

Improving Patient Safety and Hospital Service Quality Through Electronic Medical Record: A Systematic Review

Muhammad Firdaus

Postgraduate Program of Hospital Administration Studies (KARS) Department of Health Policy and Administration Faculty of Public Health, Universitas Indonesia

*Email: firdaus.juve@gmail.com

ABSTRACT

To understand the Electronic medical records (EMR) role in improving patient safety and hospital's service quality. Articles that included and assessed for the eligibility in this review was an article that show an effect of patient' safety, and product quality in hospital in correlation on using EMR. The most important function of EMR implementation is to improve patient safety in hospital, in addition to reducing cost. EMR reduce excess cost of Hospital Acquired Condition (HAC) by 16%, reduce death due to HAC by 34%. Doctor and nurse's belief that the quality of patient data is better when EMR are easier to use and suit with their dially routine. EMR can improve patient safety, but its use require some skills in technology so it won't turn to harm patients' safety. The implementation EMR requires the ability of skilled human resources in using technologies, computer and programs.

Keywords : electronic medical record, hospital, patient safety, electronic health record.

INTRODUCTION

Electronic health records (EHRs) are promoted due to their capacity to reduce clinicians' workloads, costs and errors (The Office of the National Coordinator for Health Information Technology 2013). Paper based reporting has many disadvantages, including manual data entry and requiring manual processing.

Accordingly, a systematic review on electronic patient record system for patient safety become important to be known the extent to which it is implemented. Thus, the purpose of this study was to examine the literatures on patient safety reporting based on electronic system review the finding systematically, and assess the implementation of this measurement.

THEORETICAL REVIEW

Hospitals as health centers are required to provide comprehensive services for patients. Patients need health

services that guarantee the safety and no errors occur. One of quality assurance services by improving patient safety. Patient safety is a system that makes patient more secure, including risk assessment, identification, risk management, reporting and analysis of incidents, learning ability of incidents and follow-up and implementation of solutions for the answer to the risks and prevention of clarity caused by mistakes due to the action or unnecessary actions.

Efforts to improve the safety of patients is by using the utilization of electronic medical records in the hospital as a system. Electronic medical records are beneficial to patients because they improve efficiency in the healthcare process. For administrative personnel, the use of electronic medical records can retrieval and access patient information. Doctors and health workers also get the benefit from providing health services for the convenience of accessing patient information that ultimately helps in improving patient safety and clinical decision making such as diagnosis, therapeutic therapy, allergic reactions and drug

duplication. Aspects of efficiency and the use of electronic medical records impact in reducing the operating costs and increased revenues in health care facilities, especially for hospitals.

Up The system of incident report is important for collecting and reporting adverse patient occurrences, such as medication errors and equipment failures (WHO, 2008). Therefore, the electronic data is hoped to help detect, manage, and learn from potential safety events in near real-time. The systems can be programmed to automatically detect easily overlooked and underreported errors of omission, such as patients who are overdue for medication monitoring, patients who lack appropriate surveillance after treatment, and patients who are not provided with follow-up care after receiving abnormal laboratory or radiologic tests results (Sittig & Singh., 2012).

RESEARCH METHODOLOGY

Using Proquest search engine, with a keywords “electronic medical record” resulting 7089 documents. More keyword were added “patient safety” and “hospital”, result narrow into 1061 documents. Using filter by year between 2014-2017 and journal type of document, the result became 74 documents. After reading the title and abstract we select 8 documents, 3 documents were selected by full text review and assessed for eligibility.

Using Oxford search engine we found 24050 documents with a keywords “electronic medical record. When we add keyword “Patient safety” and “hospital” the result narrow into 4901 documents. After limiting the year of document between 2014-2017 and type of document is journal, the result narow into 297. By reading the title and the abstract, 18 documents were selected, 10 document selected by full text review and assessed for eligibility.

Articles that included and assessed for the eligibility in this review was an article that show an effect of patient safety in hospital in correlation on using electronic medical record (EMR), it including some effect on medication

error, prescribing error, error in the use of EMR that potentially endanger patient safety.

RESULTS AND DISCUSSION

In most US Hospitals, the use of EMR devided into basic and comprehensive EHR systems. A hospital with at least a basic EHR system reported full implementation of the following 10 computerized function: patient demographic, physician notes, nursing assesments, patien problem list, medication list, discharge summaries, radiology reports, laboratory reports, diagnostic test results, and order entry for medications. A hospital with comprehensive EHR system reported all basic function, along with 14 additional function. Those additional are: support for advance directives, order entry for lab reports, radiology tests, consultation requests, nursing orders, ability to view radiology images, diagnostic test images, consultant reports, clinical decision support, clinical reminders, drug allergy results, drug-drug interactions, drug-lab interaction, and drug dosing support.(Adler-Milstein *et al.*, 2017). In the documentation input of EMR often to use keyboard and mouse (KBM) and speech recognition (SR). But KBM is more effective and potential patient harm chance increase when using SR (Hodgson, Magrabi and Coiera, 2017)

Reaction Patterns of Doctors and Nurses to the Use of EMR/HER

In the use of EMR, the doctor and nurses belief that that the quality of the patient data is better when EMR are easier to use and better aligned with their dialy routine. Other factor that influence the willingnes of doctors and nurses to use EMR are support from the IT departement, more bottom-up communicaton, more innovative culture, more authentic leadership, etc.(Lambooj, Drewes and Koster, 2017).

Benefits of EMR/HER

One of the most important function of EMR implementation is to improve patient safety in hospital, in addition to reducing hospital cost. EMR reduce excess cost of

Hospital Acquired Condition (HAC) by 16%, and reduce death due to HAC by 34% (Encinosa, 2012). In communication between prescribers and pharmacists, EMR reduce the incorrect dose and clarification (Singer and Fernandez, 2015). While in acupuncture unit, EMR are useful in enhancing the security of acupuncture measures in terms of accessing instruction and monitoring the patient's reaction to treatment (Li *et al.*, 2011). EMR also simplify us to trace down the patient allergic history. In some study we can track down patient's allergic history against beta lactam through hospital EMR (Moskow *et al.*, 2016). Base on interviewing physician using EMR, the use of EMR could make access to patient medical history easier, saves time, improve error awareness in medication, prevent administration of allergic drugs, and improve ordering accuracy (Holden, 2011).

Weakness of EMR/HER

As well as benefits, EMR also contributes some errors that threaten patient safety such as inability to use Computerized Provider Order Entry (CPOE) properly can lead to prescribing errors (Brown *et al.*, 2016) and delay in medication (Amato *et al.*, 2016). In other articles other EHR-related Safety concern can occur in other situation like: mismatch between information needs and content display, and one component of the EHR is unexpectedly affected by condition another component like transition of patients between wards not reflected in EHR, resulting in missed medication or orders (Meeks *et al.*, 2014). During the downtime period of EHR, whether it planned (eg; regular maintenance, updates of the software, etc) or unplanned (eg; equipment failure, cyber attacks, etc) have the potential in serious patient safety risk like: specimen misplaced or mislabeled, delay medication, placement of medication order disrupted, etc (Larsen *et al.*, 2017)

The use of Electronic Medical Record (EMR), which is the changing of conventional medical record usage to new technology based on computerization requires high consideration in planning and organizing. For details the benefits of using EMR in health services. Medical records as notes and important documents containing

the overall record of the condition and development of the patient's health should be accountable by the healthcare provider involved in providing services to the patient

The use of medical records manually in the form of paper records has a problem that is long in searching the data or provide information when needed immediately and difficulty for collecting patient data is complex and fragmented. While the EMR describes the patient's health condition record in electronic format, and can be accessed by computer from a network with the main purpose of providing or improving the care and health services are efficient and integrated. In addition to the use of manual medical records, the use of telephones and conversations is an important facility for discussion and exchange of information to make patient service decisions. But after using the EMR, the health operator of medical record involved in the care of the patient simply sees the EMR to get a patient's medical summary and quickly make a decision. The benefits of EMR can be felt both by the health operator of medical record as health providers as well as for patients to obtain safety during receiving services

In most US Hospitals, the use of EMR divided into basic and comprehensive EHR systems. A hospital with at least a basic EHR system reported full implementation of the following 10 computerized function: patient demographic, physician notes, nursing assessments, patient problem list, medication list, discharge summaries, radiology reports, laboratory reports, diagnostic test results, and order entry for medications. A hospital with comprehensive EHR system reported all basic function, along with 14 additional function. Those additional are: support for advance directives, order entry for lab reports, radiology tests, consultation requests, nursing orders, ability to view radiology images, diagnostic test images, consultant reports, clinical decision support, clinical reminders, drug allergy results, drug-drug interactions, drug-lab interaction, and drug dosing support (Adler-Milstein *et al.*, 2017). In the documentation input of EMR often to use keyboard and mouse (KBM) and speech recognition (SR). But KBM is more effective and potential patient

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Reaction Patterns of Doctors and Nurses to the Use of EMR/HER

In the use of EMR, the doctor and nurses believe that the quality of the patient data is better when EMR are easier to use and better aligned with their daily routine. Other factors that influence the willingness of doctors and nurses to use EMR are support from the IT department, more bottom-up communication, more innovative culture, more authentic leadership, etc. (Lambooy, Drewes and Koster, 2017).

Benefits of EMR/HER

One of the most important functions of EMR implementation is to improve patient safety in hospital, in addition to reducing hospital cost. EMR reduce excess cost of Hospital Acquired Condition (HAC) by 16%, and reduce death due to HAC by 34% (Encinosa, 2012). In communication between prescribers and pharmacists, EMR reduce the incorrect dose and clarification (Singer and Fernandez, 2015). While in acupuncture unit, EMR are useful in enhancing the security of acupuncture measures in terms of accessing instruction and monitoring the patient's reaction to treatment (Li *et al.*, 2011). EMR also simplify us to trace down the patient allergic history. In some study we can track down patient's allergic history against beta lactam through hospital EMR (Moskowitz *et al.*, 2016). Based on interviewing physician using EMR, the use of EMR could make access to patient medical history easier, saves time, improve error awareness in medication, prevent administration of allergic drugs, and improve ordering accuracy (Holden, 2011). One of the most important functions of EMR implementation is to improve patient safety in hospital, in addition to reducing hospital cost. EMR reduce excess cost of Hospital Acquired Condition (HAC) by 16%, and reduce death due to HAC by 34%. In the use of EMR, the doctor and nurses believe that the quality of the patient data is better when EMR are easier to use and better aligned with their daily routine. Overall, benefits

of Electronic Medical Record (EMR) application leads to improved service quality. An important issue in quality improvement is currently oriented to Patient Safety (PS) which has 6 advantages:

1. Accuracy of patient identification
2. Improved effective communication
3. Increased safety the drugs that needed to the patients
4. Certainty of precise location, precise procedure, precise patient surgery
5. Decreased the risk of infection in health services
6. Decreased the risk of the patients falls

All components of hospital services must understand and work with the purpose of maintaining patient safety. This is crucial, given the various mistakes that can occur in the service process: drug delivery; surgical procedures; radiology services; laboratory services; diagnostic determination and in the transfusion process

Weakness of EMR/EHR

As well as benefits, EMR also contributes some errors that threaten patient safety such as inability to use Computerized Provider Order Entry (CPOE) properly can lead to prescribing errors (Brown *et al.*, 2016) and delay in medication (Amato *et al.*, 2016). In other articles other EHR-related Safety concern can occur in other situations like: mismatch between information needs and content display, and one component of the EHR is unexpectedly affected by condition another component like transition of patients between wards not reflected in EHR, resulting in missed medication or orders (Meeks *et al.*, 2014). During the downtime period of EHR, whether it planned (eg: regular maintenance, updates of the software, etc) or unplanned (eg: equipment failure, cyber-attacks, etc) have the potential in serious patient safety risk like: specimen misplaced or mislabeled, delay medication, placement of medication order disrupted, etc (Larsen *et al.*, 2017)

- a. **Information Security**
Given that a service is a system with various subsystems and complex parts, then the element of information becomes very important, moreover to avoid the mistakes mentioned above. In this case fasyankes shall ensure security in data storage systems and access systems of medical records of patients. With EMR, obviously very helpful.
- b. **Avoid the Mistake of Patient Identity**
Transfusion error is 49% because blood is given to the wrong patient, wrong identification. The use of EMR allows hospitals to store electronic data each patient is equipped with a self-image, for helping avoid the mistake of patients data because the same of the name and date birth.
- c. **Management of Utilitization**
With EMR, the patient's medical history record will be stored well and can not be erased from the system. In addition, the process of care and treatment is done in a transparent, meaning that this system can avoid excessive medical therapy that is not as needed. This will support utilization management as the cost of unnecessary care and treatment becomes a disadvantage for the patient
- d. **Time Efficiency**
Order-Taker system in EMR can reduce the energy and cost in delivering information between service sections. Patients and their families do not need to manually carry out the forms (lab checks) and sheets (lab results, radiology and prescriptions). More convenient, no hassle and without having to queue for each time will take medical action or take medication
- e. **Continuous History**
The EMR system allows online and integrated databases in spite of different urban hospital locations. Older patients do not need to register as new patients, but simply by showing a medication card or mentioning the medical record number at another online hospital. This makes it easier for

patients and doctors to continue treatment wherever the patient is

CONCLUSION AND RECOMMENDATIONS

Conclusion

Electronic Medical Record is a systematic collection of electronic patient-based medical information that is connected and integrated with the information system in the hospital network. Given the importance of medical records, there is a need for progress in that. Recording of medical records digitally must be known how to record system and need to be developed in order to advance health service more effective and efficient so that can decrease the number of medical record data errors.

Electronic Medical Record is able to store patient data in large numbers using only portable computer devices. In addition, electronic medical records may provide warnings if medical personnel wrongly administer the drug or there is drug reactions. Electronic Medical Record becomes an important part in patient safety. Electronic medical record is capable of storing multimedia medical data that can be accessed anytime, anywhere, and is very useful in storing data in the long term.

Recommendation

From all the explanation, the advice that can be given based on this study is electronic Medical Record is very useful for health care facilities, for the implementation requires the ability of skilled human resources in using information technology-based resources, computer devices and programs, each user must be able to apply the computer device, then the support of all parties needed to be able to achieve the purpose of utilization of electronic medical records, both in terms of human resources and funds.

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APPENDIX – 1: Illustrates the Journal Summary Of The Title, Author, Method and Research Results.

No.	Article's Title	Author	Method	Variable	Analysis	Result
1	A Systematic Review of the Types and Causes of Prescribing Errors Generated from Using Computerized Provider Order Entry Systems in Primary and Secondary Care	Clare L Brown, Et all	Systematic review using PRISMA	<ol style="list-style-type: none"> Types prescribing errors Cause of prescribing errors 	Researchers analyzed various causes of errors in <i>Computerized Provider Order Entry (CPOE)</i>	<ol style="list-style-type: none"> CPOE is a method to reduce prescribing errors. Inability to use CPOE can lead to errors in prescribing Found 8 causes of prescribing errors associated with CPOE The cause is closely related to human factors.
2	Implication of Electronic Health Record Downtime: an Analysis of Patient Safety Event Reports	Ethan Larsen, Allan Fong, Cristian Wernz, Raj M Ratwani	Case Report Study	<ol style="list-style-type: none"> Types of disturbances occur from Electronic Health Record (EHR) operating interruption Units affected by EHR operating interruption 	Analyze which units are impacted by impaired operation of EHR	<ol style="list-style-type: none"> (-)Unexpected events related to patient safety may occur during EHR downtime such as wrong dose, medication delay, etc (-)The impact varies depending on the affected unit.
3	An Analysis of Electronic Health Record-Related Patient Safety Concerns	Derek W Meeks, Michael W Smith, Lesley Taylor, Dean F Sittig, Jean M Scott, Herdeep Singh.	Retrospective Analysis	Types of disadvantages/ errors associated with electronic health record (EHR)	Analyze the various errors associated with EHR that potentially endanger safety at Veterans specialized health facilities	(+) Describes any mistakes that have occurred due to misuse of EHR and its impact on patient safety such as corrupted data, transition between wards not reflected on EHR, failure of patient context manager, etc.
4	Use of Electronic Medical Records And Quality of Patient Data: Different Reaction Patterns of Doctors And Nurses to the Hospital Organization	Mattijs S.Lambooi, Hanneke W.Drewes, Ferry Koster	Questionnaire doctors and nurses who had experience with the implementation and use of EMR in hospitals	<ol style="list-style-type: none"> Benefits of EMR Influencing factors that support implementation of EMR and Quality of patient data 	measure the success implementation and influencing factor of EMR between nurse and doctor	<ol style="list-style-type: none"> (+) Both doctor and nurse find the patient data in the EMR of better quality when the EMR is easier to use (+) Majority doctor state that EMR is easier to work with if there is support from administrative department. (+) Majority nurse state that EMR is easier to work with if the culture is less open.
5	The Effect of Electronic Medical Record System Use on Communication Between Pharmacist And Prescribers	Alexander Singer, Roberto Duarte Fernandez	Retrospective Study	<ol style="list-style-type: none"> Difference categories of communication between pharmacies and prescribers 	Comparing the frequency of faxed pharmacy communications before and after the implementation of EMR	<ol style="list-style-type: none"> (+) EMR reduce the incorrect dose and clarification request between pharmacist and prescribers (+)EMR makes important benefit in medication safety point.
6.	Cognitive Performance –Altering Effects of Electronic Medical Records: an Applications of The Human Factors Paradigm for Patient Safety	Richard J Holden	Interviewing Physicians Using EMR in Two Different Hospitals	<ul style="list-style-type: none"> Electronic medical record Cognitive performance 	The cognitive change of medical personnel in using EMR for patient safety purposes revealed in this study through interview method, either in the form of positive things, such as faster search and negative things such as "copy-paste" a data.	<ol style="list-style-type: none"> EMR has both advantage and disadvantage. (+)Advantage : easy to access patient medical history, saves time, improves error awareness, improve ordering accuracy, prevent administration of allergic drugs, etc. (-)Disadvantage : requires many steps and numerous clicks, allergy warning require response before order can be completed,

No.	Article's Title	Author	Method	Variable	Analysis	Result
						time consuming to learn to use system, waiting for software to process, etc.
7.	Use of The Global Trigger Tool in Patient Safety Improvement Efforts: Nordic Experience	Persephone Doupi Helge Svaar Brian Bjorn Ellen Deilkas Urban Nylen Hans Rutberg	Retrospective Method	Variabel Dependen: Global trigger tool (GTT) Variabel independent: Patient safety	Describes the use of the Global Trigger Tool in the Nordic region (Denmark, Finland, Norway, Sweden), where GTT is a retrospective method for measuring patient safety in healthcare provider in order to provide comparable longitudinal data and assessment of patient safety implementation.	(+) GTT can identify some failure related to patient safety through longitudinal benchmarking.
8.	How Can We Bend the Cost Curve? Health Information Technology and Its Effects on Hospital Costs, Outcomes, and Patient Safety	William E. Encinosa Jaeyong Bae	Multivariate Regression Analysis	1. Expenditures and outcomes after patient safety events under EMRs	This article analyzes how large investments in EMR in hospital can reduce not only in reduce the patient safety events but also reduce the cost in hospital in reducing hospital event severity are required Conditions (other hospital-acquired illnesses outside primary diagnoses) and these results have proven that EMR use can also make the cost of sick to overcome the cost of out-of-hospital treatment hospital.	<ol style="list-style-type: none"> (+) EMR can increase patient safety and reduce hospital cost. EMR reduce excess cost of Hospital Acquired Condition (HAC) by 16%. EMR decrease excess readmission due to HAC by 39%. Reduce death due to HAC by 34%.
9.	An Assessment of Patient Safety in Acupuncture Process Under EMR Support	Yi Chang Li, Ming Chien Hung, Chien Hung	Cross Sectional	Reminding methods of performing acupuncture prescription	Researcher analyzed the role of EMR against the safety of acupuncture therapy	(+) <ol style="list-style-type: none"> EMR are useful in enhancing the security of acupuncture measures in terms of accessing instruction and monitoring the patient's reaction to treatment.
10	Electronic Health Record Adoption in US Hospital, The Emergence of A Digital "Advance Use "Divide	Julia Adler-Milstein, A Jay Holmgreen, Peter Kralovec	Descriptive Study	<ol style="list-style-type: none"> The level of EHR adoption The use of EHR in hospitals 	Researchers analyzed the use of EHR at 2803 rs, based on the characteristics of hospital and EHR in use.	(+) <ol style="list-style-type: none"> Adoption of EHR continues to increase in advance EHR, the main function of EHR is to monitor patient safety (eg, adverse drug effects) EHR is also useful in assessing the performance and function of patient care.
11	Computerized Prescriber Order Entry – Related Patient Safety Report: Analysis Of 2522 Medication Error	Mary G. Amato,1,2 Alejandra Salazar 1,Thu – Trang T Hicman, 1, Albor JR Quist,1	Case Control collected all available medication safety reports from participating institutions. These reports	The kind of effect inflicted by Computerized Prescriber Order Entry (CPOE) error	Review all patient safety medication reports that occurred in the medication ordering phase.	Hasil (-) <ol style="list-style-type: none"> 51.9% medication errors reported were related to CPOE the most frequent effect related to the patient were delay in medication.

No.	Article's Title	Author	Method	Variable	Analysis	Result
			have not previously been systematically			
12	Efficiency and Safety of Speech Recognition for Documentation in the Electronic Health Record	Tobias Hodgson, Farah Magrabi, and Enrico Coiera	Descriptive Analytics	EHR using Keyboard and mouse (KBM) and EHR using Speech recognition (SR)	Compare the efficiency and safety of using SR clinical documentation within EHR system with use of KBM.	<ol style="list-style-type: none"> 1. Clinical documentation took significantly longer to complete using SR compared to KBM. 2. Potential patient harm chance increase when using SR.
13	Identifying Opportunities in EHR to Improve the Quality of Antibiotic Allergy Data	Jaclynn M Moskow ¹ , Nicole Cook ² , Carisa Champion-Lippmann ³ , Saint Anthony Amofah ⁴ , Angela S Garcia ⁵	Descriptive Analytics	<ol style="list-style-type: none"> 1. Patients with beta-lactam allergy recorded by EHRs 2. Beta-lactam allergy reaction documented in EHRs 	Analyzed the percentage of patients with beta-lactam allergy and allergy reaction documented in EHR.	<ol style="list-style-type: none"> 1. Women more likely have a beta lactam-allergy than man. 2. Skin rashes was the most effect of beta-lactam allergy reaction documented in EHRs.

