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Evaluation of Electronic Medical Records (EMRs) on Patient Safety Incident (PSI)

Thalia Febriati[1]*, Adelwais Febriati Yurni[2], Muhammad Sandriyan[3], Rian Andriani[4]

[1,2,3,4,] Universitas Adhirajasa Reswara Sanjaya.
*Correspondence email: thaliafebrianti22@gmail.com

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ABSTRACT

Traditional paper-based medical record systems can be inefficient and prone to errors, necessitating the adoption of digital solutions. EMR have emerged as a critical innovation in healthcare, addressing these challenges by streamlining documentation, improving data accuracy, and enhancing patient care coordination. Patient Safety Incidents are an integral part of Patient Safety in hospitals, as they have the potential to result in preventable injuries. PSI is commonly defined as an event, incident, or condition that could have resulted or did result in harm to a patient The review systematically analyzed peer-reviewed studies from databases including PubMed, Scopus, Web of Science, and Google Scholar, published between 2015 and 2025. Result were analyzed using qualitative-descriptive statistics. The implementation of EMR has been shown to have a positive impact on patient safety incident. Near misses reported to EMR while multitasking. EMR components may also improve AE ascertainment. EMR identified more no-harm incidents compared to other incident-reporting systems The key benefits include improved patient safety by reducing medication errors, enhancing the accuracy of medical documentation, improving the traceability of vital signs and infusion administration, and facilitating better coordination among medical teams. EMR also increases patient satisfaction compared to paper-based medical records.

1. INTRODUCTION

In the era of digital transformation, healthcare institutions are required to continuously evolve and integrate technological advancements to enhance service quality and efficiency. One of the key challenges in nursing care is the time-intensive nature of documentation, especially when the patient-to-nurse ratio is disproportionate. Nurses must not only document and execute all clinical interventions but also ensure patient safety and comfort while managing multiple responsibilities (Sinaga et al., 2019).

Traditional paper-based medical record systems can be inefficient and prone to errors, necessitating the adoption of digital solutions. Electronic Medical Records (EMR) have emerged as a critical innovation in healthcare, addressing these challenges by streamlining documentation, improving data accuracy, and enhancing patient care coordination. The implementation of EMR has been widely adopted in various healthcare facilities, including Diagram Heart Hospital, to increase nursing efficiency, optimize service quality, and positively impact patient satisfaction and safety. Several studies support the benefits of EMR adoption in clinical settings. EMR implementation can reduce documentation time by up to 30%, allowing nurses to dedicate more time to direct patient care (L. Sinaga et al., 2019).

Additionally, Naamneh & Bodas, (2024) found that EMR usage reduces medication administration errors by 25%, significantly improving patient safety. This literature review aims to evaluate the effectiveness of EMR in relation to patient safety and satisfaction . Specifically, it seeks to analyze the impact of EMR on nursing efficiency, particularly in reducing documentation workload, assess the role of EMR in enhancing patient safety by minimizing medication errors and improving care coordination, and identify challenges associated with EMR implementation, including healthcare staff resistance (Naamneh & Bodas, 2024).

Investments in health information technology (HIT) can enhance the safety and efficiency of patient care and enable knowledge discovery. However, emerging evidence suggests that HIT may cause new patient safety concerns and other unintended consequences due to usability issues, disruptions of clinical processes, and unsafe workarounds to circumvent technology-related constraints. In particular, rapid adoption of electronic health records (EHRs) has revealed potential safety concerns related to EHR design, implementation, and use. Patient safety concerns are broadly defined as adverse events that reached the patient, near misses that did not reach the patient, or no harm conditions that increase the likelihood of a safety event. Detecting and preventing EHR-related safety concerns is challenging

because concerns are often multifaceted, involving not only potentially unsafe technological features of the EHR but also EHR user behaviors, organizational characteristics, and rules and regulations that guide EHR-related activities. Thus, comprehensive and newer 'sociotechnical' approaches that account for these elements required to address the complexities of EHR-related patient safety. Despite a clear need to define and understand EHR-related safety concerns, data that describe the nature and magnitude of these concerns are scarce. A few studies have attempted to quantify and classify EHR-related safety concerns by mining patient safety incident reporting databases. In addition, conceptual frameworks or models have been developed to incorporate the breadth of technical and non-technical factors into the analysis of EHR safety and effectiveness (Meeks, 2014a).

This literature review aims to evaluate EMR in relation to patient safety incident. Given the growing reliance on digital healthcare solutions, understanding the factors that influence EMR adoption is crucial for optimizing its implementation in clinical practice.

2. LITERATURE REVIEW

Electronic Medical Record (EMR)

Electronic Medical Record (EMR) is similar to any types of electronic records. EMR generates metadata that is invisible to an average computer user however, any alternations could be viewed under the "track changes" feature of the program. Hence, doctors and healthcare professionals who are authorized not only to access the EMR but also to alter or edit the record. Metadata could be used to track person(s) who accessed the electronic record, what types of information was being viewed and whether the record was modified etc. Unlike paper records, visual inspections are needed to detect any alternations. Similar to paper records, EMRs must be authenticated prior to using them as evidence in court or business transaction. Present technology helps us in knowing the authenticity of EMRs and identifies whether the documents or records have been altered or tampered. The technologies that are used could also provide an audit trail of the documents or records, even to the extent the person altered who had created or signed the records or documents could be traced. EMRs are difficult to authenticate as ownership, authorship, and validity need to be ensured. The ability of tracking the path of EMRs is important as it can

enable users to know whether when and by whom the records were revised and where the authentic version is stored (Edmund et al., 2009).

EMRs Comprises a set comprehensive database used to store and access patients' healthcare information. The EMRs replaced the paper medical records as the primary source of information for healthcare purposes including clinical, legal, and administrative requirements. It is seen as a virtual compilation of non-redundant health data about a person across lifetime, including facts, observations, interpretations, plans, actions, and outcomes. The EMRs is supported by a network of systems that captures, stores, processes , communicates, secures, and presents information from multiple disparate locations as per requirement. The system facilitates the interaction among specialists or initial attending doctors, patient, attendance of long-term care, and business administration such as risk management and billing. EMRs allows medical personnel to look at charts and histories of patients without having to search for paper based medical reports. With the use of document imaging system, cataloguing can be done according to its specific need. Moreover, patients' charts can be customized according to the preference of the medical personnel. Besides that, it can also list the type of medication and dosage on a patient's file. At the moment, there are many EMR systems available in the market. Healthcare organizations are normally caught in a dilemma either to purchase readymade or custom-made system (Edmund et al., 2009) .

Patient Safety

Patient safety in hospitals is a system in hospitals make patient care safer which includes risk assessment, identification and management of matters related to patient risk, incident reporting and analysis, ability to learn from incidents and follow-up and implementation of solutions to minimize the incidence of risk and prevent injury caused by errors due to carrying out an action or not taking action that should be taken (Sinaga et al., 2019).

The WHO's International Classification for Patient Safety was identified as a key reference document in relation to defining and coding of patient safety incidents, particularly in Europe.1 This classification was often amended to individual healthcare contexts. In the U.S., there was greater emphasis on the definitions and coding formats developed by the Agency for Healthcare Research and Quality (AHRQ) and the National Quality Forum (NQF). The AHRQ is developing and validating the Quality and Safety Review System to collect comparable patient safety data over time for acute care hospitals using standardized definitions and algorithms. More than half of the U.S. states and the District of Columbia have enacted reporting systems using at

least some portion of NQF's list to help stakeholders identify and learn from serious reportable events. Tsang et al (2012) acknowledged the potential differences between these classification systems and related definitions and called for a greater examination to allow translation across healthcare systems and support a greater consistency in the reporting of patient safety incidents. A Patient Safety Incident (PSI) is commonly defined as an event, incident, or condition that could have resulted or did result in harm to a patient. Obtained from the respondents. "Near missed incidents are potentially harmful events that impact patients but are still potential, such as potholed roads or getting wet, which patients will later pass through" "no harm incidents are potentially harmful events that impact patients but are still potential, such as potholed roads or getting wet, which patients will later pass through" (Marpaung et al., 2025).

Near-miss incident is an event that could have caused injury but did not, either by chance or timely intervention, Potential injury event is an incident with the potential to cause injury, whether or not it actually did. Adverse event is an event that was not expected and may have negative consequences commonly used in healthcare for incidents like medication errors or patient falls. No-Harm Events an error occurred, but the patient was not harmed. Sentinel Events unexpected events involving death or serious injury, signaling urgent need for investigation (Hegarty et al., 2020).

An incident can be a reportable circumstance, near miss, no harm incident or harmful incident (adverse event). A reportable circumstance is a situation in which there was significant potential for harm, but no incident occurred (i.e., a busy intensive care unit remaining grossly understaffed for an entire shift, or taking a defibrillator to an emergency and discovery it does not work although it was not needed). A near miss is an incident which did not reach the patient (e.g., a unit of blood being connected to the wrong patient's intravenous line, but the error was detected before the infusion started). A no harm incident is one in which an event reached a patient but no discernable harm resulted (e.g., if the unit of blood was infused, but was not incompatible). A harmful incident (adverse event) is an incident that results in harm to a patient (e.g., the wrong unit of blood was infused and the patient died from a hemolytic reaction). Harm implies impairment of structure or function of the body and/or any deleterious effect arising there from, including disease, injury, suffering, disability and death, and may be physical, social or psychological. Disease is a physiological or psychological dysfunction. Injury is damage to tissues caused by an agent or event and suffering is the experience of anything subjectively unpleasant. Suffering includes pain, malaise, nausea, depression, agitation, alarm, fear and grief. Disability implies any type of impairment of body structure or function,

activity limitation and/or restriction of participation in society, associated with past or present harm. A contributing factor is a circumstance, action or influence (such as poor rostering or task allocation) that is thought to have played a part in the origin or development, or to increase the risk, of an incident. Contributing factors may be external (i.e., not under the control of a facility or organization), organizational (e.g., unavailability of accepted protocols), related to a staff factor (e.g., an individual cognitive or behavioral defect, poor team work or inadequate communication) or patient-related (e.g., nonadherence). A contributing factor may be a necessary precursor of an incident and may or may not be sufficient to cause the incident (WHO, 2009)

In health information technology (HIT) can enhance the safety and efficiency of patient care and enable knowledge discovery. However, emerging evidence suggests that HIT may cause new patient safety concerns and other unintended consequences due to usability issues, disruptions of clinical processes, and unsafe workarounds to circumvent technology-related constraints. In particular, rapid adoption of electronic health records (EHRs) has revealed potential safety concerns related to EHR design, implementation, and use. Detecting and preventing EHR-related safety concerns is challenging because concerns are often multifaceted, involving not only potentially unsafe technological features of the EHR but also EHR user behaviors, organizational characteristics, and rules and regulations that guide EHR-related activities. Thus, comprehensive and newer 'sociotechnical' approaches that account for these elements is required to address the complexities of EHR-related patient safety (Meeks et al., 2014a).

3. METHODS

This research method is a literature review study. The database used as a literature source consist of PubMed, Scopus, Web of Science, and Google Scholar, published between 2015 and 2025. The keywords used for are "EMR", "Evaluation", "PSI" last 10 years (2015-2025). Immediately after a journal search was carried out on the database, a total; of 33 articles were obtained. Then the researchers carried out the first stage of selection by eliminating 4 journals that were the same. Next, the second selection was with the abstract title and title and in the final process 13 journals were obtained which included in the review.

4. RESULTS AND DISCUSSION

Clinicians need practical intrapersonal, interpersonal, and systems strategies to use Electronic Health Record (EHR) systems in mindful, relational ways. Avoiding all EHR use during patient encounters may be impossible and unsustainable, with clinicians using EHR systems over half of their workday and increasingly after clinic hours. Meanwhile, research suggests that the risk of EHR multitasking is affected by the cognitive complexity of tasks and decisions, EHR system usability, teamwork, and clinician-patient dynamics. Clinical multitasking predated EHR systems, which can reduce the risk of making errors by reducing the cognitive load of clinicians' work by synthesizing and organizing information in accessible, usable formats. A 2009 Israeli study found that clinicians perceived some benefits to reducing the cognitive load of completing some clinical tasks, particularly if they perceived the EHR system to be comprehensive and usable. At the same time, a danger of growing comfort and automaticity with EHR use was a risk of medication or documentation error. More recent research has suggested that medication errors and adverse drug events in intensive care, hospital, and ambulatory settings may be reduced with computerized provider order entry and drug-drug interaction checking, although computerized provider order entry may yield further improvements to reduce the cognitive complexity of EHR ordering. this growing literature in the context of the rapid expansion of newer-generation EHR systems in the United States under the meaningful use incentives programs (Ratanawongsa et al., 2018).

Clinician transparency with patients about using EHR system including tasks such as prescribing that require focused attention to avoid errors may result in fewer misses while preserving patient trust and satisfaction. As professional schools implement skills-based training in patient-provider communication with EHR system use, trainees may be able to practice empathic ways to negotiate the need for silent EHR use and ways to detect subtle queues from patients signaling that they need the clinician's full attention. In addition, other systematic approaches are needed to mitigate technology-induced errors—that is, medical errors arising from a technology's design and development, implementation and customization, and resultant human-computer interactions and sociotechnical work processes. These include slips (errors that are corrected) and mistakes (errors that go unnoticed or uncorrected). Gedikci (2023) recommended proactive and reactive methods for reducing technology-induced errors: heuristic evaluation, cognitive walkthroughs, ability testing, clinical and computer-based simulations, rapid assessment processes, ethnographies, and case studies (Ratanawongsa et al., 2018).

EMR-based Adverse Event (AE) ascertainment at a single institution using an automated data extraction, cleaning and grading process dramatically improves the accuracy of AE laboratory ascertainment. Notably, the automated processing steps to remove potential laboratory errors, which were not previously reported by Lencioni et al., (2015) are crucial to ensuring accurate laboratory AE identification. These results have several direct implications. First, automated laboratory AE ascertainment and grading may be able to replace the current manual ascertainment process. Given the extensive time required for manual ascertainment the limited Clinical Research Associate (CRA) time available for AE reporting, and the limited resources available to reimburse manual reporting, such an automated system may be of substantial benefit (Nass, et al 2010, Roche, et al 2002). Secondly, such course-level data can provide a more accurate estimate of true laboratory AE rates. Given that clinical outcome group (COG) AE rates were substantially lower than in EMR data, published laboratory AE rates probably substantially underestimate the true laboratory AE rates. Finally, automated EMR-based laboratory AE reporting may substantially decrease the variation in clinical trial AE reports (Huynh-Le, et al 2014, Lencioni, et al 2015, Thomas, et al 2002). EMR-based laboratory AE ascertainment may substantially improve laboratory AE reporting efficiency (Miller et al., 2017).

We found that EMR could be a valuable tool to identify safety information about no-harm incidents when used in a structured way through random samples and implicit review. EMR identified more no-harm incidents compared to other incident-reporting systems. This is in line with other EMR studies that have been found to identify more AEs compared with other safety information methods. When combined with other patient safety reporting systems, EMR may provide a clearer and broader picture of the no-harm incidents occurring in healthcare, to support study and point out safety problems that need to be prioritized for implementing safety interventions. Since EMR seems useful even for identifying no-harm incidents (Schildmeijer et al., 2013)

This literature review has examined 13 studies on the benefits of Electronic Medical Records (EMR) for patient safety, encompassing research from countries. These studies consistently demonstrate that EMR implementation enhances patient safety by reducing medication errors and improving the accuracy of medical records. For instance, a study in Saudi Arabia highlighted that widespread EMR adoption positively influences healthcare delivery and patient safety (Ratanawongsa et al., 2018). In Indonesia, the adoption of EMR systems is not yet universal, primarily due to the substantial costs associated with implementation.

While larger hospitals with sufficient budgets can manage these expenses, many smaller facilities face financial constraints. Despite these challenges, the Indonesian government has mandated that all healthcare facilities transition to EMR systems by 2023, recognizing the significant benefits for both healthcare staff and patient safety (Tilaar & Sewu, 2023). Several studies conducted in Indonesia have focused on assessing the impact of EMR on service quality and patient safety. These studies have found that EMR implementation leads to increased patient satisfaction, a reduction in medication administration errors, and improved efficiency among nursing staff. For example, research indicates that EMR systems enhance the review of medical records and medication management, contributing to better patient outcomes. International studies corroborate these findings, emphasizing that EMR systems improve service quality by facilitating faster access to patient information and enhancing coordination among medical teams. In Ethiopia, research has shown that EMR adoption improves the quality of healthcare services and patient safety (Sinaga & Sumartini, 2025). Similarly, studies have demonstrated that EMR systems reduce medication errors and enhance the traceability of vital signs and infusion administration, thereby minimizing the risk of medical data recording errors (Naamneh & Bodas, 2024).

However, the implementation of EMR systems is not without challenges. Common obstacles include user resistance, limitations in technological infrastructure, and concerns regarding data security. In Indonesia, specific challenges encompass regulatory compliance, patient data protection, and the validity of medical records (Ikawati & Haris, 2024). Additionally, inadequate training and a lack of ongoing technical support hinder effective EMR utilization. Addressing these issues is crucial to ensure the successful adoption and optimization of EMR systems in healthcare settings. In conclusion, while EMR implementation offers substantial benefits in enhancing service quality and patient safety, overcoming financial, infrastructural, and educational barriers is essential for widespread and effective adoption. Collaborative efforts between government entities, healthcare institutions, and technology providers are necessary to address these challenges and fully realize the potential of EMR systems in improving patient care (Sinaga & Sumartini, 2025).

Findings may not represent all types of EHR-related safety concerns and might not be generalize able to other institutions with different organizational characteristics, EHR infrastructure, or patient safety reporting mechanisms. The data used for our analysis were composed of safety concerns that ranged from unsafe conditions to patient harm. Although the analysis of unsafe conditions or near misses is useful to

illustrate concerns in EHR-enabled care, we acknowledge that their circumstances or implications may be different from adverse events that result in patient harm. All four emergent safety concerns affected, or had the potential to affect, multiple patients, but we did not analyze additional data on patient outcomes as a result of these concerns. In general, fewer than 10% of medical errors are captured through reporting, and such data do not allow us to calculate prevalence rates. Recent study was unable to capture the universe of EHR-related safety concerns that might be occurring. Despite capturing a low percentage of errors, we were able to gain insight about non-technical aspects of EHR-related safety concerns that may not be routinely considered in technology-focused investigations. In conclusion, our study demonstrates the potential utility of analyzing patient safety concerns using a sociotechnical approach to account for the complexities of using EHRs. We found that, even within a well-established EHR infrastructure, many significant EHR-related safety concerns related to both unsafe technology and unsafe use of technology remain. The predominant concerns we identified can help to focus future safety assessment activities and, if confirmed in other studies, can be used to prioritize ongoing interventions for further research. Safety concerns we identified had complex sociotechnical origins and would need multifaceted strategies for improvement. Thus, institutions with long-standing EHRs as well as those currently implementing EHRs should consider building a robust infrastructure to monitor and learn from EHR-related safety concerns (Meeks et al., 2014a).

EHR use has increased in recent years with the advancement of health information technology and Meaningful Use directives. Adverse Drug Event (ADE) research has spanned decades, and while prior studies have examined ADEs in the ambulatory setting, none have reported in detail the methods of identifying ADEs in the ambulatory setting with a focus on EHRs. EHRs were primarily used as sources of data for ADE detection. The majority of studies reviewed utilized a retrospective approach, which was useful to measure incidence rates of ADEs but not to catch preventable ADEs. Studies that created electronic tools capable of searching through the EHR to detect trigger phrases or laboratory values show promise of a transition away from complete manual chart review for the detection of ADEs. Manual chart review limits researchers and physicians to detecting ADEs after they have already happened. With computer monitors and electronic triggers searching the EHR in real time, health care providers may be able to identify preventable ADEs and take corrective action before patient harm occurs. Future research is needed to measure consistency of documentation in various ambulatory settings, from large outpatient

clinics to small primary care facilities. If there is a large disparity in patient data being documented, then study results will not be representative of the true measure of ambulatory. Due to the cost of EHRs, studies were most likely conducted at facilities that had the resources to afford an EHR, so results may not be generalizable. Beyond the limitations of this review, EHRs are also limited by the information entered into them; a lack of standard documentation requirements may lead to incomplete charts that hinder ADE detection and monitoring. Medication reconciliation is another important step that needs to be completed during patient visits to ensure the med list is up-to-date in the system. Together with physician compliance, enhanced research tools that work with EHRs will enable researchers to better measure, characterize, and detect ADEs in the ambulatory setting (Feng et al., 2019).

Adequate recording of medication adverse events in healthcare can help overcome this since recorded events can be communicated. Furthermore, it is a prerequisite for creating a learning health system, both at the level of society as well as at the level of health care practices. Most patient safety research in healthcare focuses on hospitalized patients. However, in many countries primary care is the first point of contact between patients and the healthcare system. As such, most of the care is provided there and the general practitioner has a large share in the medication that is prescribed. Because of the gatekeeper role, general practitioners (GPs) play an important part in patient safety by adequately signaling and recognizing medication adverse events. Subsequently, uniform recording these events in patient's electronic health record (EHR) is important to monitor progress and to ensure that all responsible parties are aware of this possible safety hazard. Routine EHRs can play an important role in achieving a learning health system, improving healthcare. At patient level, EHRs play a key role in communication since events that remain unrecorded will not be communicated. This communication is crucial when multiple health care providers are involved in patient care, especially since patient care becomes more complex. Other countries with a comparable primary care structure, such as the UK, already showed that EHR data can be used to identify medication adverse events alongside for example national incident reporting systems. When combined with other patient safety reporting systems, EMR may provide a clearer and broader picture of the no-harm incidents occurring in healthcare, to support study and point out safety problems that need to be prioritized for implementing safety interventions. Optimizing the electronic health record system can help the general practitioner to detect and record adverse events. We also found considerable variation in recorded adverse events between six

different software packages. Improvement in terms of uniformity in recording medication adverse events is possible, preventing potential damage for patients. We suggest that creating a learning health system by individual practice feedback on the number of recordings of adverse events would help practitioners to improve their recording habit (de Hoon et al., 2017).

5. CONCLUSION

Medication errors and adverse drug events in intensive care, hospital, and ambulatory settings may be reduced with computerized provider order entry and drug-drug interaction checking, although computerized provider order entry may yield further improvements to reduce the cognitive complexity of EHR ordering. Near misses reported to EMR while multitasking. EMR-based laboratory AE ascertainment may substantially improve laboratory AE reporting efficiency. When combined with other patient safety reporting systems, EMR may provide a clearer and broader picture of the no-harm incidents occurring in healthcare. EMR could be a valuable tool to identify safety information about no-harm incidents. EMR identified more no-harm incidents compared to other incident-reporting systems. Based on a review of 13 journals from various countries, Electronic Medical Records (EMR) has been shown to have a positive impact on healthcare quality and patient safety. EMR significantly enhances patient satisfaction, reduces medication errors, improves nursing efficiency, and accelerates access to and traceability of medical information. Despite these challenges, the Indonesian government has mandated EMR implementation in all hospitals starting in 2023, recognizing its substantial benefits for patient safety, satisfaction, and healthcare service efficiency. Further efforts are needed to address barriers such as healthcare staff training, technological infrastructure improvements, and data security policies to ensure the successful and universal adoption of EMR.

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