**Reserach Article**

# AN INVESTIGATION ON THE HEALTH INFORMATION SYSTEM IN THE PUBLIC SECTOR OF MAURITIUS

## Beebeejaun Mohammad Reza and Chittoo Hemant

Open University of Mauritius, Reduit, Mauritius

**A R T I C L E   I N F O**

**A B S T R A C T**

With the substantial improvement in Information and Communication Technologies (ICT) many healthcare institutions are making significant investment on these technologies which proved to have positive impact on health outcomes for patients, such as reduced error rates and improved patient safety as well as time savings for health professionals. The objectives of this study are to provide an investigation on the Health Information System (HIS) in the public sector of Mauritius and to gauge the perceptions of health professionals about the benefits and challenges of HIS. A cross-sectional approach was adopted to elicit relevant data among different cadres randomly chosen from the five regional hospitals and two mediclinics in Mauritius. One of the main findings of this study is that each department within the healthcare institutions used computers in their own means. Very few and scattered applications are used by some units to perform routine tasks within their workplace while the other units hardly make use of computers. This study provided an understanding and the need to focus on the right strategy to enhance and scale-up the use of HIS into healthcare delivery to choose on the way forward.

## INTRODUCTION

Patients' information plays an important role in the healthcare setting. Recording of patient information in many hospitals in developing countries has been on papers and several limitations of the traditional method such as illegibility, ambiguity, incomplete data, poor availability and data fragmentation has been identified (Miller and Sim, 2004). Therefore, in attempts to enhance the quality, reduce the costs and increase the access to health services, many developing countries' governments put much anticipation in electronic health records (Nyella and Mndeme, 2010) and ICT based Health Information Systems (HIS) (Mosse and Sahay, 2003)

Hospital Information System is one of the vital computer systems have been designed to support health care services. These systems are large computerized data bases were intended primarily for communication and store health and administrative information. Having electronic medical records can support medical professionals in their decision-making and also improve operating efficiency, thus improving medical care quality (Ayers *et al*, 2009). Other systems such as decision support systems have been shown to reduce medical errors in applications such as drug order entry (Bates *et al*, 2001).

The use of Information & Communication Technology (ICT) is not new in the healthcare sector and several health

*Corresponding author:* **Beebeejaun Mohammad Reza**
Open University of Mauritius, Reduit, Mauritius

information systems that can record and locate important information quickly have become a standard practice in many healthcare organizations. Thus, efforts to computerize the healthcare units in Mauritius began way back in 1990 when an information plan was formulated that aimed at computerizing all healthcare units in the public health sector. Unfortunately, this computerization development has not been realized fully and failure turned most hardware obsolete and manual system continued to be used in most of the units. Therefore, one of the most important factors in building systems is to develop a good understanding of the system and its problems.

Nowadays, various reports are generated periodically for use at different levels of management and the hospital is required to make monthly reports and annual reports as well as any situational reports in case of an outbreak. Thus, by enabling an automated and intelligent flow of patient information, the HIS could allow healthcare professionals to better serve their patients. Moreover, the government is planning to embark on the implementation of e-health in Mauritius and it is imperative to note that e-health requires huge ICT investment and failure to its successful implementation could result in great losses in terms of time, money and effort (Qureshi *et al*, 2012). Therefore, since no appropriate studies have been carried out so far, it is of paramount importance to investigate the actual health information system before any further development. The main objective of the study is thus to investigate the Health Information System in the public health sector of Mauritius in

order to provide a comprehensive view on supporting health care by technology including e-health. Hence, this study also filled in the gap that no proper research has been carried out to investigate the impediments of Information System in the health sector.

## LITERATURE REVIEW

Information Communication Technology (ICT) has become a powerful tool in the fight against world poverty, providing Health information systems as a possible solution that can be used to alleviate the disparity between rural and urban health care services (Fichman *et al*, 2011). Like all other technologies, IT is also context sensitive and ensuring technological learning is essential for its successful transfer to developing countries. Thus, we need to understand that computerized HIS in developing states is a kind of IT transfer which matters (Ansari *et al*, 2012). According to many experts, Health Information Systems (HIS) are commonly defined as "massive, integrated systems that support the comprehensive information requirements of hospitals, including patient, clinical, ancillary and financial management" (Amin *et al,* 2011). The health information system might be a property of a single organization such as a health center or a hospital or a group of organizations such as a regional or national healthcare organization (Winter *et al,* 2011). Hospital information systems include strategic decision support systems and clinical documentation systems. Some of the clinical support systems include Laboratory Information Systems (LIS), Radiology Information Systems (RIS), and Computerized Order Entry (COE). Others are pharmacy information systems and personal data analysis systems with important added feature for messaging between providers and staff, and the ability to share data with other medical facilities (Keenan *et al,* 2006). It is also believed that HIS implementation is an organizational process conducted toward information technology within user community including many different user groups such as physicians, nurses, administrators, managers, researchers. The health information system collects data from the health sector and other relevant sectors, analyses the data and ensures their overall quality, relevance and timeliness, and converts data into information for health-related decision-making (WHO, 2008).

Available literature provides common standpoint among various authors that disparities exist in the implementation of hospital information system in developing and developed countries (Grimm and Shaw, 2007). Earlier reviews of the effects of health IT have found some evidence of the benefits of the technology and highlighted that the implementation of IT-applications in developing states requires not only a transfer of technology but also the presentation of the culture that go with these systems. The HIS has the potential to deliver key tangible benefits to clients across the globe. According to Blumenthal (2010), HIS enhance the health of individuals and the performance of providers, yielding improved quality, cost savings, and greater engagement by patients in their own health care. By using the cutting edge technologies, hospital management and clinical transactions can be improved with efficient work flow and at the same time, provide better service to their consumers. Additionally, the HIS provides a host of direct benefits such as easier patient record management, reduced paperwork, faster information flow between various departments, greater organizational flexibility, reliable and timely information, minimal inventory levels, reduced wastage, reduced waiting time at the counters for patients and reduced registration time for patients. Therefore, information systems can provide the tools to capture, store, processes and communicate information to the relevant decision makers to coordinate health care at the individual and population levels, thus improving the quality of care and reduces health care costs (Fichman *et al*, 2011). An example of such a Health Information system, which makes use of both electronic communication and information technology to provide services to the health care sector, is e-health (WHO, 2013).

However, in spite of knowing about all these potential benefits of IT-applications in health, problems regarding implementation of health information system (HIS) in developing countries are considerable. Issues in connection with the implementation of HIS in developing countries mainly relate to cost, poor infrastructure, lack of ICT skills poor strategies and donor policies, as well as more sensitive issues such as power dynamics and identity forming (Kimaro and Nhampossa, 2007). To overcome interoperability issues, different approaches have to be used. It is not only technical but also the willingness and capability to cooperate in order to achieve common goal (Blobel, 2016). The design and use choices for information technologies are influenced by an individual's characteristics such as age, knowledge, expectations, and assumptions concerning the purpose, context, importance, and role of a technology in a given context (Waithaka *et al,* 2013). Although Waithaka *et al* (2013) focused on establishing adoption of Inter-Organizational Information Systems (IOIS) in Kenyan Universities; their findings that users' ICT skills affect the adoption of IOIS can be extrapolated to cover health information technologies. Abraham *et al* (2011) add their voice by arguing that optimal use of IT towards the transformation of health care requires IT knowledge in the medical communities. Moreover, Keenan, *et al* (2006) concurred that the human element is still very important in health care delivery and technology is just a tool in the hands of trained personnel. Saleem (2009) suggested that for a successful adoption and execution of IT-applications in hospitals all over the world, computer skills of physicians and staff involved is a must.

In addition, in all the studies that have been done till now regarding Information systems, failure or success have highlighted top management support as a critical success factor in any project (Dorsey, 2005). Any project without full commitment from the top management, in case of problems can collapse at any time during the project life cycle. Failure to design holistic hospital information software that addresses all users' expectations appropriately could also be ascribed to poor user participation. In a study that involved exploring hopes and fears in the conceptualisation of electronic health records, it was found that most actors are only afraid of use of ICT in health sector based on their perceptions about it (Khan *et al*, 2012). In the study for instance, some physicians thought that using an EHR would be more time consuming, which would negatively influence the time they could spend with patients. Thus, these findings clearly indicate that there is huge gap between HIS development and user needs and therefore a complete assessment of all these issues need to be

considered prior to any further development and implementation of HIS.

## METHODOLOGY

### Study and sample design

The study was conducted using a descriptive cross-sectional design to assess the Health Information System in the public sector of Mauritius. The targeted population for this study was comprised of four groups including the physicians, nursing personnel, Health records officers and pharmacy personnel from the five regional hospitals namely Abdool Gaffoor Jeetoo Hospital (AGJH), Jawaharlal Nehru Hospital (JNH), Sir Seewoosagur Ramgoolam National Hospital (SSRNH), Victoria Hospital (VH), and Flacq Hospital (FH) and two medi-clinics including L'escalier Mediclinic and Lady Sushil Ramgoolam Mediclinic of Mauritius. The study population was estimated to be 2392 healthcare providers. At 95% confidence level and 10% margin of error, the sample size was calculated to reach 97 participants. Taking into consideration for a desired response rate of at least 60 % and ensuring statistical significance, the final number of participants was estimated to 110. The study used stratified sampling to select the sample ensuring that the particular categories of individuals including physicians, nursing officers, health record officers and pharmacy personnel are represented.

### Data collection

The study used a survey method for data collection. A structured questionnaire was employed and distributed to the participants to elicit specific information with respect to the objectives of the study. Before administration of the questionnaires, pilot testing was carried out to check for the validity of the questionnaire and reliability analysis was also performed to ensure the consistency of the survey instrument.

All procedures involved in the study were approved by the Ethics Committee of the Ministry of Health and Quality of Life of Mauritius. The objective of the study was clearly explained to the participants. Anonymity of the respondents as well as confidentiality throughout the survey were clearly observed.

### Instrument

The study instrument comprised a structured questionnaire to assess the e-health readiness for employees within the five regional hospitals. The questionnaire included a number of the issues previously identified from the literature related to HIS. The questionnaire consisted of five sections. The first section assessed the participants' awareness of HIS, computer knowledge, existing computer facilities and perception of participants with respect to computerization of the department. The second section of the questionnaire laid emphasis on training and mentoring. The third section included several statements based on a five point Likert scale (1 = Not significant at all, 2 = Not significant, 3 = Neutral, 4 = Significant and 5 = Extremely Significant) assessing the perception of the participants on the benefits of Information System while section four assessed the perception of participants on the challenges of Information System. The final section included questions related to the participants' demographics (gender, age group, level of education and experience).

### Data Analysis

The questionnaires were then coded and input into the Statistical Package for Social Sciences (SPSS) Statistics v 21.0 for analysis. Frequency tables and crosstabs were used for the descriptive analysis while associations among variables were evaluated using correlation and regression analysis.

### Limitations

This study was assessed only on four cadres of health professionals and thus the perceptions of users from the other cadres of the health sector were not analysed. Moreover, this study was carried out only in the public health sector and thus the outcome could not be compared with the private health sector.

## RESULTS

### Response rate and reliability Analysis

Of the 110 questionnaires that were distributed, 98 were completed, rendering a response rate of 89.1% which was considered acceptable for analysis. Reliability analysis using cronbach's coefficient alpha value was also chosen to examine the internal consistency of the questionnaire. The overall reliability for the measuring instrument was 0.896, a value greater than the recommend threshold of 0.7 (Field, 2013), showing good reliability.

### Demographic Characteristics of Respondents

The sample comprised of 28.6% of nurses, followed by pharmacy staff (27.6 %), physicians (24.5%) and health record cadre (19.4%) as shown in table 1. With respect to gender, the male (49%) and female staff (51%) were relative equally distributed and the results also show that the higher group of respondents (38.8%) belonged to the younger age population usually under the age of 30. Regarding the level of education, 30.6% of the sample possessed a certificate, 28.8% had a university diploma and 24.5% had a MBBS while the rest possessed either a degree or post graduate degree qualification. It is also important to point out that the majority of the participants (78.6%) had working experience between 10 to 30 years.

**Table 1** Demographic Characteristics of respondents

| Demographic Variable | Frequency (n=98) | Sample (%) |
|---|---|---|
| **Gender**: | | |
| Male | 48 | 49 |
| Female | 50 | 51 |
| **Age Group Distribution:** | | |
| 25-29 | 38 | 38.8 |
| 30-34 | 24 | 24.5 |
| 35-39 | 15 | 15.3 |
| >40 | 21 | 21.4 |
| **Level of Experience:** | | |
| <10 | 8 | 8.2 |
| 10-20 | 40 | 40.8 |
| 21-30 | 37 | 37.8 |
| >30 | 13 | 13.3 |
| **Level of Education:** | | |
| Certificate | 30 | 30.6 |
| Diploma | 28 | 28.6 |
| Degree | 13 | 13.3 |
| Post Graduate | 3 | 3.1 |
| MBSS | 24 | 24.5 |
| **Occupation:** | | |
| Health records cadre | 19 | 19.4 |
| Nursing Cadre | 33 | 28.6 |
| Pharmacy cadre | 22 | 27.6 |
| Physician | 24 | 24.5 |

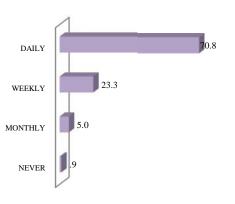## Computer and Internet Usage

Respondents were also asked to rate their frequency of use of computer and internet as illustrated in figure 1. Out of the 98 respondents, more than 70% of the sample made use of computer on a daily basis and 73.6% reported that they were either comfortable or very comfortable with a computer. As regards to Internet access, around 70% of the sample use Internet daily and they mainly use Internet for research purposes (72%) and a larger percentage (67%) also chose for using Internet for social media.

important to a large extent for healthcare delivery. 24.5% of the participants perceived ICT as important to some extent while 15.4% of the sample doesn't see the importance of ICT in the healthcare organizations.

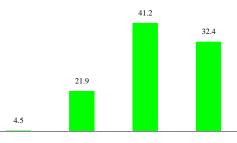## Availability of ICT facilities at workplace

As regards to the availability of ICT facilities at their workplace, 47.9% of the sample confirmed the accessibility of WI-FI service as shown in table 2. In addition, 54.1% of the respondents stated that PCs were available in their respective
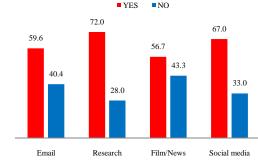
**How often do you use computers?**

**How comfortable are you with computers?**

**How often do you access the Internet?**

**Purpose of using Internet**

**Figure 1** Percent distribution of Computer and Internet Usage

## Awareness of HIS and importance of ICT in healthcare organization

Figure 2 depicts that 88.7% of the sample were aware HIS and with respect to importance of ICT in the healthcare organisation, 39.6% of the respondents agreed that ICT is

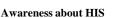units while 43.9% confirmed the unavailability of computers in their units. Further analysis indicates that the PCs for doctors were placed in the conference room to access journals and other related databases for their continuing professional development.

**Awareness about HIS**
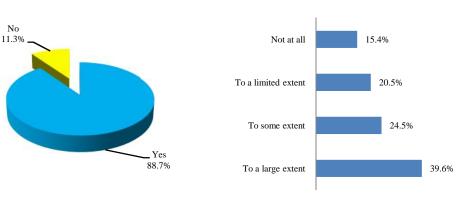
**Importance of HIS at workplace**

**Figure 2** Percentage responses on awareness of HIS and its importance at health sector
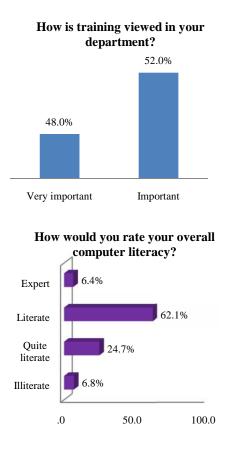
The records unit comprised of standalone PCs to prepare returns and for records keeping of demographics of patients using DBase III software. The records officers also pointed out that they make use of excel software for their own analysis purposes and they suggested for a complete HIS be implemented to facilitate their daily activities rather than using standalone PCs and limited software. Some of the staffs from pharmacy department also use computers for preparing returns and to access up-to-date information. Most of the nursing staff notified that PCs were not available for the daily routine activities while only 7.1% affirmed that one PC was available in the ward manager office but rarely used.

**Table 2** Respondent's perception on availability of ICT facilities at workplace

| ICT Facilities | Frequency (n-98) | Percent |
|---|---|---|
| **Availability of Wi-Fi** | | |
| Yes | 47 | 47.9 |
| No | 51 | 52.1 |
| **Availability of computers** | | |
| PC not available | 43 | 43.9 |
| PC in conference room | 24 | 24.5 |
| PC in Pharmacist Office | 4 | 4.1 |
| PC in Pharmacy Store Department | 7 | 7.1 |
| PC in Ward Manager Office | 4 | 4.1 |
| PC in Records office | 16 | 16.3 |

*Computer literacy and Training*

Figure 3 depicts the percentages of respondents regarding their computer literacy and training aspects. The study shows that more than 60% of the respondents were computer literate; however, more than 32% of the sample felt the need to upgrade their computer skills for efficiency. Concerning training, all the respondents indicated the importance of training in their departments and 87.1% of the sample highlighted that new technology, processes, services and community needs are considered in assessing training needs.
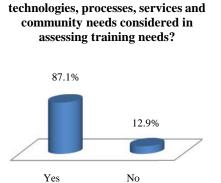
The respondents were also asked to rank several statements regarding their perceptions on training using a 5-point Likert scale from 1="Strongly disagree" to 5="Strongly agree". Mean scores and standard deviation were used to identify the most significant factor and it is apparent from table 3 that "Training on ICT is provided" was the most significant factor reported.

**Table 3** Mean scores of participants' perception on training

| Statement | Mean | Std. Deviation |
|---|---|---|
| Training on ICT is provided | 4.10 | 1.030 |
| There is an increasing use of coaching methods | 3.67 | 1.138 |
| There is an induction period for new staff | 3.59 | 1.283 |
| Staff are encouraged to take training classes on regular basis | 3.57 | 1.292 |

*Benefits of Health Information System*

Literature shows that information system has brought many benefits and is achieving a steady change from the traditional health care delivery system to appropriate electronic health care delivery systems. In line with this, the respondents were asked to rank several statements regarding their perceptions on the benefits of Health Information System using a 5-point Likert scale from 1="Not significant at all" to 5="Extremely significant".
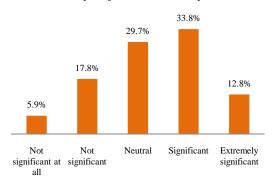


**Figure 3** Responses on Computer literacy and Training

Mean scores and standard deviation were used to identify the most significant benefit and it is apparent from table 4 that "Improving delivery of care" and "Improving quality of service" were the most significant benefits reported

**Table 4** Mean scores of participants' perception on benefits of HIS

| | Mean | Std. Deviation |
|---|---|---|
| Improving delivery of care | 4.74 | 0.442 |
| Improving quality of service | 4.74 | 0.442 |
| Competitive Advantage | 4.45 | 0.611 |
| Employee development | 4.17 | 1.094 |
| Cost reduction | 4.11 | 0.672 |
| Better Decision making | 4.11 | 0.931 |
| Faster response to key issues | 4.07 | 1.087 |
| Innovation | 4.05 | 1.049 |
| Improving Customer focus | 3.99 | 0.767 |
| Revenue growth | 3.73 | 1.080 |

### Barriers for adopting HIS

As regards to the barriers for adopting HIS, the respondents were asked to point out their perceptions on the factors as depicted in figure 4. The results reveal that most of the respondents found "lack of user uptake due to insufficient communication" (76.5%) and lack of motivation (72.4%) to be the most common barriers of HIS adoption. More than 63% of the respondents perceived "lack of training" and "lack of proper IT tool identification" to be among the barriers of HIS adoption. More than half of the sample also stated that lack of time to learn new technology may hinder HIS and even found HIS to be complicated.
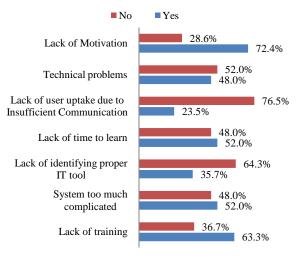


**Figure 4** Distribution of respondents' perception on barriers of HIS

### Challenges for HIS implementation

This section covers the descriptive analysis on the challenges for HIS implementation as perceived by the respondents. Figure 5 shows that 83.7% of the respondents stated that lack of user commitment is the most significant factor. 69.4% of the sample also pointed out that difficulty to change people's behavior and the type of knowledge to be shared are also among the primary challenges. Other reasons that were also significant include: lack of understanding of HIS and its benefits (53.1%), lack of top management support (63.4%) and a strong focus on overcoming technological limitations (59.2%).
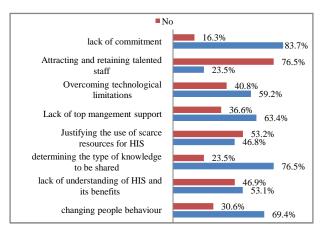


**Figure 5** Distribution of respondents' perception on challenges of HIS implementation

### Significance Testing

### Significance between Computer Literacy and Comfortability with computers

Research shows that computer literacy is an important component in having the ability to successfully and confidently use technology (Croxall & Cummings, 2000). So, this study aimed to evaluate for any significance between computer literacy and comfortability with computers and thus a spearman correlation analysis was performed to explore the relationship between these two variables. The result revealed a correlation coefficient (r) of 0.388 and a p-value <0.001, indicating a significant moderate correlation between the two variables.

### Association between training and HIS adoption

Evaluating for any significance between training and HIS adoption, a regression analysis was performed and the result revealed a strong positive correlation (R=0.778) between the two variables. The value of r-square (0.605) indicated that the independent variable accounts for 60.5% of the variation in HIS adoption. The results also revealed that both factors were significant (p<0.001) for HIS adoption and thus it indicated that the emerged factor have a major role for HIS.

### Significance between benefits of HIS and HIS adoption

A regression analysis was performed and the result divulges a correlation coefficient, r (0.757) signifying a strong correlation between the variables examined. The $R^2$ value of (0.573) gives a measure of effect with only 57.3% of the variance on outcome of intention to HIS adoption is accounted significantly (p<0.001) by the benefits highlighted in this study.

### Significance between Challenging factors and use of HIS

As regards to the challenges identified, chi square tests were performed between each factor as shown in table 5 and use of HIS. The results yielded p-values< 0.05, which indicates that the factors are significantly associated with the use of HIS.

**Table 5** Significance testing between challenging factors and use of HIS

| Factors | P-value |
|---|---|
| Changing Behaviour | 0.010 |
| User commitment | 0.002 |
| Top management support | 0.004 |
| Type of Knowledge to be shared | 0.033 |

## DISCUSSION

The present study investigated the HIS among health professionals across the five regional hospitals and two mediclinics mentioned earlier. The findings of this study revealed that most of the healthcare professionals included in the study made use of computers regularly whether at home or workplace. More than 65% of the sample was found computer literate and comfortable with computers and they perceived the importance of HIS in their department. This is line with the study done Abraham *et al* (2011) who stated that optimal use of IT towards the transformation of health care requires IT knowledge in the medical communities

The findings of this study also confirmed that HIS is beneficial for quality improvement, providing better service to their consumers in the health care settings. This is in line with the studies done by Blumenthal (2010) and Fichman *et al* (2011) who specified that information systems can provide the tools to process and communicate information to the all the stakeholders, thus improving the quality of care and reduces health care costs. Additionally, this study also found significant association between training and HIS adoption thus agreeing to the statement of Keenan *et al (2006)* who affirmed that technology is just a tool in the hands of trained personnel.

The results also showed that there was no standardization in the use of computers. Each department within the healthcare institutions used computers in their own means. It was also notified that only the records and pharmacy departments used few and scattered applications to perform some useful tasks within their workplace, the nurses did not use computers for any activities while the physicians used computers only to access information for their continuing professional development. Moreover, no networking of the computers was also reported in the units where routine activities were carried out through computers and this renders their tasks difficult.

In addition, this study also revealed significant challenges such as top management support, user commitment and changing people behavior for application of HIS. This is entirely in line with study done by Dorsey (2005) and khan *et al* (2012) who stated that any project without full commitment of users and support from management can collapse at any time during the project life cycle.

## CONCLUSION

This study was conducted in light of the need to examine the health information system in order to identify the drivers and the potential causes of failure to technological innovations. From the literature, it is evident that implementation of technological innovation starts with the complete examination of the existing infrastructure which prepares the organizations to join the networked community. This study found that the majority of healthcare professionals in the public health sector of Mauritius are willing to use HIS at their workplace. Therefore the findings of this study can be considered by decision makers to enhance and scale-up the use of HIS into care delivery to decide on the way forward.

### Recommendations

The main recommendations emanated from the findings of this study suggest that it is necessary to determine the knowledge of using HIS through formal training during different levels of professional education and training. Sensitisation campaign should also be done to change the staff behavior towards the adoption of HIS. In addition, it is also important to provide the healthcare units with the necessary and standardize infrastructure to allow them to organize their work environment. Moreover, hospital management should develop a strategic plan for any future development of HIS and should provide full support as well as encourage the users to accept technology innovations.

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