International Academic Institute for Science and Technology

International Academic Journal of Science and Engineering
Vol. 3, No. 1, 2016, pp.234-242.
ISSN 2454-3896

International Academic Journal of Science and Engineering

www.iaiest.com

Evaluating Hospital Information System in selected hospitals of Tehran city according to ISO 9241-10 standard

Reza Pasandideh[a]* , Farzaneh Sharifi [b]

[a] *Master of Industrial engineering, Amirkabir University of Technology, Tehran, Iran.*
[b] *Master of Industrial engineering, Amirkabir University of Technology, Tehran, Iran.*

Abstract

Extensive use of Hospital Information Systems (HISs) has caused the task of evaluation of such systems to turn into an important tenet. The present study aims to assess Hospital Information Systems as the users of such systems perceived them during 2015 in "Bu Ali" and "Mofid" hospitals in Tehran city based on ISO 9241-10 standard. Basically, the standard ISO 9241-10 questionnaire was used as the evaluation tool. However the original questionnaire was shortened to 40 questions in order to help users to respond better; and reliability of the new version was approved through Cronbach's alpha test method. Statistical population was consisted of all users of HIS in those two hospitals. Questionnaires were filled out by 180 users who were selected through a random sampling process. Data were analyzed using descriptive statistics (frequency percent and mean value) and SPSS 22 software package. Results showed that the highest level of users' satisfaction from HISs in both hospitals was related to "adequacy for task performance", while lowest satisfaction level was observed in Mofid hospital related to "being customizable" and in Bu Ali hospital related to "being self-explanatory" characteristics of the software. In general, system users in Bu Ali hospital were 62% satisfied by the Hospital Information System while users in Mofid hospital were 59.08% satisfied in this context.

Keywords: performance assessment, Hospital Information System, ISO 9241-10 standard .

Acknowledgement

Now we feel the necessity of acknowledging Dr. Kiani, general manager of Mofid hospital, personnel of nursing department of that hospital, Ms. Maleki, supervisor of training department of Bu Ali hospital and all HIS users in two hospitals of Mofid and Bu Ali particularly Ms. Touran Kianpour administration executive of emergency services department of Bu Ali hospital who patiently supported us during data collection phase.

* Corresponding author

Introduction

Within structures of various information systems, Hospital Information Systems (HISs) are described as an inherently complicated type. Those systems have to support activities in hospital within application, tactical and strategic levels. Organizations aim to use computers and communication systems in order to collect, store, process, retrieve and share data pertaining to phases of healthcare services provided to patients and administration data regarding all activities of the hospital. Information technology (IT) has had profound effects on various businesses and social implementations. It has lead to quality improvements as well as lower operations costs for businesses including healthcare facilities.

Today, information systems are used in various daily activities; and many of those systems have already taken the place of traditional manual procedures. Information systems have expanded in recent decades in such a way that it seems inevitable to implement them. Information technology has been introduced into most of the fields and has lead to fundamental changes resulting in reengineering of previous methods (Abedian & Bitaraf, 2008). Information has become more important; on the other hand, increasing volumes of information renders data management task more complicated than ever.

Information Technology has been developed in order to help with easy and proper information management; and it is continuously accelerating in growth. Today, we see that various organizations and companies spend significant budgets on IT issues in order to benefit from it and keep up with ongoing evolution while ensuring their survival in the technology age.

Before performing any assessment of a product or a system, we need to have a certain definition for it. A Hospital Information System (HIS) is defined as an information system which usually does information administration tasks that can include retrieval, storage, analyze or selective query of data. HIS is an integrated and comprehensive system designed for managing administrative and clinical information within the hospital. All information about various activities and tasks related to the hospital are circulating within its HIS.

Although any hospital is considered as an independent organization which provides healthcare and medical services, local and regional regulations regarding to health issues and government laws would inevitably affect hospitals everywhere. This causes HIS as software systems to be highly influences by local and regional rules and regulations both in design and evaluation processes. Therefore, unlike many software packages which are developed somewhere in the world and are used ubiquitously in other countries, HIS software are not following and cannot follow this pattern. Hence, a series of locally customized standards have to be implemented in order to assess and evaluate HIS with purchasing, ranking, or designing intentions (Abedian & Bitaraf, 2008).

Assessment is defined as determining the importance, value and normal ranking of a subject through measurements and meticulous examination. Evaluation is a part of this process which shows whether certain activities of the subject lead to desirable outcomes. Evaluation is an indispensable part of developing information systems (Riazi et al., 2013).

Objectives of evaluation are as the following, in brief (Barabadi et al., 2008):

- to prove a project is feasible
- to decide about human investments
- to overview the processes of information system projects
- to understand complexity and difficulties of an information system within the organization
- to understand the value added by the information system as a service provider

Steggers et al. (2010) conducted a study titled “A usability of Armed forces Health Longitudinal Technology Application in ambulatory clinics at a military medical center”. Following results were suggested by that study.

1. Limited application of armed forces health technology software in real implementation environment
2. Difficulties in collecting career information and patient conditions
3. Fields of work with non-integrated systems
4. Suggesting use of structured documents

On that basis, it was announced that potential development of clinical information system application by military health system in the future could lead to clinical decision making systems, patient safety and information verification (Staggers et al., 2010).

Horsky et al. (2010) suggested in their study titled "Complementary methods of system usability evaluation: surveys and observations during software design and development cycles" that weak usability of clinical information will delay physicians to choose and adopt such systems while limiting their potential capabilities to safer and more efficient healthcare activities. Hence, recurrent assessment of usability is an integrated part of system design process (Horsky et al., 2010).

Hubner Bloder et al. (2009) conducted a study titled "Key performance indicators to benchmark hospital information systems – a Delphi study". That study was using Delphi methods within one qualitative and two quantitative fields. Forty four hospital information system experts from IT department of healthcare academy participated in three fields under study. Results obtained from that study suggested 77 performance indices categorized into eight groups, namely technical quality, software quality, interface quality and architecture, IT sales quality, quality of IT and IT support, workflow support quality, IT output quality, and IT costs. Most important indices were workflow support index and user satisfaction index (Hubner Bloder & Ammenwerth, 2009).

Aggelidis et al. (2008) in their study titled "Methods for evaluating hospital information systems: a literature review" stated that using information and telecommunication technologies in healthcare and medical industry potentially can improve quality of services, efficiency and efficacy of personnel, and also reduce organizational costs. Authors have examined various texts and literature pertaining to evaluation methods for HIS and provided three approaches to assess those systems: user satisfaction, economic usability and economic evaluation. They eventually concluded that user satisfaction assessment approach towards information systems might be the most effective evaluation method when compared to others (Aggelidis & Chatzoglou, 2008).

Leclercq (2007) addressed the subject of system assessment in his study on user satisfaction in a large French group specialized in information systems (Leclercq, 2007).

Studies by Hamborg et al. (2004) titled "Questionnaire based usability evaluation of hospital information systems" in Germany showed that isometric evaluation is a reliable technique for assessing HIS in order to support HIS usability in large organizations. An isometric questionnaire was used in this study to ask various groups of employees (secretaries, nurses, physicians) about characteristics of the system. Secretaries and nursing employees reported higher levels on content from the system under study (Hamborg et al., 2004).

Littlejohnes et al. (2003) addressed the subject of HIS assessment in one state of Republic of South Africa. This evaluation was conducted within a broad area and covered 42 hospitals in that state. 2.5% of annual healthcare and wellbeing budget was devoted to the system implemented by those hospitals. Education optimization, change and support management, project management, inter-system communication improvement level, information confidentiality, level of standardization for hospital administrative processes, revenue level and service package costs, were declared as important factors associated with HIS assessment (Littlejohns et al., 2003).

Simpson (2000) conducted a study addressing the usage of HIS by 340 nurses working in hospitals; he enumerated advantages of those systems as: better access to information, improved quality of

documentation, improved supervision over the patients, improved productivity of nurses, decreasing errors caused by forgetting things decreasing errors related to medicines, improved job satisfaction amongst nurses, higher level of compliance with joint committee of healthcare organizations' authentication, creating a common clinical database, improved patients' perception over healthcare, higher capability to track patients' profiles, improved capabilities to implement and guide users, and finally general improvement of situations in hospital (Simpson, 2000).

Darbyshire (2000), concluded that indices of being user-friendly for physicians and nurses who use computerized information systems are: easy access, access to terminals, clarity of computer screens, using intuitive charts and figures, presence of guidelines in case that users need help, access to on screen reminders and follow-ups, possibility of printing documents on paper as needed, speed and response capabilities which are the functional capabilities of HIS software (Darbyshire, 2000).

Saeedbakhsh et al. (2012) examined user satisfaction levels by seven measures set in a selected number of hospitals in Isfahan city in Iran in their study titled "evaluating module medical documents of hospital information system in selected ministry of medicine hospitals in Isfahan based on ISO 9241-10 standard". The authors concluded that evaluated measures show relatively desirable conditions in hospitals under study (Saeedbakhsh et al., 2012).

Farzi et al. (2012) tried to assess HIS in three selected hospitals in Sistan and Balouchestan province in Iran. Their findings were similar to Saeedbakhsh et al. findings (Farzi et al., 2012).

Ghaderi Nansa et al. (2011) evaluated HIS as perceived by nurses in educational-medical hospitals in Tabriz city of Iran. They assessed content level of nurses as desirable regarding those systems, while suggesting guidelines to achieve maximum desirability (Ghaderi Nansa et al., 2013). Alipour et al. concluded their study in a similar way (Alipour et al., 2010).

Rahman (2006) examined the administrative difficulties associated with HIS in three dimensions of organizational, workflow and technical aspects. He suggested some requirements and technical standards which need to be considered; and concluded that existing difficulties cannot be overcome just by copying common used systems in the world, but those paradigms need to be localized according to specific requirement of Iranian users (Rahman, 2006).

Farzi et al. has defined seven measures of ISO 9241-10 standard in this field as the following (Farzi et al., 2012).

- Adequacy for task performance: A dialogue is suitable for a certain task, if it helps the users to perform their task more efficiently and with higher effectiveness. Such a dialogue just provides the user with information needed to perform the task.
- Being self-explanatory: A dialogue is self-explaining when feedbacks are present in every stage of interaction, and explanations are provided as may be needed by the user.
- Control capability: A dialogue is controllable if the user is able to keep track of his/her instructions during all interactions with the system.
- Compatibility with user's requirements: A dialogue can comply with requirements and needs of users, only if it is adapted to working knowledge, education, and working experiences of its users.
- Being robust: A dialogue can be robust against errors if requires only minor further modifications (or none) to accomplish the required task despite of errors in data entry.
- Being customizable: A customizable dialogue allows users to change things according to their individual needs and skills.
- Being informative: An informative dialogue guides the user through various stages and further eliminated the need for specific training.

Assessment of HIS has turned into a principle due to its ubiquitous implementation. Hence, understanding and successful usage of HIS plays a critical role for improving healthcare provision; meanwhile, decision makers and information system users attach a high level of importance to evaluation of those systems (Ghaderi Nansa et al., 2013).

As it is suggested by above considerations, it is necessarily important to research about evaluating HIS systems designed based on 9241-10 standard in order to set the stage for improving productivity in hospitals, and eventually providing better services to patients and system users.

Methodology

The present study aims to evaluate Hospital Information Systems in "Bu Ali" and "Mofid" hospitals in Tehran according to ISO 9241-10 standard. Hence, it is an applied research. This study uses a descriptive methodology. A questionnaire has been used as a data collection and analysis tool. The questionnaire was design in three sections. The first section included a brief introduction and indications to clarify the task for respondents. Second section included demographic information such as age, education level, gender, and marital status which the respondents were asked to provide. The third section of the questionnaire was designed to assess HIS based on ISO 9241-10 standard. This section used a Likert scoring scale in concordance with objective, types of hypotheses and type of the questionnaire (ranking), and in consideration of more simple structure and results interpretation. Each specific question with positive charge was evaluated through a five level scale (very high = 5, high = 4, medium = 3, low = 2, very low = 1). Questions with negative charge were designated with a reverse scale. The Cronbach's alpha test was implemented in order to evaluate reliability of the questionnaire using SPSS 22 software package. Reliability coefficient was calculated using Cronbach's alpha method and results of 92% and 89% were obtained for Bu Ali and Mofid hospitals, respectively. Those figures suggest that reliability is high and the questionnaire is desirably reliable.

Statistical population for the present study was consisted of all users of HIS in two mentioned hospitals. In total, 180 copies of the questionnaire were distributed among users based on a random sampling method. Data were analyzed using descriptive statistics (frequency percent and mean values) through SPSS 22 software packages; Results are categorized as into the following levels:

- Undesirable (0 – 50%)
- Relatively desirable (50 – 80%)
- Desirable (81-100%)

Results

For Bu Ali hospital, the results are as follows:

Findings from the present study showed that from 100 respondents who filled out the questionnaire in Bu Ali hospital, 22% were men and 78% were women. 19% of respondents were at education levels of high school diploma or lower, 9% had completed college, while 49% had bachelor's degree and 23% were graduated with master's degree or higher. According to the collected data from Bu Ali hospital, 10% of respondents were younger than 25, while 52% were between 25 and 35 years old, 32% were between 35 and 45, and 6% of those respondents were older than 45. Also, 11% of respondents had been working for less than 1 year, 18% had worked more than one and less than 5 years, 23% had been working between 5 to 10 years, 19% had worked between 10 and 15 years, while 25% of those respondents had been working for 15 to 20 years and 2% of them were working for more than 20 years. 42% of respondents in Bu Ali hospital were single and 58% were married.

Figure (1) shows levels of content for HIS users in Bu Ali hospital based on seven measures of ISO 9241-10 standard as mean values.

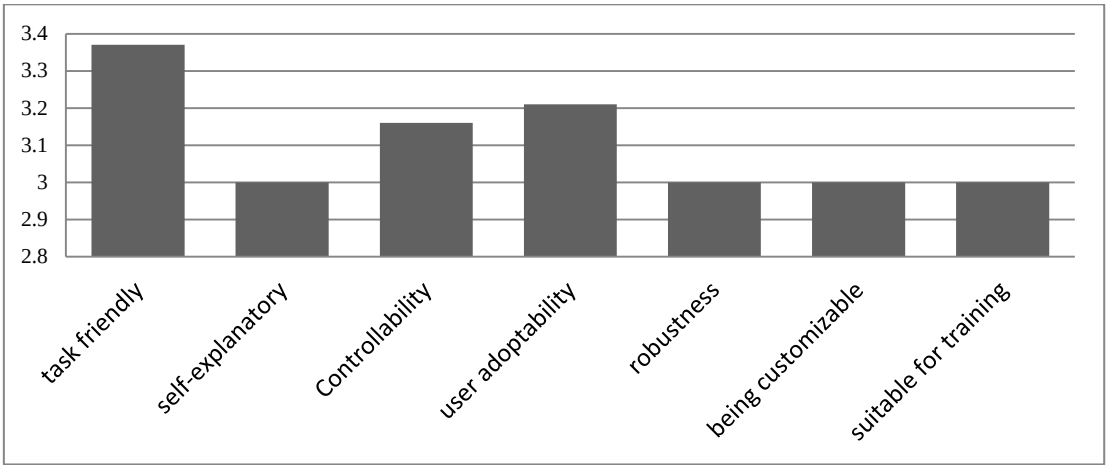

Figure (1) Users' content level of HIS in Bu Ali hospital by ISO 9241-10 measures.

Results obtained for Mofid hospital are as the following:

Descriptive statistics showed that, among 80 users who filled out questionnaires in Mofid hospital, 22.5% were men and 77.5% were women. Also, 12.5% of those respondents were at educational level of high school diploma or lower, 7.5% had finished college, while 43.8% had a bachelor's degree, and 36.2% were graduated with master's degree or higher. Descriptive statistics results showed that 22.5% of respondents were younger than 25, 51.2% were between 25 and 35 years old, while 20% were between 35 and 45 years old and 6.3% were older than 45. Data also showed that 18.8% of respondents in Mofid hospital were working for less than one year, 28.7% had been working there for more than one and less than 5 years, 12.5% had worked between 5 and 10 years in that organization, while 16.3% had been working more than 10 and less than 15 years there, 12.5% were working for between 15 and 20 years, and 5% of respondents were working for more than 20 years in that hospital. 52.5% of respondents were single, and 47.5% were married.

Figure (2) shows the level of content among HIS users in Mofid hospital based on seven measures of ISO 9241-10 standard as mean values.

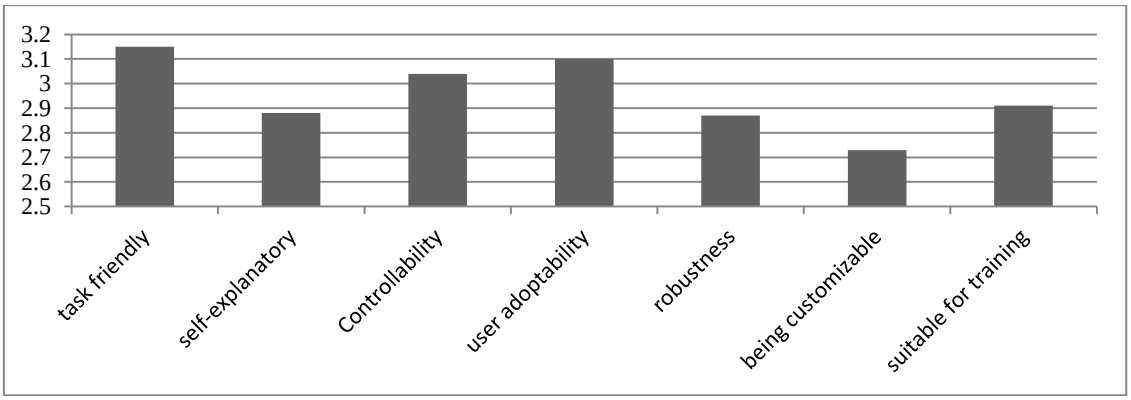

Figure (2) Users' content level of HIS in Mofid hospital by ISO 9241-10 measures.

Discussion and conclusions

As the obtained results show, HIS system users in Bu Ali hospital have been 67.56% satisfied in sense of "adequacy for task performance" with the average score of 3.37, while system users in Mofid hospital

have been 63% satisfied with average score of 3.15 for this measure. Satisfaction level with the same measure was previously reported by Saeedbakhsh et al. to be 68% while Ghaderi Nansa reported an average score of 2.93 for that. Farzi et al. reported that 80% of users believed that the system is adequate for performing their tasks, while Alipour et al. found that 72.7% of system users in hospitals of Bandar-e Abbas city of Iran expressed that they agree or totally agree about the system being adequate for task performance.

Users in Bu Ali hospital were 60.12% satisfied with the system in sense of "being self-explanatory" measure (average score = 3), while figures for the same measure in Mofid hospital were 57.6% and average score of 2.88. Saeedbakhsh et al. has reported satisfaction of 67% and Ghaderi Nansa et al. reported average score of 2.77 in their studies. In addition, 71% of respondents in Farzi et al. study reported that they relatively agree that their HIS is adequate in sense of being self-explanatory; while 58.9% of system users who responded to Alipour et al. study agreed or totally agreed that their HIS is self-explanatory.

Satisfaction level of HIS users regarding the "controllability" measure in Bu Ali hospital was 63.26% (average score = 3.16) while the figure in Mofid hospital was 60.8% (average score = 3.04). Saeedbakhsh et al. has reported a 70% satisfaction level with controllability measure, while Ghaderi Nansa et al. have reported average score of 2.72 for this measure. 57% of system users had evaluated their HIS as relatively adequate in sense of controllability, and Alipour et al. reported that 76.9% of system users agreed or totally agreed that their HIS is controllable.

The level of satisfaction among system users with "user adoptability" measure in Bu Ali hospital was 64.24% with average score of 3.21 while satisfaction level in Mofid hospital was 62% with average score of 3.1 for that measure. Saeedbakhsh et al. has reported a 74% satisfaction level and Ghaderi Nansa et al. reported a 2.96 average score. Also 61% of respondents to farzi et al. study evaluated their HIS as being relatively user-adoptable; while 73.7% of respondents to Alipouur et al. stated that they agree or totally agree that their system is adequate in sense of adoptability with requirements and needs of users.

Satisfaction level of HIS users regarding the "robustness" measure in Bu Ali hospital was 61.78% (average score = 3) while the figure in Mofid hospital was 57.4% (average score = 2.78). Ghaderi Nansa et al. had reported average score of 2.83 for robustness measure, while Saeedbakhsh et al. reported a 69% satisfaction level with robustness. 75% of system users had evaluated their HIS as relatively robust against errors, and Alipour et al. reported that 53.7% of system users agreed or totally agreed that their HIS is robust.

The level of satisfaction among system users with "being customizable" measure in Bu Ali hospital was 60.66% with average score of 3 while satisfaction level in Mofid hospital was 54.6% with average score of 2.73 for that measure. Ghaderi Nansa et al. reported an average score of 2.56 and Saeedbakhsh et al. concluded that HIS users are 53% satisfied with the system in sense of being customizable. 72% of respondents to Farzi et al. perceived their HIS as being adequate for customizing, while Alipour et al. reported that 66.3% of respondents agreed or totally agreed that the HIS in their hospital is adequately customizable.

Results show that level of satisfaction of HIS system users with "suitability for training" measure was 60.84% with average score of 3 in Bu Ali hospital and 58% with average score of 2.91 in Mofid hospital. Ghaderi Nansa et al. have reported an average score of 2.93; while Saeedbakhsh et al. reported 68% satisfiaction with this measure. Farzi et al. found that 79% of respondents perceived their HIS system as being adequate; and Alipour et al. reported that 58.9% of respondents agreed or totally agreed that their system is suitable for training.

Results suggest that highest scores were given to the measure of "adequacy for task performance" in both hospitals; while lowest scores were associated with "being self-explanatory" and "being customizable" in Bu Ali and Mofid hospitals, respectively. General level of satisfaction amongst HIS users in Bu Ali hospital based on seven measures of ISO 9241-10 standard was 62.6% while this figure in Mofid hospital

was 59.08% according to the collected data. Therefore, all seven measures are assessed as being in a relatively desirable condition.

Considering all above mentioned information, it can be said that Hospital Information Systems are developed in coverage with such a fast pace in recent decades that implementing those systems seems inevitable. However, there are challenges associated with using HIS as well. Some of those challenges are:

- Benefit from data and information to improve medical services and keeping patients' Health Status records
- Benefit from data and information to improve safety, record events of infection control and patient safety
- Benefit from data and information to calculate the acquisition price of services and recognitive payment systems
- Benefit from data and information to assess performance of employees
- Benefit from data and information to reduce double works and save personnels' time
- Error reduction means and double checking entered data using smart mechanisms
- Data integration and redundant data collection up to 70% by various bureaus and departments
- Documenting implementation and application of clinical technologies while benefitting from clinical facilities
- An island perspective over hospital resources and lack of integrity of Information Management System to help hospital administration
- Negligence over adequate infrastructures before introducing new a technology into hospital
- Network infrastructure
- Physical space for installation of central servers
- Improvement and standardization of processes before computerizing in order to improve performance and productivity within the organization

Following the assessment of above challenges and system implementation, any deficiency of the system should be identified and addressed in order to evaluate the system, since assessment is an indispensable part of information system development. As the results of the present study suggest, HIS users in both Mofid and Bu Ali hospitals as well as most of the hospitals investigated through this research are relatively satisfied with Hospital Information Systems; and the satisfaction level is relatively desirable.

References

Abedian, S., & Bitaraf, E. (2008). Evaluation Model for HIS in Iran. Center of Statistics and Information Technology, Ministry of Health and Medical Education.

Aggelidis, V.P., & Chatzoglou, P.D. (2008). Methods for evaluating hospital information systems : a literature review. EuroMed Journal of Business, 3(1): 99-118.

Alipour, J., Hoseini Teshnizi, S., Hayavi Haghighi, M., Feghhi, Z., Sharifi, R., & Kouhkan, A.H. (2010). Users view about hospital information system in children's hospital Bandar Abbas. Hormozgan Medical Journal, 14(2): 140-7.

Barabadi, M., Ahmadi, M., & Hosseini, F. (2008). A Survey on the compatibility of the Hospital Information Systems(HIS) with the needs of medical records users from the system. Journal of Health Management, 11(23): 27–38.

Darbyshire, P. (2000). User-friendliness of computerized information systems. Computers in nursing, 18(2): 93.

Farzi, J., Nosratpanah, O., Aliabadi, A., & Hamedi Shahraki, S. (2012), Evaluation of hospital information systems in Sistan and Baluchestan. Iranian Journal of Health Information Management, 7(2): 5-12.

Ghaderi Nansa, L., Piri, Z., Salmani, E., Gholipour, H., & Sharghi, R. (2013). Evaluation of Hospital Information Systems in Hospitals of Tabriz University of Medical Sciences of Iran: Nurses Perspectives. Health Inf Manage, 10(2): 190-200.

Hamborg, K.C., Vehse, B., & Bludau, H.B. (2004). Questionnaire based usability evaluation of hospital information systems. Electronic journal of information systems evaluation, 7(1): 21-30.

Horsky, J., McColgan, K., Pang, J.E., Melnikas, A.J., Linder, J.A. & Schnipper, J.L. (2010). Complementary methods of system usability evaluation: Surveys and observations during software design and development cycles. Journal of biomedical informatics, 43(5): 782-790.

Hubner Bloder, G. & Ammenwerth, E. (2009). Key Performance Indicators to Benchmark Hospital Information Systems: A Delphi Study. Methods of Information in Medicine, 48(6): 508.

Leclercq, A. (2007). The perceptual evaluation of information systems using the construct of user satisfaction : case study of a large French group. ACM SIGMIS Database, 38(2): 27-60.

Littlejohns, P., Wyatt, J.C. & Garvican, L. (2003). Evaluating computerized health information systems: hard lessons still to be learnt. Bmj, 326(7394): 860.

Rahman, A. (2006). Analysis and evaluation of management information systems in hospitals of Iran. The First National Conference of Software Engineering.

Riazi, H., Bitaraf, E. & Abedian, S. (2013). Hospital Information Systems Performance Evaluation. Sorur Kian Publication, First Edition.

Saeedbakhsh, S., Ehteshami, A. & Kasaei Isfahani, M. (2012). Evaluating the Medical Records Module of the Selected Hospital Information System Software in Hospitals of Isfahan University of Medical Sciences Iran, According to ISO 9241-10. Health Information Management, 9(4): 490-501.

Simpson, R. (2000). Nursing Informatics," Nursing Administration Quarterly. 24(2): 87-90.

Staggers, N., Jennings, B. M. & Lasome, C.E. (2010). A usability assessment of AHLTA in ambulatory clinics at a military medical center. Mid Med, 175.