REVIEW ARTICLE

Hospital administrative services with electronic medical records: A meta-analysis

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ABSTRACT

Electronic medical record (EMR) is an online record of patient's personal and clinical data stored in a healthcare treatment administration. It has been increasingly in demand and is perceived as the "backbone" of digital healthcare. The current study aims to analyse the effectivity of electronic medical records in improving health services in terms of administration. It is a systematic review and meta-analysis of articles published in Science Direct, ProQuest, PubMed, and Google Scholar. The inclusion criterion is a full-text article with observational research design published from 2013 to 2022. The articles were analysed using Review Manager 5.3. The database searches produced nine articles from Asia (China, Australia, and Singapore), Africa (Ethiopia), and nationwide studies in the USA and New York. The finding suggested that hospitals or health services that employ electronic medical records can improve the quality of health care by 1.84 times compared to those that do not make the most of EMR. The results were significant by statistics (aOR = 1.84; 95% CI = 1.20 to 2.83; p = 0.005; I2= 98%).

Key words:
electronic medical records; health services; health clinics; hospitals

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INTRODUCTION

Health is a field that is information intensive in nature. Every day, it produces data from people who visit for health services.[1,2] To keep pace with the flow of information, a healthcare facility is supposed to consider technology to support the management.[3,4] All information stored related to the patients, from diagnosis, anamnesis, physical examination, treatment, and other services should be completely recorded in their respective medical record.[5] A medical record contains very personal information that should accompany an individual wherever he or she travels. Ownership of this information is in the fundamental interest of the patient and should not be withheld from the patient by any health institution, for it is the right of the patient.[6,7]

Medical record document management system that uses a paper-based medical record system is considered ineffective and inefficient in the current era of developed information technology.[8,9] It can bring about losses - such as vulnerable to be lost, damaged, difficult to find, and difficult to read, increased storage space, excessive activity, and un-optimal presentation of information - while patient's medical history is crucial for diagnosis. [10]

In this era, health facilities, such as hospitals, clinics, and health centres extremely need effective and efficient technology to accelerate the health services.[11,12] As an institution that stores a lot of data, hospitals also require correct and accurate data processing that can be easily presented as reports.[2,13] The presentation of the report should correspond to the usefulness and functionality of each section. Hospitals store all data in files called medical records.[14]

One of the uses of information technology (IT) in the health sector that has come to be a global trend in health services is Electronic Medical Record (EMR).[15,16] EMR has been extensively adopted by hospitals around the world as a substitute to paper-based system.[17] In principle, EMR is the use of technology to collect, store, process, and access patients' medical records regarding medical information, demographics, and any occurrences in patient management in the hospitals and clinics.[18] The medical record data can be texts (both structured and narrative), digital images (if digital radiology is applied), sound (such as heart sounds), video, or bio signals such as ECG recordings.[6]

The medical record unit in a health care facility is busy that desperately needs high performance of officers.[19] Although the medical record officer is not directly involved in the patient's clinical practice, the information recorded in the medical record is extremely crucial. Besides, the problem of limited funds has resulted in a lack of efforts to increase the capacity of resources that ultimately complicate the achievement of effective and efficient medical record services.[20]

One of the efforts to realize quality health services is through a good patient data management with information technology.[19] The information system is expected to be able to filter errors upon inputting patients' data, as well as provide a clinical decision support system that greatly helps doctors in making drug decisions for patients.[21] Electronic medical records also pose several benefits: some of which, RME can cut paper usage, maximize patient documentation, improve information communication among doctors and other staff, increase access to patient medical information, reduce errors, optimize billing, and facilitate service turnover, facilitate data access for research, and improve quality. For the academic field, EMR supports the development of information systems and can benefit various parties. Besides, it improves

academic medical records in the regions. Meta-analysis in this study will increase the accuracy and strength of findings by gathering information from various studies regarding hospital administrative services with electronic medical records. One of the keywords in this study is "multivariate analysis" because multivariable regression analysis has been one of frequently used methods to control for confounding variables. To minimize the confounding variables in the EMR study, the authors decided to include these keywords. Therefore, a comprehensive study on the implementation of EMR is required to advance administrative services in the hospital.

MATERIALS AND METHODS

This study was conducted using a systematic review and meta-analysis with PICO (Population: public health centre; Intervention: Electronic Medical Record (EMR); Comparison: paper-based record; Outcome: quality health services). Articles were selected from four leading journal databases using PRISMA flow, and they were analysed using Review Manager 5.3.

Data Source Strategy

The article searches covered PubMed, Science Direct, Google Scholar, and ProQuest. The author used the databases because they had been the most effective search engine for an overview of a health topic. The study included articles written in English with observational research design and published from 2014 to 2023. The search input some keywords as follows "Electronic Medical Record "OR" EMR "or" Electronic Health Records "or" EHR "AND" Health Service Quality "or" service quality "and" hospital quality "and" health outcomes "and "multivariate analysis". In addition, the articles were filtered from the previously conducted research by observational study design, and related studies according PICO.

Study Selection

The study or article search refers to the inclusion and exclusion criteria. The inclusion criteria were: a) full text articles; b) articles in English; c) population: health care centres; d) intervention: electronic medical records (EMR); e) comparison: not using EMR; f) results: quality of health services; g) observational study design; h) the effect size used is *adjusted odd ratio* (aOR) and 95% CI. It excludes articles that require subscription to access.

Data extraction and Assessment

The research was grounded to PRISMA flowchart and critical appraisal by the Centre for Evidence Based Medicine (CEBM, 2014). Two reviewers independently assessed the quality of studies included in quantitative synthesis (meta-analysis) using critical appraisal tool with the following questions:

1. Does the objective clearly discuss the research problem?
2. Is the research design applicable to address the research question?
3. Is the research subject selection method clearly written?
4. Does the sampling method cause bias (selection)?
5. Are the samples collected representative of the population?
6. Is the sample size grounded to the pre-study considerations?
7. Is the measurement method achievable?
8. Is the research instrument valid and reliable?
9. Is the significance statistically examined?
10. Are confidence intervals provided for key results?
11. Are there any confounding factors that have not been considered?
12. Are the results applicable to your research?

Statistical Analysis

To analyse the data, this study used Review Manager (RevMan). RevMan was adopted to provide and maintain Cochrane. It prepares protocols and reviews by texts, figures, and tables. It can analyse data input and present the results in graphic mode.

The software has been widely adopted and successfully helps authors perform meta-analysis to present the results of adjusted odd ratio (aOR), illustrate confidence interval (CI) through effects model and data heterogeneity (I^2) (the data used can be seen in table 3).

RESULTS

PRISMA flow chart

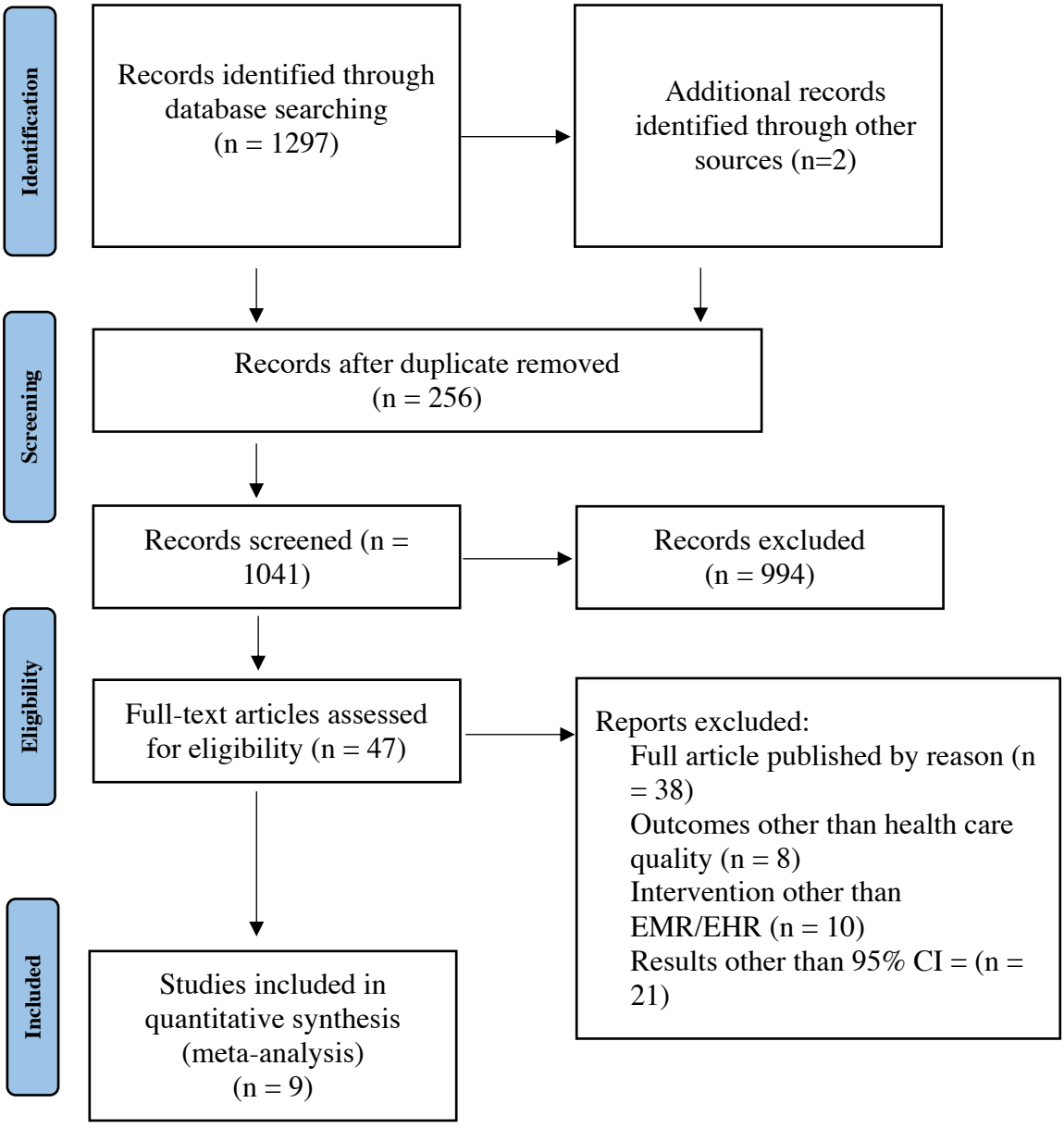

Figure 1. PRISMA flow chart.

Critical assessment

Table 1. Assessment of learning quality with Critical Appraisal by The Centre for Evidence Based Medicine (CEBM, 2014).

Primary Studies	Criteria												Total
	1	2	3	4	5	6	7	8	9	10	11	12	
(Kokkonen et al., 2013)[21]	2	2	2	2	2	2	2	2	1	2	2	2	23
(Hatef et al., 2021)[22]	2	2	2	2	2	2	2	2	2	2	2	2	24
(Harrison-Id et al., 2020)[23]	2	2	2	2	2	2	2	2	1	2	2	2	23
(Rahman et al., 2018)[24]	2	2	2	2	2	2	2	2	1	2	2	2	23
(Wang et al., 2022)[25]	2	2	2	2	2	2	2	2	2	2	2	2	24
(Rotmensch et al., 2017)[26]	2	2	2	2	2	2	2	2	2	2	2	2	24
(King et al., 2014)[27]	2	2	2	2	2	2	2	2	2	2	2	2	24
(Adler-Milstein et al., 2017)[28]	2	2	2	2	2	2	2	2	2	2	2	2	24
(Clegg et al., 2016)[29]	2	2	2	2	2	2	2	2	2	2	2	2	24

Note: Answer: Yes=2; Can't Tell = 1; No = 0.

Table 1 provides critical appraisal information for each study. There are 12 assessment criteria with a score of 0 for the answer "No", 1 for the answer "can't tell" and 2 for the answer "Yes". Of the 9 articles above, none received an assessment with a score of 0 for each criterion. However, studies by Kokkonen et al. (2013), Harrison-Id et al. (2020), and Rahman et al. (2018) obtained an assessment with a score of 1 on criterion 9 (Is the significance statistically examined?).[21,23,24] It indicated that the level of significance is not presented in the study results. Each score on each criterion is added up, which means the higher the score, the better the quality.

Table 2. Article Summary

Author (Year)	Country	Study Design	Population	Intervention	Comparison	Results
(Kokkonen et al., 2013)[21]	Australia	Cross-Sectional	Health care services based on the National Survey of outpatient medical care in 2003-2010 were conducted.	Using EMR	Not using electronic-based data.	Improving the quality of hospital services.
(Hatef et al., 2021)[22]	Ethiopia	Cross-Sectional	Academic medical centres and exploring how housing need levels affect health care utilization	Using EMR	Not using electronic-based data.	Quality health services in administrative data.
(Harrison-Id et al., 2020)[23]	US	Cross-Sectional	The study involves adults aged 18-90 with COVID-19 codes in their electronic medical records.	Using EMR	Not using electronic-based data.	Quality health services, patient satisfaction.
(Rahman et al., 2018)[24]	Singapore	Cross-Sectional	The adoption of the National University Hospital EMR system International Classification of diseases, the 9th revision (ICD-9), Clinical modification (CM)	Using EMR	Not using electronic-based data.	Quality health services in administrative data.
(Wang et al., 2022)[25]	China	Cross-Sectional	Collection of recognised patient data and NSW ambulance data for people admitted to New South Wales hospitals	Using EMR	Not using electronic medical records	Assessment of emergency medical services, protocols, and quality of service
(Rotmensch et al., 2017)[26]	New York	Cross-Sectional	Trauma centre and tertiary academic teaching hospital	Using EMR	Not using electronic medical records	Outcome: quality health services

Author (Year)	Country	Study Design	Population	Intervention	Comparison	Results
(King et al., 2014)[27]	US	Cross-Sectional	Hospitals in the US	Using EMR	Not using electronic medical records	Outcome: quality health services
(Adler-Milstein et al., 2017)[28]	US	Cross-Sectional	American Hospital	Using EMR	Not using electronic medical records	Outcome: quality health services
(Clegg et al., 2016)[29]	China	Cross-Sectional	Patients aged 65-95 years and enrolled in ResearchOne or Small Exercises	Using EMR	Not using electronic medical records	Outcome: quality health services

Table 2 summarized that all studies appraised show that using EMR improves the quality of health services, such as in administrative data, patient satisfaction, assessment of emergency medical services, and protocols.

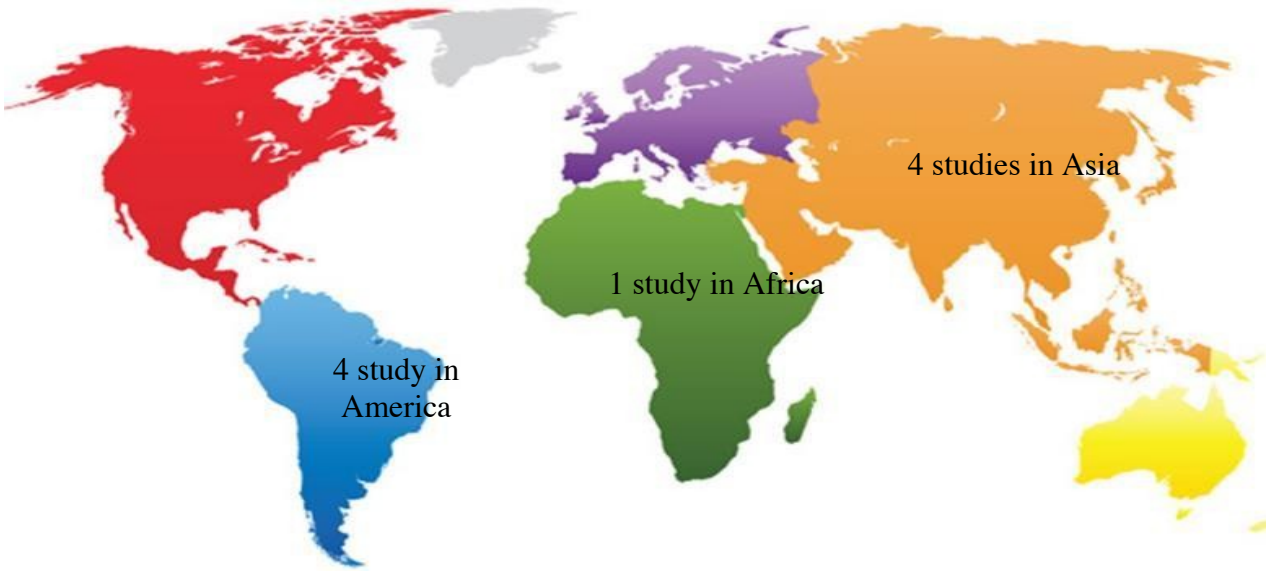

Figure 2. Research Distribution Map

Figure 2 presents the initial characteristics of the studies using meta-analysis. There are nine fundamental research articles from Asia (China, Australia, Singapore), Africa (Ethiopia), and America (US and New York) with cross-sectional research designs included in this study.

Table 3. Adjusted odds ratio (aOR) and 95% CI about Electronic Medical Record implementation on the Improvement of Health Services

(Author, year)	aOR	95% CI	
		Lower limit	Upper limit
(Kokkonen et al., 2013)[21]	1.04	0.80	1.35
(Hatef et al., 2021)[22]	2.58	1.06	6.25
(Harrison-Id et al., 2020)[23]	1.75	1.55	1.98
(Rahman et al., 2018)[24]	4.75	1.38	12.35
(Wang et al., 2022)[25]	1.01	0.99	1.04
(Rotmensch et al., 2017)[26]	2.32	1.22	4.44
(King et al., 2014)[27]	1.80	0.90	3.60
(Adler-Milstein et al., 2017)[28]	1.62	1.11	2.36
(Clegg et al., 2016)[29]	3.04	2.90	3.19

Table 3 displays the amount of aOR in each selected article. It is necessary to pay attention to the collection of articles by selecting articles that have controlled for confounding factors, which can be seen from the study inclusion requirements, namely the adjusted odds ratio (aOR).

Forest Plot

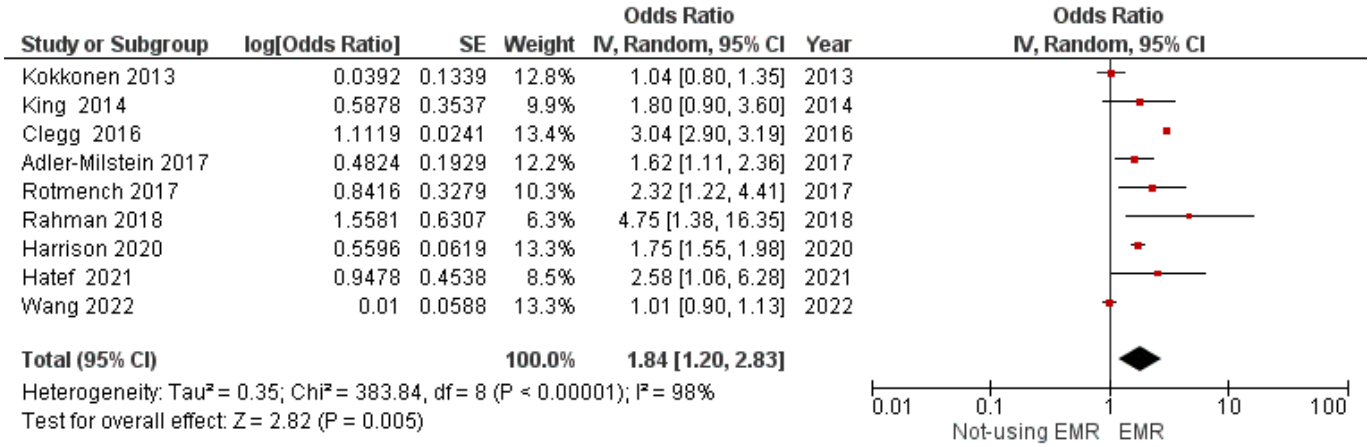

Figure 3. The Forest Plot of Electronic Medical Record Relationship for the Improvement of Health Services

Based on Figure 3, forest plot demonstrated a high heterogeneity of data between studies (I^2= 98%; p< 0.001). If I^2>50%, data analysis uses a random effect model; if I^2<50%, data analysis uses a fixed effect model. Therefore, it employed REM (Random Effect Model) because I^2>50%. The findings suggested that hospitals or health services that employ electronic medical records can improve the quality of health care by 1.84 times compared to those that do not make the most of EMR. The results are significant by statistics (aOR = 1.84; 95% CI = 1.20 to 2.83; p = 0.005; I^2= 98%).

Funnel Plot

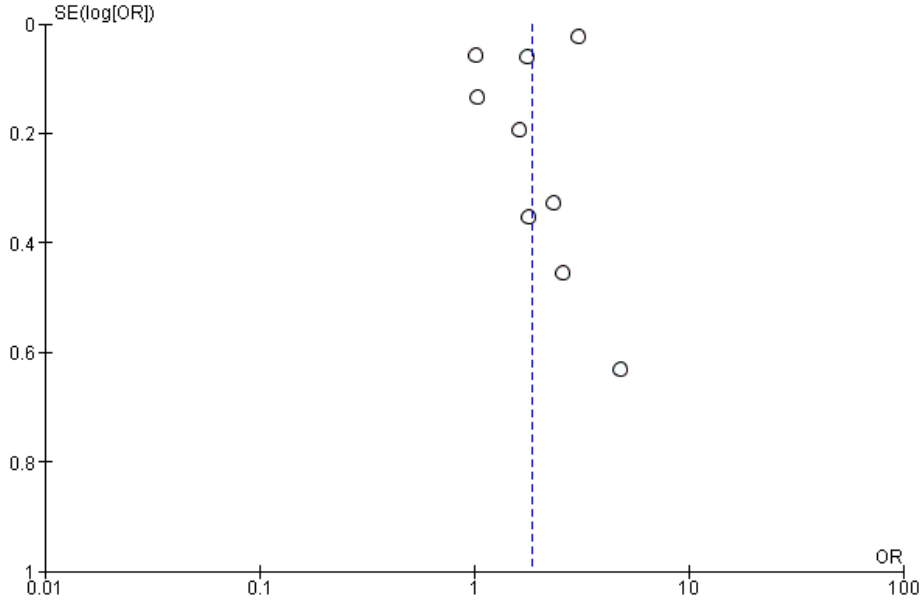

Figure 4. The Funnel Plot of Electronic Medical Record Relationship for the Improvement of Health Services

Figure 4 indicated that the funnel plot graph is symmetrical, which implies objectivity.

DISCUSSION

The number of studies that have been discussed suggested that health care providers employ EHRs to gather demographic data and incorporate them into medical treatment and public health interventions. The current study can be used as the basis for subsequent research that examines the impact of social needs and social aspects of health on health outcomes and health care utilization using data of the patients from EHRs connected to the data of the population. The data produced by healthcare systems is increasing dramatically as a result of the growing digitalization of clinical records, the usage of smart tools, and IoT connected to medical devices. The transformation of health care necessary for sustainability depends on the ability to rapidly analyze and organize the information gathered.

EMR data is challenging to understand for four main reasons, according to the studies reviewed: The doctors' and nurses' notes are less formal than those of typical textbooks, which makes it hard to reliably recognize instances of diseases and symptoms. The second, in order to facilitate learning, textbooks and periodicals frequently give cases that simply detail the most prevalent symptoms. Real patients are shown in EMR data together with all of the comorbidities, confounding variables, and nuances that make them unique. The third, the relationships between diseases and symptoms in the EMR are statistical, as opposed to textbooks that explain these relationship declaratively, making it simple to mistake correlation with causation. The last, the way that observations are recorded into EMR is filtered through the decision-making process of the doctor. Information that is perceived irrelevant may be left out or ignored, which causes information gaps that are not random. EMR data has the advantage of being more accurate than the idealized and curated material found in textbooks and journals, despite the fact that it is more challenging to work with for the reasons mentioned above. For example, learning from EMRs gives the researchers the chance to identify previously known relationships. Besides, by simply learning models from the patients' records, we can study specialized figures with varying levels of granularity for various specialties or settings. Finally, building a graph of potential causal relationships between diseases and symptoms using electronic medical records (EMRs) is the initial act for developing models that perform diagnostic inference directly from the real data that is continuously produced by the healthcare system.

Health sciences are always evolving, and one of the biggest changes facing healthcare professionals is the impact of technology in healthcare practices.[30] New technologies drive changes in all areas of healthcare.[31] Technology is helpful for clinical decision making. It can also function as a health care facility management system. The application of technology also includes various types, such as EMRs, EHRs, and PHRs.[32] Technology is helpful for clinical decision making. It can also function as a health care facility management system.[33,34]

Medical records are prominent in health services. Healthcare quality of a hospital is greatly influenced by the support of medical record technology employed.[35] Every action and health services provided by health workers must be accurately recorded and managed.[36] These medical records function as a history of healthcare provided by the hospital, in addition to providing assistance for health workers in making

decision and actions.[37,38]

EHR or EMR is an online record of patient's personal and clinical data stored in the system.[39] It is increasingly in demand and is described as the "backbone" of digital healthcare and fundamental platform for storing and retrieving patient information. It has been applied in health and nursing organizations around the world. This system is implemented to help organization/hospital achieve several benefits, such as patient safety, better documentation, and improved service quality. [28,40,41]

Health services around the world have now switched to electronic health records and started leaving health records by paper.[32,42] The benefits of electronic health records have been well understood by the hospital management and health workers, yet in the shifting process, they encounter many obstacles. [6] The shift from paper to electronic health systems has influenced the quality of health care documentation and broader organizational culture. Transformation must be fully supported in the organizational system so that this transition can run and be properly managed because poor implementation may lead to unsatisfactory service quality.[43]

EMR is highly recommended for use in health services to reduce errors, improve the service quality, and minimize costs.[15,44] With the recommended use of electronic medical records, a lot of health care providers employ electronic medical records to improve service quality, increase patient satisfaction, and diminish medical errors. [45,46] Digital transformation must be addressed by how to choose the right technology in the application of electronic medical records. Therefore, the technology must promise a safe, informative, effective, and efficient output, as well as excellent service.[47,48]

The implementation of the electronic health record system also comes with obstacles, such as the complexity in the initial process and long-time adaptation phase. The lack of documentation with the absence of detailed guidelines, inconsistent recording methods, and the lack of facilities in the EMR system are obstacles that health workers face when using EMR.[25]

Despite the challenges, a good EMR provides some advantages. For example, it is equipped with a clear and effective mechanism of a punctual communication with multiple healthcare providers, thereby celebrating advanced discussions. It also allows healthcare providers to make better decision by guidelines, reminders, and supports. Electronic documentation solves the problem of misinterpretation over handwritings that are sometimes complicated; EMR allows multiple people in multiple locations to have direct access to data.[49,50,51]

Rotmensch dkk. (2017) found that health workers who employ EMR record more information than those who use paper-based records. It also advances healthcare documentation. In addition, health care documentation using EMR is helpful in comprehensively and thoroughly documenting patients' pain symptoms, helping to effectively assess pain achievement. [52,53] To make the best use of EMR, organizations or hospitals must fully support the transition from paper to electronic-based records. Although the transition process takes quite a long time, answering the challenges of the development of digital-based world health technology is fundamental. Health care documentation with EMR can also help integrate patient data, save hospital cost, and reduce the workload of health workers. The use of EMR must be accompanied by adequate facilities and systems, as well as the readiness of health personnel resources to use them in order for the patient health records to be well documented in the EMR system. [54,55].

Though the use of EMR offers a lot of benefits, certain obstacles cast doubt among the general public and medical practitioners. One of the primary issues encountered relates to the expenses associated with the implementation of the necessary technological infrastructure, personnel training, and system maintenance. It becomes especially burdensome for healthcare facilities located in the village or smaller institutions with limited resources. Apart from that, apprehensions arise concerning the security of patient data, which remains susceptible to cyber-attacks and potential data breaches. Without appropriate or sufficient safeguards, patient medical information can be an attractive target for hackers, posing a significant threat.

EMR faces a limitation in terms of user resistance in its implementation. To address this challenge, some solutions can be employed, such as quality leadership, friendly environment that fosters optimism, providing education, mentoring, and comprehensive training for staff, and adopting the new RME system. Another challenge is the insufficient knowledge and experience of healthcare professionals in computer usage. Therefore, it is necessary to adequately prepare, educate, and train staff in the utilization of the new system. If the hospital decides to adopt this strategy, several steps can be considered, before, during and after the system implementation. First, hospital management should assess the computer literacy and knowledge level of the staff regarding EMR implementation. Furthermore, conducting user evaluations after training and implementation is important to identify any additional training requirements. This step plays a vital role in ensuring that the educational sessions have successfully achieved their goals, leading to enhanced productivity, efficiency, and effectiveness.

CONCLUSION

EMR offers significant benefits to doctors and healthcare professionals by providing easy access to patient information, which ultimately supports clinical decision making. The hospitals or healthcare services that utilize EMR have the potential to enhance the quality services by approximately 1.84 times compared to those that do not completely utilize EMR. It improves healthcare documentation, making it more comprehensive and complete records of patient care. This study is merely a meta-analysis and review of the previous literatures. Further research is expected to involve a field study regarding the effectiveness EMR in certain hospitals.

LIMITATION

Our meta-analysis has limitations. We did not perform protocol registration of meta-analysis and the number of databases used in this meta-analysis is limited for the identification of potentially eligible studies.

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CONFLICT OF INTEREST

The authors declare no conflict of interest

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