmacists at pharmacy department.</td>
<td>Pharmacy</td>
</tr>
</tbody>
</table>
In Malaysia, the different categories of HIS have different components as shown in Table 2.7. Hence, Suleiman (2008) explained the various IS components involved in THIS, IHIS and BHIS shown in Table 2.7. THIS has all the features of the complete HIS, while IHIS and BHIS have the essential components of HIS. THIS is also called paperless hospitals in Malaysia.

**Table 2.7: The components of HIS in Malaysia**

<table>
<thead>
<tr>
<th>Total Hospital Information System (THIS)/Basic</th>
<th>Intermediate Hospital Information System (IHIS)</th>
<th>Hospital Information System (BHIS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>IHIS + Radiology + PACS + administration + Financial + Inventory + Personnel Information System</td>
<td>Integration of BHIS + Laboratory + Pharmacy Information System</td>
<td>Patient Management System + Clinical Information System</td>
</tr>
</tbody>
</table>

**2.4 Development of Hospital Information System (HIS)**

In the 1960s, a physician named Lawrence L. Weed first expressed the idea of computerised or electronic medical records when he introduced the concept of the Problem Oriented Medical Information System (PROMIS) into medical practice at the University of Vermont (Weed, 1964; Weed & Zimny, 1989). In 1967, the development of an automated system started. Later, in 1970, the Problem-Oriented Medical Record (POMR) was used in a medical ward of the Medical Centre Hospital of Vermont for the first time, including a touch screen technology (Goldberg, 1988; Lee et al., 2009).
Other examples of HIS for the early inpatient care systems are the Hospital-Based Technical System, Harvard’s Computer-Stored Ambulatory Record (COSTAR) system for ambulatory care and Health Evaluation Through Logical Processing (HELP) system (Zielstorff et al., 1985; Soini & Tolpnanen, 1982; Lumsdon, 1993; Gardner & Lundgaard, 1994).

Although the concept was widely spreading in the medical practice, physicians initially were not attracted to the technology due to integration problem (Starfield et al., 1976). Furthermore, Subjective and Objective observation, Assessment and Plan (SOAP) could be inappropriately complex for simple patient care problems and in some instances, Problem-Oriented Medical Record (POMR) did little to organise the narrative and confusing note keeping of the healthcare professionals (Switz, 1976).

Today, the HIS implementation has wide spreading around the globe. For example, the United Kingdom employed Health Information Technology (HIT) (Detmer, 2000), United States, Canada, United Kingdom (UK), Germany, Netherlands, Australia, and New Zealand employed Electronic Health Record (EHR) (Jha et al., 2008; Inokuchi et al., 2014; Protti et al., 2009), Switzerland employed DIOGENE (Borst et al., 1999; Breant et al., 2000), Germany employed Smart-Card Technology, Taiwan employed Taiwan’s Bureau of National Health Insurance (TBNHI) smart card (Liu et al., 2006), Japan employed electronic medical records (EMR), New Zealand employed E-Health (Otieno et al., 2008), Spain employed Diraya (Protti et al., 2009) and Denmark employed Medcom (Protti et al., 2009).

However, the rate of HIS implementation in developing countries is slower than that of the developed countries. This is because the planning and implementation of HIS began late in most developing countries. However, the HIS is implemented widely in most developing countries such as Greece, Indonesia and China.

The Greek government introduced HIS in the country about 18 years ago to change the healthcare and patient management in the hospitals (Zikos et al., 2009). The Greek version of HIS is known as Hospital Information System Implementation Assessment Tool (HIS.I.A.T) (Zikos et al., 2009). HIS has also been developed and implemented in Indonesian hospitals to improve the healthcare services as the system becomes popular in other countries. Thus, in 2005, an Indonesian version of HIS,
namely SIRS was implemented in RAA Soewondo Hospital (Hidayanto et al., 2012). Hence, the Indonesian Government programmes through its Ministry of Health launched the electronic health (e-health) in 2011 (Hayani et al., 2013). All hospitals are required to have HIS for health care. Until 2012, there were six teaching hospitals that have implemented HIS. China’s hospital information systems have been progressively developed over the last twenty years to provide the essential support for medical care (Fang et al., 2007). This is because HIS is one of the requirements in modern hospitals that enables information-sharing within a hospital and with users. HIS in China is separated into two parts, the management information system to manage administrative requirements and the clinical information system to manage clinical requirements (Rao, 2008).

In a nutshell, the HIS has been applied in both developed and developing countries as it benefits to the hospital environment and patients in enhancing healthcare quality and services, although it has different terms using in different countries. Thus, any study of HIS implementation need to explore issues related to HIS implementation phases.

2.5 Hospital Information System (HIS) Implementation Phases

The HIS implementation phases remains important to systematic procedures planning to attain optimum efficiency of system functions. This is to ensure proper functioning of the system when it is used by the hospital staff.

Houser et al. (1984) indicated that the HIS implementation process is divided into three phases, namely preparatory activities for system implementation, certification and acceptance testing, and system implementation as explained below:

(i) Preparatory Phase

In this phase, the site preparation needs to be arranged. In this area, the determination of specifications for a computer supplier, design facility and environmental factors had been set. In addition, a project team comprising staff, representatives of the
multidisciplinary user community, and the contractor’s personnel will manage the automated implementation of the system.

(ii) Certification and Acceptance Testing Phase
In the second phase of HIS implementation, the system should be tested. This includes certification and acceptance testing of a hospital information system, which includes for example, material preparation test to actual conduction test for final analysis. The test is conducted by a small group of staff members who are familiar with the system.

(iii) System implementation
The last phase is the completion of an automated system, which requires a plan of action. The plan includes an implementation strategy, according to departments within the hospital. This phase also involves the installation of the system to be used within the hospital.

However, Rossi (2009) claimed the HIS implementation process entails only two phases, which are preparatory phase and utilisation phase. The preparatory activities are:

(i) Involvement of stakeholders in the system programming
(a) Reviewing the existing hospital data, identifying gaps and needs at different levels of a hospital’s network
(b) Defining of the most appropriate reporting tools
(c) Deciding on the coding system for different types of collected information
(d) Defining of methods for data collection and processing, and acquisition of the requisite materials
(e) Organising educational programmes for data managers and users

The preparatory phase also cover the designing and development of a system according the needs of a hospital. The second phase of utilisation comprises of three activities, which include:


Boonstra, A., Broekhuis, M., & a,. (2010). Barriers to the acceptance of electronic medical records by physicians from systematic review to taxonomy and interventions. *BMC Health Services Research, 10*(1), 231.


Ministry of Health Malaysia (2014). Health Indicators. Putrajaya, Malaysia: MOH.

Ministry of Health Malaysia (2015). Health Indicators. Putrajaya, Malaysia: MOH.


Nagi, A. (2014). *How the relationship of technology has changed work & home life; & if this has increased or decreased stress as a consequence?* (Bachelor Degree). University of Derby.


Simon, S., McCarthy, M., Kaushal, R., Jenter, C., Volk, L., & Poon, E. et al. (2008). Electronic health records: which practices have them, and how are clinicians using them?. *Journal Of Evaluation In Clinical Practice, 14*(1), 43-47.


