

Contents lists available at [ScienceDirect](https://www.sciencedirect.com)

Journal of Radiology Nursing

journal homepage: www.sciencedirect.com/journal/journal-of-radiology-nursing

Implementation of Electronic Medical Record in Vascular and Interventional Radiology

Khalid Othman, RN^{*}, Omar Bashir, MBBS, FRCR, Mohammad Arabi, MD

Medical Imaging Department, King Abdulaziz Medical City, Riyadh National Guard Health Affairs, Riyadh, Saudi Arabia

A B S T R A C T

Keywords:

Electronic medical records
Workflow
Interventional radiology

This article discusses the implementation of a new electronic medical record (EMR) on workflow in vascular interventional radiology (VIR) and briefly discusses the preparation for launching EMR system, obstacles, advantages, and disadvantages based on an electronic survey of employees in the VIR unit at King Abdulaziz Medical City, Riyadh, Saudi Arabia. Launching the EMR system was preceded by 6-month period of a hospital-wide training introducing the new EMR system to all health care providers and associates. During this period, all hospital units were equipped with new computers, iPads, and special printers compatible with the new system. Integration of the radiology information system and new EMR was carefully conducted and monitored by the radiology team and new preprocedure and postprocedure order sets for every VIR procedure were uploaded to the system; these order sets helped in improving the quality of patient care and patient workflow in VIR. Intensive training of staff and “super users” was done in preparation for the actual launch of the system. On call clinical and information technology teams along with hotlines were available on the day of “Go Live” for troubleshooting.

© 2019 Association for Radiologic & Imaging Nursing. Published by Elsevier Inc. All rights reserved.

Introduction

The use of information technology (IT) has measurable impact on health care quality (Campanella et al., 2016). The introduction of electronic medical record (EMR) has improved work efficiency by saving time, increasing accessibility of information, and enabling data sharing to facilitate communications among multiprofessionals. The EMR has allowed standardization of data collection and protocols reducing the chances for medical errors and facilitating long-term data maintenance (Okuboyejo & Eyesan, 2014). Implementation of EMR in vascular interventional radiology (VIR) represents a unique challenge, where both clinical and radiology information systems have to be integrated.

The hospital chose to use the BESTCare, which is a web-based system developed by the Seoul National University Bundang Hospital and ezCareTech (Seongnam City, Gyeonggi-do, South Korea) in 2013 (Sojung, 2014) that integrates outpatient and

inpatient services and provides multiple functions including EMR, computerized physician order entry, and patient and social services.

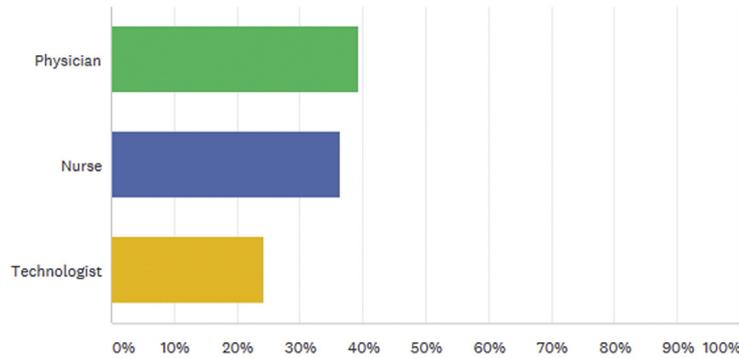
This selected EMR system operates in several modules, depending on the scope of services such as physician module, radiology, pharmacy, and nursing modules ([KAMC-R BESTCare 2.0A User Manual (Radiology)], King Abdulaziz Medical City [KAMC], Riyadh, information system and informatics division, technical IT program management office). The system integrates self-services such as appointments and the clinic locations (Hospital Information System BESTCare) and offers personal verification by either a fingerprint, smart card, or the medical record number.

This system received international recognition in 2013 by being selected as one of the world’s best hospital IT systems (Sojung, 2014) and it successfully went live in KAMC in January 2016 (Hospital Information System BESTCare; MNGHA BestCare Go-Live). KAMC is a tertiary medical city located in Riyadh, Saudi Arabia. KAMC has 1722 beds, 40 operation rooms, 13 interventional radiology and cardiac catheterization suites, 7 endoscopy rooms, and 172 ICU beds; the total number of staff (clinical and nonclinical) in the medical city is approximately 1,500 physicians; 4,800 nurses; 3,000 allied health care

^{*} Corresponding author. Khalid Othman, Medical Imaging Department, King Abdulaziz Medical City, Riyadh National Guard Health Affairs, Riyadh, Saudi Arabia.
E-mail address: OthmanKh@ngha.med.sa (K. Othman).

Describe your specialty ?

Answered: 33 Skipped: 0



ANSWER CHOICES	RESPONSES
▼ Physician	39.39% 13
▼ Nurse	36.36% 12
▼ Technologist	24.24% 8
TOTAL	33

Figure 1. The specialty of the surveyed staff.

providers; 880 residents; and 5,000 nonmedical personnel (“MNG-HA Book of Measures,” accessed on March 19, 2019). The number of procedures performed in VIR suite equaled 9,282 procedures in 2016; 9,520 procedures in 2017; and 8,469 procedures in 2018.

The purpose of this article is to highlight the transitioning of VIR section in KAMC from paper documentation to a paperless unit after hospital-wide implantation of EMR.

The authors also looked at the effect of this transition on workflow and on the staff satisfaction after 2 years' experience with the EMR. We did this by conducting surveys.

Materials and methods

A survey, using SurveyMonkey (San Mateo, CA, USA), was done by the staff of the VIR section. Staff from different specialties received the survey. It was sent to the staff through social media application (Figure 1).

Results

The satisfaction survey about the implementation of the EMR and its impact on workflow in VIR section consisted of 17

How satisfied are you with the privacy of patient information on the EMR system

Answered: 30 Skipped: 0

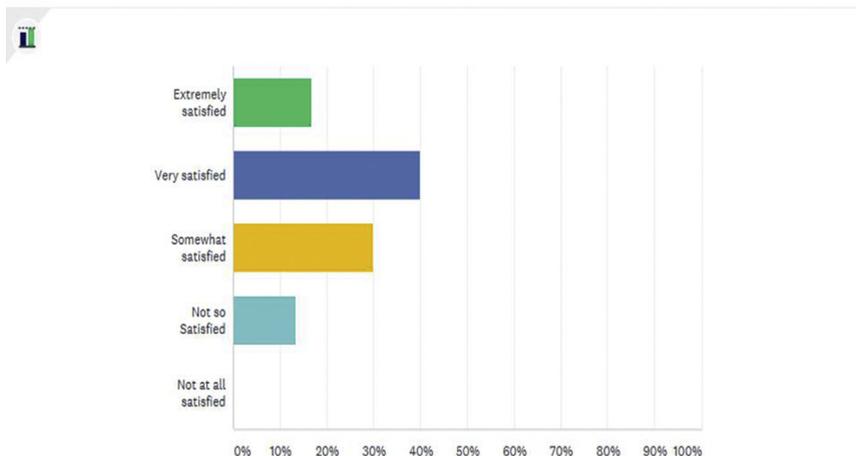


Figure 2. Staff satisfaction result on privacy by using EMR. EMR = electronic medical record.

How satisfied are you with the way of doing any documentation in the EMR system

Answered: 30 Skipped: 0

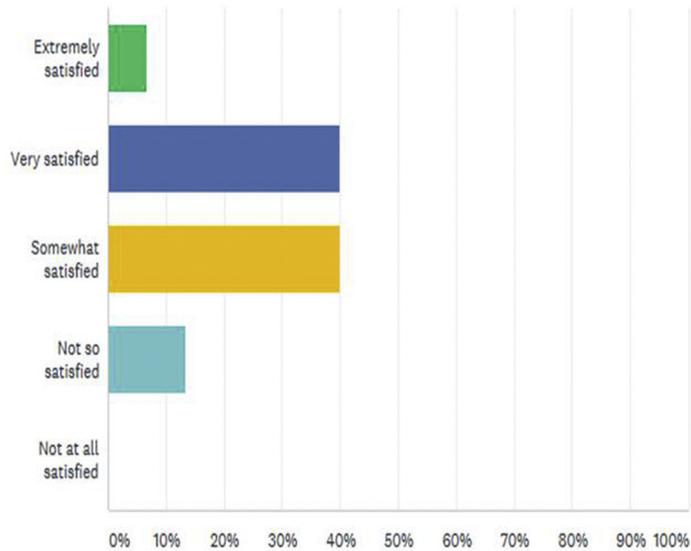


Figure 3. Staff satisfaction result on documentation in EMR. EMR = electronic medical record.

questions. A link to the survey was sent out using emails and social media to 58 staff members in the VIR unit, including physicians, nurses, and technicians. The survey included questions on the quality of the BESTCare system and the difference that the EMR made in clinical area and in the patient care from the staff point of view. The response rate was 66%; the response rate was considered excellent (Portney and Watkins 2009)

classification (Chow, Chin, Lee, Leung, & Tang, 2012). Most responders were physicians (39.39%).

The survey showed that most of the staff are satisfied with the privacy of patient information (76%). The satisfaction rate with the documentation process such as progress note, procedure order, nursing note, documents of patient vital signs, and so forth, was very high (86.6%) (Figures 2 and 3).

I feel that using the EMR system is easy

Answered: 33 Skipped: 0

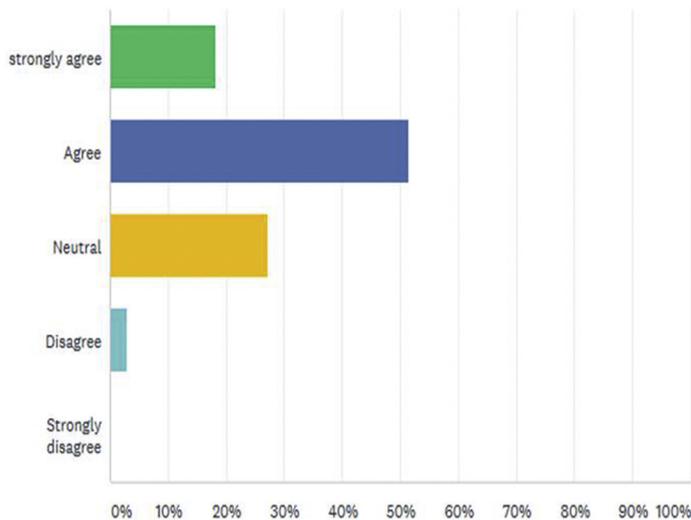


Figure 4. Staff feeling about the easiness of using EMR. EMR = electronic medical record.

I feel that it is easier to access the patient data through the EMR system compared to paper records

Answered: 30 Skipped: 0

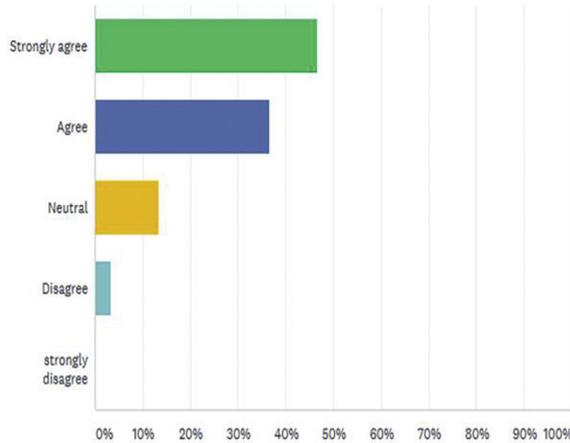


Figure 5. Staff feeling about accessing the patient data through EMR. EMR = electronic medical record.

The surveyed staff felt that the EMR was much safer in protecting patient record from loss (77%) because all of these records were saved in the system. Most of the staff preferred using the EMR to paper record (84.8%) (Figure 4) because the system provides them with very organized and easy access to data and 69% of them felt that using the EMR is easy (Figure 5).

Sixty three percentage of surveyed staff believe that the EMR reduces the preparation time before the procedure (Figure 6), but almost half of the VIR team member felt that the EMR system did not reduce the duration of patient stay in holding area after the procedure (51.7%) (Figure 7).

Percentage of 75.76 of the surveyed staff believed that the EMR system provided high-quality service (Figure 8).

Sixty two percentage of the surveyed staff believed that the EMR reduced the risk of medical errors compared with paper records (Figure 9).

Forty five percentage of the staff felt that the EMR is very innovative (Figure 10).

The EMR met the surveyed staff expectations in 68% very well (Figure 11).

Changing to an EMR system brings new challenges and new obstacles, and in this line, 60% of the surveyed staff encountered problems while using the EMR (Figure 12).

I feel that the EMR system reduces the pre-procedure preparation time

Answered: 30 Skipped: 0

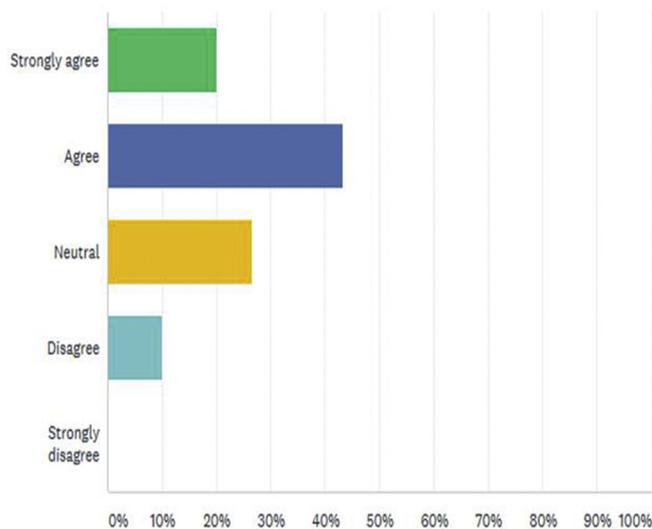


Figure 6. Staff feeling about preprocedure time by using EMR. EMR = electronic medical record.

I feel that the EMR system decreases the duration of patient-stay in holding area after the procedure

Answered: 29 Skipped: 1

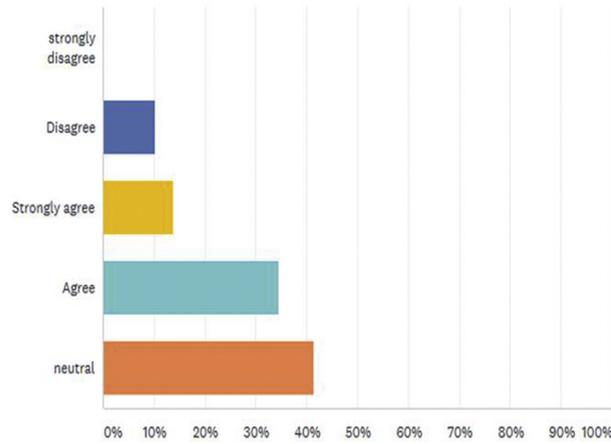


Figure 7. Staff feeling about the duration of patients' stay in holding area after procedure.

Eighty one percentage of the staff are satisfied with the training received before using the EMR (Figure 13) and 90% of them are satisfied with the Information Systems and Informatics Division support (Figure 14).

Most of the staff felt that using the EMR is better for patient care (84%) (Figure 15).

Discussion

The transition to EMR took place in several steps. In the first step, there was an intensive search for a system that met requirements of international standards with possibility of internalizing the system to bring out a copy that will meet the requirements of Saudi Arabia (Hospital Information System BESTCare).

In preparation for implementing the EMR system, the special training center was created. This training center was considered a simulation laboratory, which creates a realistic environment to train users and super users and to reduce anxiety associated with computer training in health care. The super users were from all specialties (nurses, technologists, physicians), and they received extensive training by the developer of the system in special simulation laboratories. These super users were responsible for training and supervising other staff and troubleshooting any problems that users may encounter during the actual launch. To make the staff familiar with the new system, a training version was created and installed in all hospital computers to let the staff practice on it before the conversion.

The hospital was equipped with new computers, iPads, and special printers compatible with the new system, and data were collected

How would you rate the overall quality of the EMR system services

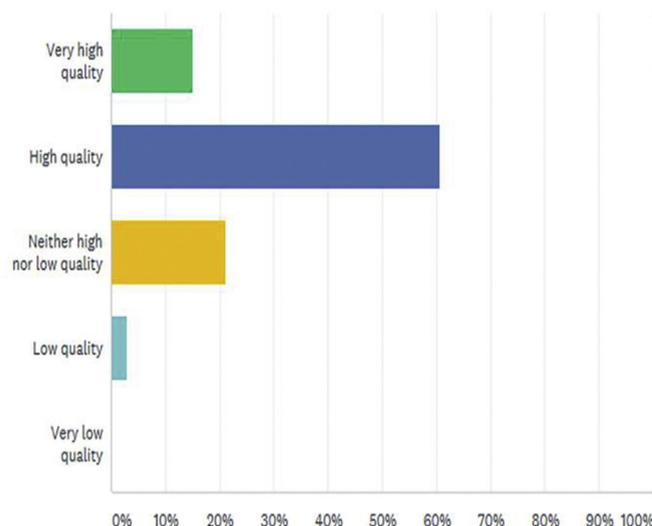


Figure 8. Satisfaction survey result about the quality of EMR. EMR = electronic medical record.

I feel that using the EMR system reduces the risk of medical error compared with paper record

Answered: 29 Skipped: 1

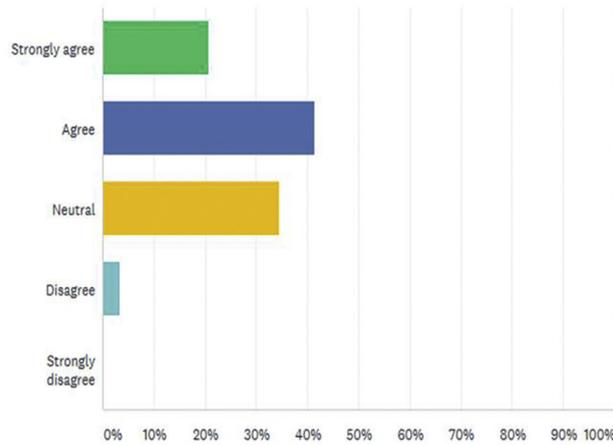


Figure 9. Survey result about medical error by using EMR. EMR = electronic medical record.

from each department. Data included procedure orders, management protocols, and templates for clinical documentations.

An EMR was created for all patients, and all old paper documents were scanned and stored in the system. All the paper documents were used in medical imaging department and were modified and uploaded on the system in collaboration between the medical imaging department and relevant sections. All staff members were provided with login information and passwords (Mountain, Redd, O’Leary-Kelly, & Giles, 2015).

Before launching the hospital-wide EMR notices contacting information about the exact time of implementation were distributed.

The “go live” was done in two stages. The first stage was implemented in the outpatient areas, and the second stage was

implemented in the inpatient areas. All hospital staff got continuous support from the EMR team during the early stage of using the system. A special team from Information Systems and Informatics Division (Ask Me Team) was formulated for helping and supporting the staff. This team conducted rounds in all hospital units to identify any problems and solve them. A hotline was created to facilitate process of reporting problems in system.

The hospital created a backup plan in case the EMR shut down or had any unexpected malfunctions. For any downtime shorter than 2 hours, the plan was to use paper forms and then transfer all the data onto the system once the system is back to normal function. If the downtime was more than 2 hours, the paper documents were scanned and stored in the system. This plan was made clear for all

How innovative was the EMR system

Answered: 33 Skipped: 0

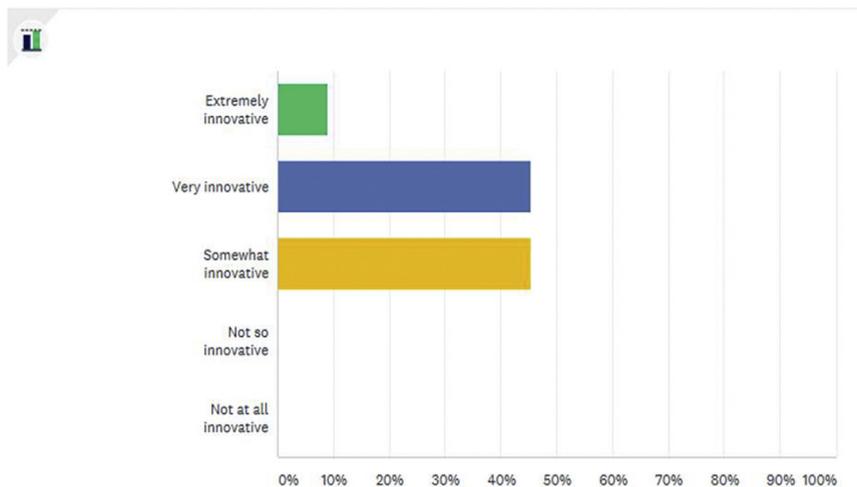


Figure 10. How innovative is EMR system. EMR = electronic medical record.

How will dose the EMR system meet your needs

Answered: 33 Skipped: 0

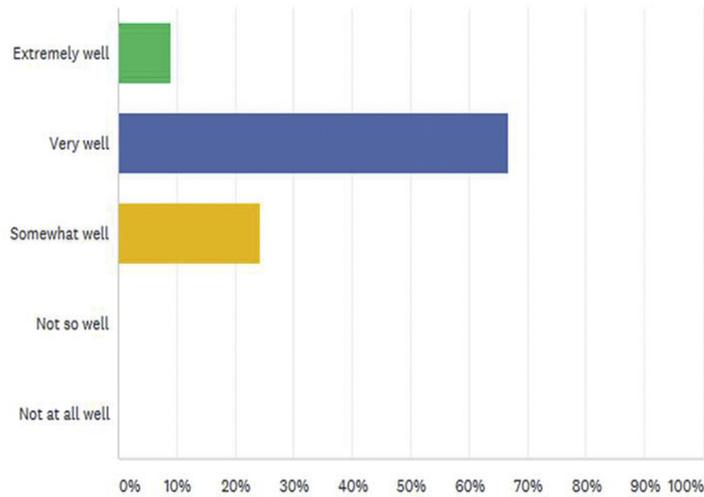


Figure 11. How does EMR meet the staff needs. EMR = electronic medical record.

staff from all units to avoid compromising patient safety during the launching phase.

Challenges

Changing the old habits of employees is one of the most difficult challenges we encountered, especially during the early stage of using the system (Ayatollahi et al., 2013).

Some employees thought that adopting the EMR system without using paper would be very difficult. Over time, the staff became more familiar with the EMR system, and these fears gradually faded

away. A study found that the nurses' satisfaction with EMR system is improved over time (Samoutis et al., 2007; Waneka & Spetz, 2010).

Data storage, remote access for authorized users inside the hospital, and partial remote access for nonresident staff were considered advantages of the EMR system. By using the EMR system, management can limit access to the patients' data in accordance with staff privileges. By using a user name and password to get in the EMR system makes the tracking of user activity very easy to capture according to login data.

Have you encountered any problem while using the EMR system

Answered: 33 Skipped: 0

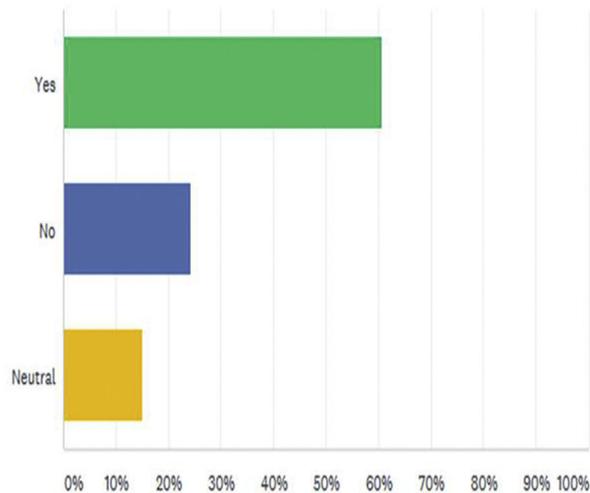


Figure 12. The percentage of staff encountered problem while using EMR system. EMR = electronic medical record.

How satisfied are you with the training you received before using the EMR system

Answered: 33 Skipped: 0

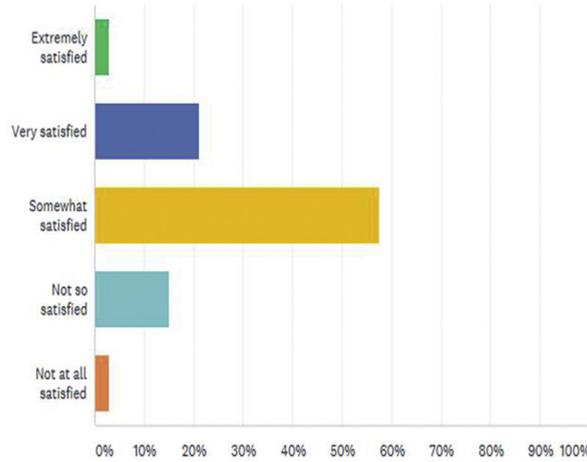


Figure 13. Staff satisfaction about the training received.

Limitations

One of the potential advantages of EMRs is to ensure medication safety by preventing medication errors because of unclear handwritten orders (Aldosari, 2017). On the other hand, there are some disadvantages in the EMR system that must be mentioned. Examples include slowness of the EMR system and staff forgetting their login information. There is a potential risk of hacking, electronic viruses, and data theft. Using the EMR may lead to an increase in the indirect patient care and decrease in the patient and physician interaction time (Asaro & Boxerman, 2008).

A majority of postprocedure physician orders are generated from order sets; this helps in standardization and decreases the

time of writing postprocedure order. Standardized orders and improved information flows appear to have reduced the need for direct physician-nurse interactions (Asaro & Boxerman, 2008).

Lessons Learned

Transition from paper charts to EMR is a challenging and complex task in any health system. VIR section integrates all clinical, nursing, pharmacological, and radiological modules. Adequate preparation, training, and identification of potential pitfalls facilitated timely implementation of EMR in the VIR section and minimized any patient safety issues.

How satisfied are you with the ISID support for any technical problem when using the EMR system

Answered: 33 Skipped: 0

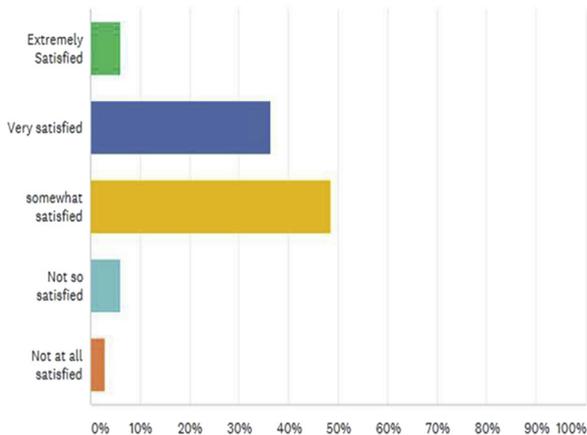


Figure 14. Staff satisfaction about the ISID support for technical problems. ISID = Information Systems and Informatics Division.

Do you agree that using the electronic medical record instead of paper is better for patient care ?

Answered: 33 Skipped: 0

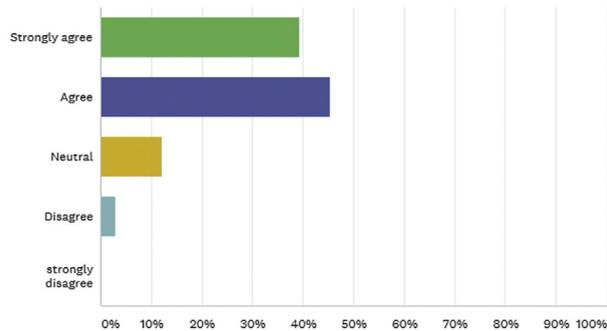


Figure 15. What is better for patient care from the staff point of view, the EMR or paper record? EMR = electronic medical record.

Conclusion

The EMR system has the capability of changing the workflow in VIR department, improving the quality of patient care and safety and improving the quality of documentation by using standardized order sets. The satisfaction survey indicated that most users felt that the EMR system is easy to use and it met their practical expectations. However, EMR may compromise interaction between care providers and patients. Patient privacy and potential data loss related to IT issues are potential concerns by the end users.

References

- Aldosari, B. (2017). Supportive care pathway functionalities of EHR system in a Saudi Arabian hospital. *Comput Biol Med*, 89, 190-196.
- Asaro, P.V., & Boxerman, S.B. (2008). Effects of computerized provider order entry and nursing documentation on workflow. *Acad Emerg Med*, 15(10), 908-915.
- Ayatollahi, H., Bath, P.A., Goodacre, S., Lo, S.Y., Draegebo, M., & Khan, F.A. (2013). What factors influence emergency department staff attitudes towards using information technology? *Emerg Med J*, 30(4), 303-307.
- Campanella, P., Lovato, E., Marone, C., Fallacara, L., Mancuso, A., Ricciardi, W., & Specchia, M.L. (2016). The impact of electronic health records on healthcare quality: a systematic review and meta-analysis. *Eur J Public Health*, 26(1), 60-64.
- Chow, S.K., Chin, W.Y., Lee, H.Y., Leung, H.C., & Tang, F.H. (2012). Nurses' perceptions and attitudes towards computerisation in a private hospital. *J Clin Nurs*, 27(11-12), 1685-1696.
- Hospital Information System "BESTCare". Accessed on March 19, 2019.
- KAMC-R BESTCare 2.0A User Manual (Radiology). King Abdulaziz Medical City-Riyadh/information system and informatics division/technical IT program management office. Accessed on March 19, 2019.
- MNG-HA Book of Measures. Accessed on March 19, 2019. 1st ed.
- MNGHA BestCare Go-Live. Accessed on March 19, 2019.
- Mountain, C., Redd, R., O'Leary-Kelly, C., & Giles, K. (2015). Electronic medical record in the simulation hospital: does it improve accuracy in charting vital signs, intake, and output? *Comput Inform Nurs*, 33(4), 166-171.
- Okuboyejo, S., & Eyesan, O. (2014). mHealth: using mobile technology to support healthcare. *Online J Public Health Inform*, 5(3), 233.
- Samoutis, C., Soteriades, E.S., Kounalakis, D.K., Zachariadou, T., Philalithis, A., & Lionis, C. (2007). Implementation of an electronic medical record system in previously computer-naïve primary care centres: a pilot study from Cyprus. *Inform Prim Care*, 15(4), 207-216.
- Sojung, Y. (2014) Saudi hospital adopts Korean IT. Retrived from Korea.Net.
- Waneka, R., & Spetz, J. (2010). Hospital information technology systems' impact on nurses and nursing care. *J Nurs Adm*, 40(12), 509-514.