

The Healthcare Quality and Hospital Information Management System: A Sample From Turkey

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ABSTRACT

Objective: The aim of the study was to evaluate the relationship between quality of healthcare and hospital information management system (HIMS) in the perspective of health professionals and patient registry officers in a private hospital.

Material and Methods: In this cross-sectional study, 118 health professionals (75 nurses and 43 physicians) and 58 patient registry officers were selected from the same private hospital. Data was collected by two structured questionnaires.

Results: “The electronic health record (EHR) provides an accurate summary view about the situation of patients” and “Nursing information is easily accessible and readable” in nurses, “The EHR provides me appropriate feedback about the tasks it performs” and “HIMS helps to monitor reception of orders and instructions I have given to the nursing staff” in physicians and “HIMS improves my productivity”, “HIMS improves patient safety” and “HIMS meets my operational needs” in patient registry officers’ group were found to be predictive factors for improving the quality of healthcare services.

Conclusion: Consequently, different items were found to be predictive factors for the improving in the quality of healthcare according to the participating groups.

Key words: hospital information management system, physician, nurse, patient registry officer, quality.

SAĞLIK HİZMETLERİ KALİTESİ VE HASTANE BİLGİ YÖNETİMİ SİSTEMİ: TÜRKİYE’DEN BİR ÖRNEK

ÖZET

Amaç: Bu araştırmanın amacı özel bir hastanede çalışan sağlık profesyonelleri ve hasta kayıt çalışanları perspektifinden sağlık hizmetleri kalitesi ve hastane bilgi yönetimi sistemi (HBYS) arasındaki ilişkiyi değerlendirmektir.

Gereç ve Yöntemler: Bu kesitsel çalışmaya aynı özel hastanede çalışan 118 sağlık profesyoneli (75 hemşire ve 43 hekim) ve 58 hasta kayıt çalışanı katılmıştır. Veriler yapılandırılmış bir anket formu ile toplanmıştır.

Bulgular: Hemşireler için “Elektronik sağlık kaydı hastaların durumu hakkında genel bir bakış sağlar” ve “Hemşirelik hizmetleri kayıtları kolayca okunabilir ve ulaşılabilir” ifadeleri; hekimler için, “Elektronik sağlık kaydı hasta ile ilgili yapılan işlemler hakkında uygun geribildirimler sağlar” ve “Hastane bilgi sistemi hemşirelere verilen orderların takip edilmesine yardımcı olur” ifadeleri; hasta kayıt çalışanları için ise “Hastane bilgi sistemi çalışma verimliliğimi artırır”, “Hastane bilgi sistemi hasta güvenliğini artırır” ve “Hastane bilgi sistemi çalışma ihtiyaçlarını hızlıca karşılar” ifadeleri sağlık hizmetleri kalitesini artıran prediktif faktörler olarak tespit edilmiştir.

Sonuç: Sonuç olarak, araştırmaya katılan her üç grup için sağlık hizmetleri kalitesinin artırılması için HBYS ile ilişkili prediktif faktörler birbirinden farklıdır.

Anahtar sözcükler: hastane bilgi yönetimi sistemi, hekim, hemşire, hasta, hasta kayıt çalışanı, kalite.

Introduction

e-health applications generate real-time data for improvements in quality in healthcare. Such a system allows multiple users to communicate and share data easily. However, the implementation and acceptance of e-health technologies could be slow due to the configuration of the technology, unrealistic expectations from the system and end-user related problems (1). In 2003, the government of Turkey launched an e-health reform plan called the 'Health Transformation Program' in an attempt to solve problems in the health sector and to deliver health services in a more effective, productive and equal way. According to the e-health vision, the National Health Information System generates adequate quality health data at both national and international standards. It can be reached by individuals or institutions whose access rights and authorities can be determined by taking patient consent to protect privacy and security. The data can also be shared to a limited extent nationally (2).

Healthcare is highly complex environment that involves many special trained individuals working together effectively. It is necessary to provide the best care with the least cost from the perspective of quality. Although both the administrative and clinical applications of healthcare are the focus of quality in the system, the improvement of medical intervention is a critical part of the whole process. Safety, effectiveness, patient-centeredness, timeliness, efficiency and equity are the dimensions of quality that must be met by any medical institution (3). Since electronic health records and the E-prescription system that collect, organize, share and report of data have vital roles for these dimensions in the hospitals, a well-organized hospital information management system (HIMS) could meet the needs of an organisation in terms of healthcare quality (4). However, it also affects the administrative and clinical work processes and changes daily practices for users (1) (5).

Aim

Health professionals focus on patient care whereas patient registry officers access patients' health information and support clinical applications by using HIMS. Therefore, the aim of the study was to evaluate the relationship between quality of healthcare and HIMS from the perspective of health professionals and patient registry officers in a private hospital.

Methods

In this cross-sectional study, 118 health professionals (75 nurses and 43 physicians) and 58 patient registry officers

(F/M: 44/14, the mean age: 26.22±4.14 years) were selected from the same private hospital. Data was collected by two structured questionnaires by face-to-face interviews. In the questionnaires, the functions of HIMS were evaluated from two different perspectives: those of the health professionals and the patient registry officers.

The health professionals evaluated the functions of HIMS within the framework of clinical information and communication technology (ICT). Data was collected with a 32-item questionnaire which focused on the functions of ICT (6). It evaluated the system according to 3 dimensions regarding compatibility between clinical ICT systems and physicians' tasks (13 items), supporting for information exchange, communication and collaboration in clinical work (5 items), and interoperability and reliability (14 items). The questionnaire was coded by a Likert type scale (1-5 points). High scores indicate the positive effects of ICT on clinical practice for health professionals.

Patient registry officers assessed HIMS from the perspective of patient related tasks. Data was collected by questions obtained from the literature because there was no standardized questionnaire that could be utilized. Patient related processes were evaluated in a questionnaire with 19 items coded by a Likert type scale (1-5 points). High scores indicate the positive effects of HIMS on patient related tasks for each function.

The effects of clinical ICT and HIMS on the quality of health services were evaluated using a Likert type scale (from 1: very bad effect, to 5 points: very good effect) by health professionals and patient registry officers.

The study was approved by the Ethical Committee of Marmara University Medical School and informed consent was taken from the study groups.

Statistical analysis. An unpaired T-test was used to analyse the ICT scores of between nurses and physicians. Pearson correlations were carried out on the scores between ICT/HIMS items and the quality of healthcare services in each group. Following this, the most significant items were selected for Linear multiple regression analysis. According to the analysis, the predictive factors among selected items were identified for the quality of the health services within each group. Chronbach-alpha values were calculated using the clinical ICT questionnaire (0,9751 in the nurses' group and 0,912 in the physicians' group) and the patient related process questionnaire (0.871) in

Table 1. Comparison of key functionalities relating clinical information and communication technology according to nurses and physicians.

<i>ICT System Items</i>	<i>Nurse</i>		<i>Physician</i>		<i>p*</i>
	<i>Mean</i>	<i>SD</i>	<i>Mean</i>	<i>SD</i>	
<i>Dimension 1: Compatibility between clinical ICT systems and health professional's tasks</i>					
System provides support for decision making	3,39	1,06	2,16	1,01	0.000
System helps to prevent medication errors	3,16	1,18	2,52	1,09	0.004
EHR provides an accurate summary view about the situation of the patient	3,50	1,04	2,12	1,01	0.000
System helps to improve health outcomes	3,43	0,97	2,25	1,06	0.000
<i>Efficient use</i>					
Routine tasks can be performed in a straightforward manner using the EHR system	3,50	0,95	1,91	0,57	0.000
System requires me to perform a fixed sequence of tasks	3,55	0,90	2,14	1,01	0.000
I find it easy and fluent to manage patient information using the information system	3,49	1,04	1,62	0,63	0.000
<i>Intuitiveness of EHR user interfaces</i>					
The EHR system responds quickly enough to inputs	3,13	1,18	2,12	0,89	0.000
I perceive the arrangements of the fields on-screen as sensible for the work I do	3,51	0,93	2,34	1,10	0.000
The EHR provides me appropriate feedback about the tasks it performs	3,52	1,03	2,30	0,91	0.000
The terms and concepts used in the EHR system are clear and unambiguous	3,61	0,92	2,29	0,96	0.000
I find it easy to learn how to use the EHR system	3,52	0,85	2,35	0,99	0.000
Learning the use the EHR system does not require long training	3,46	0,91	2,29	1,05	0.000
<i>Dimension 2: ICT support for information exchange, communication and collaboration in clinical work</i>					
<i>Support for information exchange</i>					
Information about the laboratory results are presented in a logical form	3,55	0,96	1,91	0,82	0.000
Nursing information is easily accessible and readable	3,46	0,96	2,83	1,07	0.002
Patient's medication list is clearly presented	3,11	1,18	2,81	1,01	0.001
Information about the patient's medication from other organisations is easily accessible	2,91	1,21	2,89	1,23	0.918
Delivery of patient information from other healthcare organisations often takes too long time	3,28	0,99	2,95	3,16	0.455
<i>Dimension 3: Interoperability and reliability</i>					
<i>Support for collaboration</i>					
ICT systems support in achieving continuity of care	3,40	1,08	2,25	1,02	0.000
ICT systems support collaborative activities between physicians working in the same organisation	3,48	1,03	2,76	0,92	0.000
ICT systems support for physicians in cross-organisational collaboration	3,15	1,00	2,52	1,23	0.004
ICT systems support collaboration between physicians and nurses	3,44	1,00	2,52	1,14	0.000
ICT systems help to monitor reception of orders and instructions I have given to nursing staff	3,29	1,14	2,45	1,03	0.000
ICT systems support collaboration between physicians and patients	3,26	1,10	2,56	1,10	0.001
ICT systems often capture attention away from patients	3,28	1,07	2,56	1,08	0.001
Logging into several systems takes too long time	3,31	1,06	2,42	0,85	0.000
I have easy access to radiology results	3,65	0,98	2,10	0,97	0.000
The EHR system is reliable and no system errors occur when I work with the system	3,08	1,22	2,79	1,05	0.195
I feel that occasionally some of the data I have entered disappear from the information system	3,52	0,98	2,58	0,87	0.000
If I have problems with EHR system, I can easily get help or recover from error situation	3,21	1,03	2,55	0,95	0.001
A significant proportion of my working time is wasted on struggling with technical problems	3,79	0,99	1,95	0,84	0.000
Incorrect functionality has or nearly has caused serious injury to a patient	3,56	1,01	2,45	0,98	0.000

*Independent samples test was used in the analysis.

Chronbach-alpha values: 0,9751 in nurses and 0,912 in physicians.

Table 2. Patient related tasks of patient registry officers in HIMS.

		<i>n</i>	%
Authorization for accessing to patients' health information*	Reading	32	55,2
	Writing	26	44,8
	Transferring	15	25,9
	Copying	11	19,0
	Adding/updating	36	60,4
Access to patients' health information*	Personal information	51	87,9
	Communication information	43	74,1
	Medical history	35	60,3
	Physician's reports	37	63,8
	Information relating previously provided healthcare services in the hospital	39	67,2
Auditing access to patients' health information*	Directorate of patient services	12	20,7
	Managers	5	8,6
	Directorate of information technology	19	32,8
	Head office	1	1,7
	No response	21	36,21

*More than one item could be selected by patient registry officers.

the patient registry officers' group. The data was analyzed using an SPSS 11.5 program (SPSS Inc, Chicago, IL) and a P-value of <0.05 was accepted as significant.

Results

The clinical ICT items were evaluated by both groups. The scores of 29 items were higher in nurses than those of physicians ($p < 0.05$). The scores of the other 3 items regarding "Information obtained from different healthcare organisations, patient medication and system error" were found to be similar in both groups ($p > 0.05$) (Table 1).

The tasks of patient registry officers are presented in Table 2. They had authorization to add/update ($n=36$, 60.4%), read ($n=32$, 55.2%), write ($n=26$, 44.8%), and transfer ($n=15$, 25.9%) patients' records. They obtained personal information ($n=51$, 87.9%), and communicated information ($n=43$, 74.1%), any previously provided healthcare services ($n=39$, 67.2%) and the physicians' reports ($n=37$, 63.8%) of patients. Auditing access to patients' health information for them was organized by directorate of information technology (Table 2).

Scores of HIMS items were presented in Table 3. The highest scores (mean score ≤ 4 points) were seen in "Laboratory and radiology results are obtained with suitable formats in

Table 3. The evaluations of hims's properties according to patient register officers.

	Patient Register Officer (n=58)	
	<i>Mean</i>	<i>SD</i>
1. HIMS provides doing my duties sequentially	3,92	0,79
2. HIMS allows me to carry out my duties in a standard way	4,09	0,64
3. It is easy to manage patient health information by using HIMS	4,11	0,66
4. Operational needs are rapidly fulfilled by the HIMS	3,60	0,97
5. On-screen menus are well organized in HIMS	4,03	0,60
6. Terms are clear in HIMS	4,12	0,63
7. Usage of HIMS does not require a long time training	3,66	0,89
8. Laboratory results are obtained with suitable formats in HIMS	4,21	0,53
9. Radiology results are obtained with suitable formats in HIMS	4,12	0,66
10. User accesses patient's all information for provision via HIMS	3,85	0,82
11. Accessing to associated institutions through HIMS takes too much time.	3,51	0,94
12. HIMS is reliable and stable.	3,74	0,86
13. There is no system error when working with HIMS	2,63	1,09
14. System related problems cause losses in working period.	4,07	0,95
15. HIMS saves my working time	3,50	1,02
16. My productivity is increased by HIMS	3,68	0,82
17. User can respond questions from other users easily via HIMS	3,72	0,81
18. Patient safety is improved by HIMS	3,90	0,65
19. Patient's information is protected in HIMS	3,69	1,01

Chronbach-alpha value: 0.871 in patient registry officers.

HIMS", "HIMS allows me to carry out my duties in a standard way" and "System related problems cause losses in working period", "On-screen menus are well organized", "Terms are clear in HIMS" and "It is easy to manage patient health information by using HIMS". The lowest score was seen in "There is no system error when working with HIMS" (Table 3).

When the effects of clinical ICT/HIMS on quality of health services were evaluated, the scores of quality of healthcare services were similar in both the nurses' group (3.49 ± 0.95) and physicians' group (3.53 ± 0.86) and are lower than

Table 4. Linear regression analysis for the quality of healthcare services in physicians, nurses and patient registry officers.

ICT System Items		
Nurse*	b	P
EHR provides an accurate summary view about the situation of the patient	0,624	0.032
Nursing information is easily accessible and readable	0,611	0.027
Physician**		
The EHR provides me appropriate feedback about the tasks it performs	0,401	0.024
ICT systems help to monitor reception of orders and instructions I have given to nursing staff	0,65	0.005
Patient Registry Officer***		
HIMS improves my productivity	0,319	0.008
HIMS improves patient safety	0,301	0.019
HIMS meets my operational needs	0,264	0.015

R2 *:0.57, **:0.52, ***: 0.56

that of the patient registry officers' group (3.87 ± 0.89) ($p=0.000$). According to the Linear regression analysis results, the two items regarding "The electronic health record (EHR) provides a proper summary view about the situation of patients" and "Nursing information is easily accessible and readable" were found to be predictive factors for improving the quality of health services according to the nurses' group (Table 4). In the physicians' group, "The EHR provides me appropriate feedback about the tasks it performs" and "HIMS helps to monitor reception of orders and instructions I have given to the nursing staff" were significant determinants in the enhancement of the quality of healthcare services. In addition, the three items regarding "My productivity is increased by HIMS", "Patient safety is improved by HIMS" and "Operational needs are rapidly fulfilled by the HIMS" were found to be predictive factors for improving the quality of healthcare services according to the patient registry officers' group (Table 4).

Discussion

HIMS supports clinical practice as well as improves quality of care (7) by allowing the utilization of electronic medical records, computerized provider order entry, clinical decision support systems, and picture archiving and communication systems (8). In our country, increases in applications of health informatics regarding clinical information systems (9), clinical decision support systems (10) and tele-medicine applications (11) are observed to improve patient care and quality of health services. Since the

study aimed to analyse the particular functions regarding clinical and patient related applications in HIMS, the responses of nurses, physicians and patient registry officers supporting clinical practices were included.

In the present study, clinical ICT items were evaluated for compatibility between the system and the tasks of health professionals, information exchange and communication in terms of workflow, interoperability and reliability dimensions. A majority of the clinical ICT items were given high scores by nurses when their results were compared with those of the physicians. Although Turkish healthcare is a complex system operated by health professionals, the number of physicians and nurses per 10.000 people is not satisfactory when it is compared to the figures for more developed countries (12). They are overloaded by the number of tasks that they must perform during patient care. When physicians can directly enter their medical orders, consultation requirements and medications, instances of miscommunication among health professionals reduces and patient safety increases (13) (14). It is also an advantageous situation for nurses in our health system because they routinely interact with the healthcare providers in the care of patients (15). Reduction of medical errors and better tracking of patients' treatment details improves safety and quality of care (14).

When we examine national publications, the importance of the information and communication technologies were accepted by health professionals in a study carried out in 11 hospitals of Sakarya province. They thought that they were supported in patient care by using modules related with their clinical applications in the system (16). In contrast to results, negative opinions were reported by physicians and nurses for the system in a public hospital of Ankara province. The evaluation of system design in the perspective of users and staff training for the efficient use are critical points to improve performance of health professionals (17).

The scores regarding difficulty in health data exchange from other organisations and occurrences of system error were similar for the sample groups. Since health data is not shared throughout all the healthcare organisations in the country, nurses and physicians were equally affected by the condition.

Physicians and nurses thought that technical problems could be seen in HIMS. Health professionals require access to all the medical data from different locations such as radiology and laboratory results, and records of any consultations from different clinics. The users require that

the system be easy to operate and for it (18) to have a high storage capacity to allow access to previously obtained information (19). Therefore, some technical problems for such a complex information system could be predicted.

Patient registry officers were authorized to read and write of patients' health information and to access personal/communication information. There were critical roles for patient registry officers in supporting clinical practice. In addition, they were mostly audited by the directorates of patient services or by information technology. When the properties of HIMS's functions were examined by the patient registry officers' group, accessing laboratory and radiology test results and supplying workflows were the most prominent issues in the system. HIMS reduces the barriers among medical and non-medical staff in the multidisciplinary communication framework and supports the teamwork that is essential in healthcare (20). In daily practice, the data of each patient is recorded and updated in out-patient and in-patient clinics. Patient registry officers support clinical practices by accessing data from the system. When the technology is better fitted to the task, employee performances are increased (18). Therefore, HIMS affects both clinical endpoints of patients and quality of care from the perspective of patient registry officers.

Since quality of service is a factor related with the investment in technology (9), the evaluation of it gives critical information for the hospitals. Quality of health services related factors were evaluated by a Linear regression analysis according to the groups participating in the study. "Providing an accurate summary of the patient's situation" and "Providing easily accessible nursing information" in the nurses' group and "Providing appropriate feedback about

tasks performed" and "Orders given to nurse" in physicians' group were predictive factors for improving healthcare quality. In the patient registry officers' group, "Supplying operational needs", "Increase in productivity" and "Patient safety" were predictive factors in improving the quality of health services. Healthcare quality is defined in 6 aspects regarding safety, effectiveness, patient-centeredness, timeliness, efficiency, and equity in the IOM report (3). Healthcare organizations use information systems to document patients' information and track patients' conditions in multidisciplinary team work. Errors could result from incorrect prescribed/applied medications and/or inappropriate monitoring (21). Clinical information technologies such as electronic medical records and computerized order entry support patient care improve the quality of care (20) because they reduce errors while increasing work-flow efficiency and patient safety by allowing the utilisation of real-time data (14, 22). Processes provide the knowledge about the requests and the needs of the patients. Because of this reason, ICT is a chance to improve the quality of the service.

The main shortcoming of the study was that patient perspective was not included because the main objective was to evaluate the system in the frame of user perspective in hospitals.

Conclusion

Consequently, this study suggests that HIMS could improve the quality and effectiveness of healthcare by improving the tracking of patient care and by allowing better coordination between physicians, nurses and patient registry officers in a private hospital modal. Different items were found to be predictive factors for the improving in the quality of healthcare according to the participating groups.

References

1. Sheikh A, Cornford T, Barber N, Avery A, Takian A, Lichtner V, et al. Implementation and adoption of nationwide electronic health records in secondary care in England: final qualitative results from prospective national evaluation in "early adopter" hospitals. *Bmj*. [Research Support, Non-U.S. Gov't]. 2011;343:d6054.
2. Health TMO. Transformation in Health. 2008:www.kalite.saglik.gov.tr/content/files/uluslaratras.../turkiyeSDP.pdf
3. IOM. Crossing the quality chasm: A new health system for the 21st century: National Academies Press; 2001.
4. Zeman VL. Clinical quality management; Health Information Management: Concepts, principles and practice. AHIMA. 2010;Third edition:517-58.
5. Mumcu G. Bilişim Teknolojileri ve Sağlık Hizmetlerinde Kullanımı: Sağlık Hizmetlerinde Bilişim Teknolojisinin Uygulama Alanları. Bedray Yayıncılık. 2011:1-13.
6. Viitanen J, Hypponen H, Laaveri T, Vanska J, Reponen J, Winblad I. National questionnaire study on clinical ICT systems proofs: physicians suffer from poor usability. *Int J Med Inform*. 2011 Oct;80(10):708-25.
7. Bagayoko CO, Dufour JC, Chaacho S, Bouhaddou O, Fieschi M. Open source challenges for hospital information system (HIS) in developing countries: a pilot project in Mali. *BMC Med Inform Decis Mak*. 2010;10:22.
8. Amarsingham R, Pronovost PJ, Diener-West M, Goeschel C, Dorman T, Thiemann DR, et al. Measuring clinical information technology in the ICU setting: application in a quality improvement collaborative. *J Am Med Inform Assoc*. [Research Support, Non-U.S. Gov't Research Support, U.S. Gov't, P.H.S.]. 2007 May-Jun;14(3):288-94.
9. Ömürbek N, Altın FG. Sağlık Bilişim Sistemlerinin Uygulanmasına İlişkin Bir Araştırma: İzmir Örneği. *Sosyal Bilimler Dergisi*. 2009(19):211-32.

10. Koç E, Şengül YA, Özkaya AU, Gökçe B. Klinik Karar Destek Sistemleri Kullanımına Yönelik Bir Araştırma: Acıbadem Hastanesi Örneği. www.turkmi.org/kongre2012/cd/pdf-format/64-74pdf. 16.08.2013.
11. Ertek S. Endokrinolojide Tele-Sağlık ve Tele-Tıp Uygulamaları. *Acıbadem Üniversitesi Sağlık Bilimleri Dergisi* 2011;2:126-30.
12. Kisa A, Kavuncubasi S, Ersoy K. Is the Turkish health care system ready to be a part of the European Union? *J Med Syst. [Evaluation Studies]*. 2002 Apr;26(2):89-95.
13. Gluck ME. Is health information technology associated with patient safety in the United States? *Find Brief*. 2009 Apr;12(3):1-3.
14. La Pietra L, Calligaris L, Molendini L, Quattrin R, Brusaferrò S. Medical errors and clinical risk management: state of the art. *Acta Otorhinolaryngol Ital. [Review]*. 2005 Dec;25(6):339-46.
15. Ay F. Uluslararası elektronik hasta kayıt sistemleri, hemşirelik uygulamaları ve bilgisayar ilişkisi. *Gülhane Tıp Dergisi*. 2009;4(51):131-6.
16. Işık O, Akbolat M. Bilgi Teknolojileri ve Hastane Bilgi Sistemleri Kullanımı: Sağlık Çalışanları Üzerine Bir Araştırma The Use of Information Technology and Hospital Information Systems: A Study on Health Employees. *Bilgi Dünyası*. 2010;11:365-89.
17. YILMAZ M, DEMİRKAN AE. Hastane Yönetim ve Bilgi Sisteminin Kullanılabilirliğinin Değerlendirilmesi. *BİLİŞİM TEKNOLOJİLERİ DERGİSİ*. 2012;5(3):19-28.
18. Rahimi B, Vimarlund V, Timpka T. Health information system implementation: a qualitative meta-analysis. *J Med Syst. [Meta-Analysis]*. 2009 Oct;33(5):359-68.
19. Cruz-Correia RJ, Wyatt JC, Dinis-Ribeiro M, Costa-Pereira A. Determinants of frequency and longevity of hospital encounters' data use. *BMC Med Inform Decis Mak*. 2010;10:15.
20. Amarasingham R, Diener-West M, Plantinga L, Cunningham AC, Gaskin DJ, Powe NR. Hospital characteristics associated with highly automated and usable clinical information systems in Texas, United States. *BMC Med Inform Decis Mak. [Research Support, Non-U.S. Gov't]*. 2008;8:39.
21. Sherman H, Castro G, Fletcher M, Hatlie M, Hibbert P, Jakob R, et al. Towards an International Classification for Patient Safety: the conceptual framework. *Int J Qual Health Care. [Research Support, Non-U.S. Gov't]*. 2009 Feb;21(1):2-8.
22. Rahimi B, Timpka T, Vimarlund V, Uppugunduri S, Svensson M. Organization-wide adoption of computerized provider order entry systems: a study based on diffusion of innovations theory. *BMC Med Inform Decis Mak*. 2009;9:52.