Effectiveness and Outcome of Electronic Medical Record in Patient Service: A Systematic Review

Turido Pratama

Faculty of Public Health, Univeritas Airlangga, Surabaya, Indonesia
Email: dr.turidopratama@gmail.com

Abstract: Using electronic medical records is one endeavor to enhance healthcare services and patient outcomes. The electronic medical record (EMR) is employed in healthcare facilities to accomplish every objective. This study aimed to evaluate the effectiveness and effect of medical record usage in hospitals. This was a systematic review study. Three databases—PubMed, ScienceDirect, and Cochrane—were searched for research publications in this study. Publications published during the last ten years were targeted for search. Three reviewers were involved in the screening of the title and abstract to establish eligibility. Information was acquired from the studies included in this systematic review using a data extraction form that had been pilot tested. The results obtained a total of 1341 articles selected through a search process by entering keywords in a predetermined database. Articles based on inclusion and exclusion criteria were selected, so that, seven articles were included in this study. Most of the studies indicated that EMR benefited health workers to give better clinical performances to the patients, improving quality-adjusted life year (QALY) of the patients, and reduce the mortality rates. In conclusion, implementing the EMR system may benefit health workers and increase their hospital performance.

Keywords: electronic medical record; outcome; hospital; health workers

INTRODUCTION

Information technology has been socialized in many spheres of life, including health. Healthcare facilities use information technology for various tasks, such as management, control procedures, medical services, scientific investigations, and decision-making related to procedure preparation. Electronic information systems have until now been deemed essential for managing data and information. The caliber of the information is a factor in determining the level of service in healthcare institutions. Because of this, it is necessary to have a quality information system to produce quality information.[1]

The usage of electronic medical records is one endeavor to enhance healthcare services and patient outcomes. The electronic medical record (EMR) is employed in healthcare facilities to accomplish every objective. A health professional's EMR can be a communication tool. This EMR allows other healthcare professionals to be responsible for patient care to read recorded medical and social data. Without having to meet face-to-face, these medical professionals are already familiar with the patient's condition, the therapy they received, and the steps taken to care for them. It is possible to decide and put into practice patient care, starting with problem diagnosis, assessment, management plan, and monitoring, using documentation on the EMR. According to earlier research, using EMR in doctor and pharmacy departments can dramatically reduce communication about drug types and doses.[2] Additionally, prior research has shown that EMR is utilized in medical education and professional communication.[3]

This EMR can provide considerable information regarding the patient's condition and circumstances based on the data that has been recorded. Documentation of medical data and patient administrative data integrated from the time of the patient's arrival until the time of the patient's departure facilitates collaboration among healthcare professionals on patient care, treatment, and services. Moreover, EMR is also known to help doctors in managing diseases better, improving medical decision-support tools, and reporting standards for patient medical records.[1]

Neves et al's prior study sought to determine the effects of patient EMR sharing on the quality of care (i.e., patient-centeredness, equity, timeliness, efficiency, efficacy, and safety).[4] According to the study, using EMR in healthcare effectively raised patient safety and lowered the risk of errors in providing health services. The usage of EMR at the Darul Arqam Garut Clinic for outpatient services was deemed to be efficient and highly useful in the process of assisting patients, according to Farid et al's study.[5] Before using the EMR, there was a noticeable difference in how long it took to provide patient services. As a result, patients had to wait patiently for their turn in line to receive treatment.[5] Therefore, EMR is a very effective tool for speeding up the process of providing patients with the needed services.[5] Although numerous studies have shown the benefits of using electronic medical records to improve health outcomes, no study has developed this into a systematic review. This study aimed to systematically review the effectivity use of medical records on health outcomes.

METHODS

The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement was the foundation for this systematic review's preparation. Three databases—PubMed, ScienceDirect, and Cochrane—were searched for research publications to use in this systematic review. Publications published during the last ten years were targeted for search. Electronic medical records, health results, and effectiveness were the search terms used to find this research articles. Additional data sources for this systematic review were added, including review articles, systematic reviews, and meta-analyses.

The following inclusion criteria were used to create this systematic review: 1) Research article manuscripts written in English; 2) Discussion of the effectiveness of using electronic medical records to improve health outcomes; and 3) Effect size to assess statistical significance. Review articles, case reports, the protocol alone, qualitative research, and research that omitted the data needed for this systematic review were all exclusion criteria.

Three reviewers screened the title and abstract to establish eligibility for additional examination based on inclusion and exclusion criteria. Full-text manuscripts that made them through the initial screening stage were downloaded. Independent reviewers did not perform the risk of bias analysis of the chosen publications.

Information was acquired from the studies included in this systematic review using a data extraction form that had been pilot tested. Each survey included in this systematic review had the following data: the initial author and the year of publication, the study's nation, the sample size, the healthcare quality domain being evaluated, the health result, and the effect size all listed. The collected data were subjected to statistical and qualitative analysis to assess the efficacy of utilizing medical records to influence health outcomes. It involved reviewing the results of each study and examining the observed patterns and advancements within each study.

RESULTS

A total of 1341 articles were selected through a search process by entering keywords in a predetermined database. After excluding duplicated articles from searches in different databases, we screened them based on titles and abstracts and obtained 16 reports for full-text review. Then we selected papers based on inclusion and exclusion criteria so that seven articles were included in this systematic review (Figure 1).

The basic characteristics of the studies included in this systematic review were retrospective cohort studies design. Each article was categorized as a good quality article based on the Newcastle-Ottawa scale (NOS) (Table 1).

DISCUSSION

The EMR is one of the leading technologies to upgrade the healthcare system. This modality may improve the quality of healthcare facilities, improve clinical research, and give patients the best clinical performance. According to the study's result, the EMR benefits health workers to give the best performance to the patients.
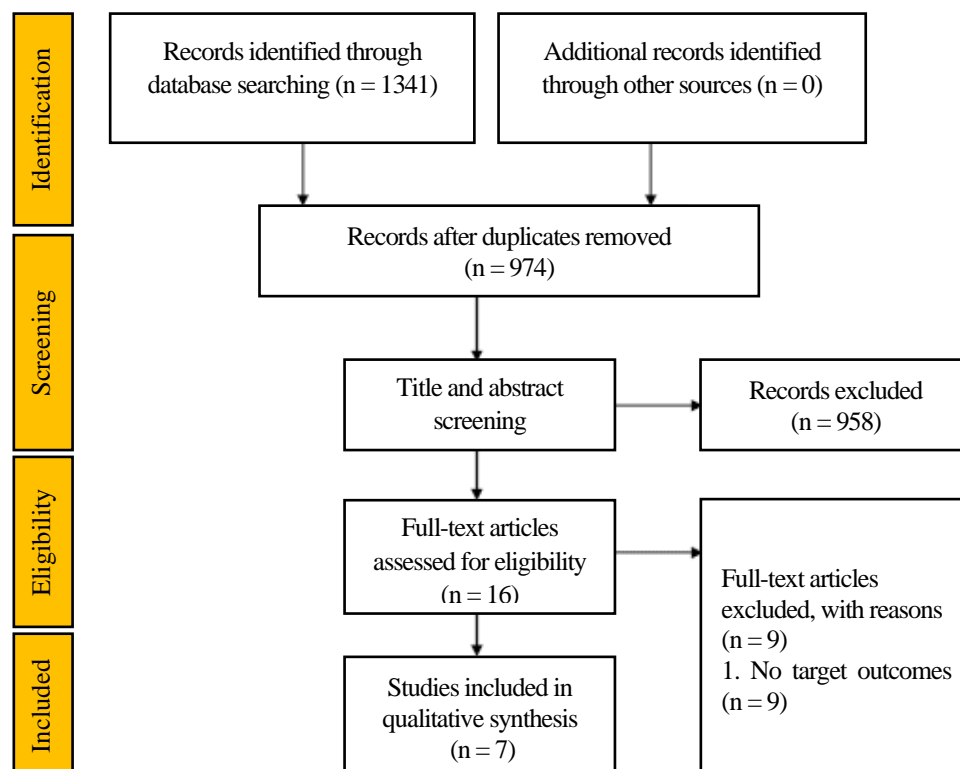

Figure 1. PRISMA flowchart

Table 1. Quality of the study based on the Newcastle-Ottawa scale (NOS)

Authors, years	1	2	3	4	5	6	7	8	Criteria
South et al., 2021[6]	√	-	√	√	√	√	√	√	Good
Liu et al., 2020[7]	√	√	√	√	√	-	√	√	Good
Beauvais et al, 2021[8]	√	√	√	-	√	√	√	√	Good
Yuan et al, 2019[9]	√	-	√	√	√	√	√	√	Good
Wu et al, 2020[10]	√	√	√	√	√	-	√	√	Good
Ben-Assauli et al, 2014[11]	√	-	√	√	√	√	√	√	Good
Ben-Assauli et al, 2016[12]	√	√	√	-	√	√	√	√	Good

De Benedictis et al's study[2] stated that the EMR positively impacted quality and efficiency in health workers such as nurses and physicians. Another study showed that the EMR could improve the quality of giving the best performance to the patients in terms of patients' waiting time in healthcare facilities. According to Farid et al,[5] the implementation of EMR in a clinic showed the effectiveness of patients' services at the clinic. The service time became more effective and only takes a shorter time than before using the EMR application.

In addition, implementing EMR also improves healthcare quality by reducing the patients' mortality risks based on the previous study that compared the healthcare facilities with no EMR, partial EMR, and full EMR systems. Furthermore, the full EMR system improves the quality of healthcare facilities with lower inpatient mortality, lower risk of patients' readmission within 14 days, and lower risk of 48 hours of postoperative mortality. The EMR may alaso improve the quality of healthcare facilities, which includes increasing clinical communication among the health workers and a better understanding of the information management related to better treatment decisions for the patients.[13]

When the EMR system is applied in healthcare facilities, all the data related to the medical records that use paper-based systems will be integrated into the computer. Furthermore, it gives an easier way to access the data and deliver the information to the health workers. The time to input the data and integrate health workers will be reduced. So, the quality to give a better performance to the patient will be improved. The inpatient mortality rates showed these results, and the 14-day readmission was significantly reduced.[13] It was also shown in the previous study that the EMR systems were associated with the decrease in length-of-stay and 30-day mortality of the patients in US hospitals. It can occur due to the EMR system that provides an integrated system accessible to the health workers, such as physicians when they want to order additional tests or procedures or give medications. This order can be done by just inputting the data into the computer, and it can be received by other health workers and done faster than conventional methods.[14]

The previous study stated that using an EMR system may also reduce the risk of mortality of the patients. It may happen because the EMR provides data that can improve the physician and nurses' awareness of patient monitoring. It can alert the physician about the time to give the treatment regarding the patient's condition and minimize the risk of complications.[14]

The previous study, which compared the EMR system and the conventional system, showed that the EMR system had higher quality healthcare services than the traditional system.[15] To give a better outcome in the hospital, the EMR system includes accurate and complete data collection. This data was integrated into the computer and consisted of the patients' precise identity, such as the patient's name, date of birth, identity card number, sex, age, race, address, phone number, and medical record number. Collecting patients' data is important as a database of the patient's history. Based on the previous study, one of the important things in patients' identity is the age of the patients. This information can give better considerations to decide the treatment of the patients, such as the medicine dosage. Moreover, the better treatment that can be given to the patients will give better outcomes and safety to the patients.[16]

Implementation of the EMR system may benefit health workers by increasing their

performance in the hospital. The use of EMR increases medical decision-making, giving more efficient admission choices and reducing the patients' readmission period. However, the EMR systems still need to be evaluated in the future. Based on the previous study, there are inconsistent results regarding the perception of the ease of EMR system implementation. The study showed that most of the respondents did not feel any relief when using the EMR system. Although most health workers already use the EMR, some doctors still use the conventional ones.[17] Therefore, it still needs a higher motivation when using the EMR system to improve its usage of EMR system and give more efficient healthcare quality.

CONCLUSION

Electronic medical record (EMR) implementation provides hospitals with a more efficient and effective outcome.

Conflict of Interest

There is no conflict of interest in this study.

REFERENCES

1. Andriani R, Wulandari DS, Margianti RS. Rekam medis elektronik sebagai pendukung manajemen pelayanan pasien di RS Universitas Gadjah Mada. J Ilm Perekam dan Inf Kesehat Imelda. 2022;7(1):96–107. Available from: https://jurnal.uimedan.ac.id/index.php/JIPIKI/article/view/599
2. De Benedictis A, Lettieri E, Gastaldi L, Masella C, Urgu A, Tartaglini D. Electronic medical records implementation in hospital: an empirical investigation of individual and organizational determinants. PLoS One. 2020;15(6):e0234108. Available from: https://dx.plos.org/10.1371/journal.pone.0234108
3. Singer A, Duarte FR. The effect of electronic medical record system use on communication between pharmacists and prescribers. BMC Fam Pract. 2015;16(1):155. Available from: http://bmcfampract.biomedcentral.com/articles/10.1186/s12875-015-0378-7
4. Neves AL, Carter AW, Freise L, Laranjo L, Darzi A, Mayer EK. Impact of sharing electronic health records with patients on the quality and safety of care: a systematic review and narrative synthesis protocol. BMJ Open. 2018;8(8):1–8. Doi:10.1136/bmjopen-2017-020387
5. Farid ZM, Fernando NR, Sonia D. Efektivitas penggunaan rekam medis elektronik terhadap pelayanan pasien rawat jalan di Klinik Darul Arqam Garut. Cerdika J Ilm Indones. 2021;1(9):1247–54. Available from: https://cerdika.publikasiindonesia.id/index.php/cerdika/article/view/178
6. South M, Cheng D, Andrew L, Egan N, Carlin J. Decreased in-hospital mortality rate following implementation of a comprehensive electronic medical record system. J Paediatr Child Health. 2022;58(2):332–6. Available from: https://onlinelibrary.wiley.com/doi/10.1111/jpc.15718
7. Liu S, Gnjidic D, Patanwala AE, Rubin G, Nielsen M, Penm J. Effect of an electronic medical record design modification on laxative co-prescribing among hospitalised patients taking opioids: a before-and-after study. Int J Med Inform. 2020;140(May):104172. Available from: https://linkinghub.elsevier.com/retrieve/pii/S1386505619313152
8. Beauvais B, Kruse CS, Fulton L, Shanmugam R, Ramamonjiarivelo Z, Brooks M. Association of electronic health record vendors with hospital financial and quality performance: Retrospective data analysis. J Med Internet Res. 2021;23(4):e23961. Doi: 10.2196/23961
9. Yuan N, Dudley RA, Boscardin WJ, Lin GA. Electronic health records systems and hospital clinical performance: a study of nationwide hospital data. J Am Med Informatics Assoc. 2019;26(10):999–1009. Available from: https://academic.oup.com/jamia/article/26/10/999/5522435
10. Wu C, Zhang D, Bai X, Zhou T, Wang Y, Lin Z, et al. Are medical record front page data suitable for risk adjustment in hospital performance measurement? Development and validation of a risk model of in-hospital mortality after acute myocardial infarction. BMJ Open. 2021;11(4):e045053. Available from: https://bmjopen.bmj.com/lookup/doi/10.1136/bmjopen-2020-045053
11. Ben-Assuli O, Shabtai I, Leshno M. Using electronic health record systems to optimize admission decisions: the creatinine case study. Health Informatics J. 2015;21(1):73–88. Available from: http://journals.sagepub.com/doi/10.1177/1460458213503646
12. Ben-Assuli O, Ziv A, Sagi D, Ironi A, Leshno M. Cost-effectiveness evaluation of EHR: simulation of

an abdominal aortic aneurysm in the emergency department. J Med Syst. 2016;40(6):141. Available from: http://link.springer.com/10.1007/s10916-016-0502-9

13. Lin H-L, Wu D-C, Cheng S-M, Chen C-J, Wang M-C, Cheng C-A. Association between electronic medical records and health care quality. Medicine (Baltimore). 2020;99(31):e21182. Available from: https://journals.lww.com/10.1097/MD.0000000000021182

14. Lee J, Kuo Y-F, Goodwin JS. The effect of electronic medical record adoption on outcomes in US hospitals. BMC Health Serv Res. 2013;13(1):39. Available from: https://bmchealthservres.biomedcentral.com/articles/10.1186/1472-6963-13-39

15. Ayaad O, Alloubani A, ALhajaa EA, Farhan M, Abuseif S, Al Hroub A, et al. The role of electronic medical records in improving the quality of health care services: comparative study. Int J Med Inform. 2019;127:63–7. Available from: https://doi.org/10.1016/j.ijmedinf.2019.04.014

16. Pahlevi AR, Wardhana ES, Agustin ED et al. Electronic medical record at RSIGM Sultan Agung Semarang reviewed from the completeness and the safety format system. Medali J. 2021;3(1):20–8. Available from: https://www.researchgate.net/publication/357803571

17. Maryati Y. Evaluasi penggunaan electronic medical record rawat jalan di Rumah Sakit Husada dengan technology acceptance model. J Manaj Inf Kesehat Indones. 2021;9(2):190. Available from: https://jmiki.aptirmik.or.id/index.php/jmiki/article/view/180

Table. 2 Outcome details of the included studies

No	Authors, years of Publication	Country	Size of samples	Methods	Outcomes
1	South et al., 2022[11]	Australia and New Zealand	202 hospitals	Pre and post-method retrospective data analysis	Fatalities decreased by 33 percent, from 202 in the two years before the EMR's implementation to 169 in the two years following its deployment. In the two years before the adoption of the EMR, the mortality rate was 2.20 deaths per 1000 discharges and 1.72 deaths per 1000 discharges in the two years after the implementation. It yields a mortality reduction of 0.48 per 1000 discharges and a relative 22% decrease.
2	Liu et al., 2020[12]	Australia	3014 patients	Pre and post-method retrospective data analysis	There was a significant increase in the co-prescription of docusate with ginsenosides among patients in aged care, despite the EMR modification having no impact on the co-prescribing of laxatives for surgical patients.
3	Beauvais et al., 2021[13]	USA	2667 hospitals	Retrospective data analysis	Epic was not associated with patient safety quality ratings but was linked to improved TPS outcomes and greater patient perceptions of quality. Efficiency rose when Cerner and Epic were compared ($R2=31.9\%$; Cerner:.0330, SE 0.0135, $p=0.01$; Epic:.0465, SE 0.0133, $p0.001$). Finally, while having good clinical care performance across the board (Epic: =.0388, SE 0.0122, $p=0.002$; Cerner: =.0283, SE 0.0124, $p=0.02$; Meditech: =.0273, SE 0.0123, $p=0.03$), none of the three vendors' explanatory power ($R2=4.2\%$) was particularly strong.
4	Yuan et al., 2019[14]	USA	1246 hospitals	Retrospective data analysis	On 5 of the 11 process metrics, hospitals with EHRs outperformed those without them over time. The rates of readmission or mortality did not vary statistically significantly. Several procedural and outcome metrics showed poor performance for hospitals utilizing CPSI EHR systems.
5	Wu et al., 2021[15]	China	9704 patients	Retrospective data analysis	The median absolute difference between full medical record data supplied as a "reference model" and hospital RSMR predicted by hierarchical generalized linear models developed using MRFP data was 0.08% (10th and 90th percentiles: 1.8% and 1.6%, respectively). In the regression model comparing the RSMR of the two models, the slope and intercept of the regression equation were 0.90 and 0.007 in the modeling cohort and 0.85 and 0.010 in the validation cohort, respectively. It indicates that the two models' assessment abilities were roughly equivalent.
6	Ben-Assauli et al., 2015[16]	Israel	340.804 patients	Retrospective data analysis	Utilizing the EHR results in better admission decisions and reduces the number of unnecessary admissions. Readmissions decreased when the patient's history was reviewed. Using EHR can help solve the global issue of unnecessary hospital readmissions.
7	Ben-Assauli et al., 2016[17]	Israel	Department of Emergency Medicine, Tel-Hashomer Hospital	Retrospective data analysis	EHR use in the ED improves medical judgment and raises the patient's QALY. The cost per patient for one QALY unit due to implementing the EHR was $1229, based on generally accepted threshold values (less than all of these values). Thus, in this particular but typical circumstance, using the EHR helps to make a cost-effective selection.