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The Appraisal of Electronic Health Record Technology Contribution to Hospital Management: A Systematic Review

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ABSTRACT

The use of electronic Health Records in hospital management has significantly changed over the past decade, with developed nations increasingly utilising them due to their advantages over paper records. However, there is no consensus on EHR's effectiveness. This systematic review aims to explore its impact on clinical performance, financial performance, and free staff communication in hospital settings. A comprehensive research Primary sources from peer-reviewed papers are collected through the databases Science Direct and CINAHL Plus Science Direct and CINAHL Plus databases. Initially, 9880 articles were selected for the investigation, removing 1822 duplicates, 7617 papers, and 440 items after full-text screening. Thematic analysis was used in the mixed study, and narrative analysis was used for quantitative investigations. Three papers were excluded after analysis. Citations were generated using the Boolean operator (AND). The PICO research question were used to understand the impact of EHR implementation on quality care, physician productivity, financial performance, and staff communication. This investigation revealed the transformative aspect of EHR system and acknowledged the capability of the system to improve healthcare management, clinical quality and physician productivity. This study not only revolves around the EHR efficacy and its contribution in healthcare system but also provide recommendations to the management regarding the system and its advantages and betterments.

INTRODUCTION

The development of Information Technology (IT) and Electronic Health Records (EHR) are crucial components of the hospital administration system. The EHR is advancing how medical records can be stored and created. Many nations have switched from paper to electronic health records (EHR), allowing healthcare providers to access patient information electronically (Wilson & Khansa, 2018) However, the existing literature has conflicting information on the effect of (EHR) on clinical performance, hospital workflow, and income vs. cost.

This systematic review aims to investigate the impact of Electronic Health Record Systems on hospital management on a three-dimensional scale of clinical performance (quality care process, physician productivity), financial performance, and free text messaging between hospital staff members who use EHRs (Alsahafi & Gay, 2018). This section will cover the background and context of employing EHR systems in hospitals and the amount to which this will aid hospital management systems at various management levels, including identifying the research gaps that may exist. The research study rationale for adopting a systematic review will be provided, moving to consolidating the research objectives and questions.

Literature Review Due to technological innovation and IT development, the world has undergone tremendous change (Campanella *et al.*, 2016) underlined the potential impact of information and communication technology breakthroughs. Ten years later, as athe result of the third worldwide survey on electronic health (e-Health), which the Global Observatory created for eHealth, the WHO clarified this by listing various benefits of electronic health records (EHRs) (Uslu & Stausberg, 2021). Healthcare providers can address their health issues and challenges by utilising EHRs. This has improved coordination and reduced error risk, which become increasingly crucial in healthcare delivery. EHRs simplify hospital management; automotive mechanisms expedite physician workflows, facilitate cost control, and support various aspects of the healthcare industry. EHRs affect public health organisations, hospitals, healthcare professionals, patients, pharmacists, and researchers (Shah & Khan, 2020).

Transitioning to an electronic patient information system is vital to advancing hospital service efficiency. The key to a successful application outcome appears to be developing in-depth knowledge to support management oversight and implementation.

There is, nevertheless, no current consensus on the benefits of EHR over traditional methods. Disagreements also exist regarding the consumption of EHRs. Several studies additionally indicate that issues with healthcare organisations, healthcare workers, technology, and ethical issues make it challenging to use EHRs (Yuan *et al.*, 2019). Therefore, the present research examines the impact of EHR on hospital management from various angles, taking into account the constraints and challenges in diverse settings and hospital facilities. Additionally, what further study is required to enhance the efficacy of the EHR implementation procedure (Alvandi, 2015).

To improve clinical performance, hospital management system and communication line among employees, many public and private hospital worldwide have adopted EHR

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as an advancement in technology (Denham *et al.*, 2013). However, studies and perspectives on EHRs conflict with health care and financial outcomes. Early Electronic Medical Record (EMR) research suggests no evidence of a long-term, meaningful gain in hospital efficiency related to EMR due to the transitional challenges and lack of knowledge of how to use the system (Kazley & Ozcan, 2009). Later, it was demonstrated in previous studies/literature that hospitals observed a greater benefit from combining EHR with observation. In contrast, other studies/literatures reported that hospitals with more complex technologies had a decline in quality performance (Appari *et al.*, 2013). The absence of EHR training programs and the restricted time for research observation were the gaps in these studies, which impacted the safety, quality, accuracy, and timeliness of patient or medical treatment (Plantier *et al.*, 2017).

It was shown that patient-centred incentives were the sole factor that improved EHR adoption (nonpatient revenues). This gap requires additional time to evaluate the impact of EHR implementation on financial performance (Collum *et al.*, 2016). According to a study on Communication through the Electronic Health Record: Frequency and Implications of Free Text Orders, there was a significant difference in the use of Communication for non-medication orders (CNMOs) among hospitals, provider locations, and provider types Because of inaccurate information, using CNMOs to communicate medication-related information may cause missing or delayed medication. However, there is no individual chart review, and the study is limited to a year's worth of data from a single EHR in a healthcare institution

Two conflicting researches regarding EHR state the positivity and negativity of its implementation. However, US government has implementes various program of EHR and claimed its meaningful aspects (Pai *et al.*, 2021). Health Information Technology for Economic and Clinical Health (HITECH) Act passed to improves financial concern about the implementation (Congress, 2009). Moreover, several programmes conducted to teach the staff the EHR usage in collaboration with the Center for Medicare and Medicaid services (CMS) and the Office of National Coordinator (ONC) (Schreiber *et al.*, 2021).

MATERIALS AND METHODOS

Search strategy

In order to execute this scoping review, recent research articles/publications are based on the use of electronic health record technology in healthcare sectors. Auguste Compte coined the term positivist, which emphasises facts and the causes of behaviour, to characterise a rigorous empirical approach in which knowledge claims are based only on experience, arguing that the former was more suggestive of the truth than the latter (Kivunja & Kuyini, 2017). This systematic review uses positivist and pragmatism paradigms, incorporating quantitative and mixed approaches. This may lead to the preference for qualitative methods in mixed methods. In mixed methods research, researchers use pragmatism to assess a design's applicability ahead of time. Variables such as research questions and study goals are considered when selecting a design. The efficacy of a mixed methods design cannot be ascertained until the project is finished and the data analysis has been completed. However, pragmatism is not the only rule or explanation for using a combination of strategies (Hall, 2013).

Data collection

The CINAHL Plus and Science Direct databases collect primary sources from peer-reviewed papers. Also, quantitative surveys, usage metrics analysis, clinical quality and patient outcome measures, and cost-benefit analysis can be used. Before starting the research, the inclusion criteria and research questions had already been established. The search terms selected from the research study question were: what effects do EHR implementations have on clinical performance, financial performance, and staff communication?

Selection criteria

For this study, searching is achieved through literature to find articles that address the pros and cons of implementing electronic health record systems in healthcare settings. Preferred Reporting Items for Systematic Study (PRISMA) were followed to complete this systematic review. The selection criteria are used following the inclusion and exclusion criteria and response to the PICO research question. Studies were selected between 2015 to 2023 using the keywords Electronic Health Record, EHR, Hospital management, and Hospital administration. Technology Assessment Biomedical, Health Information Management, Hospital Information System. Citations were generated using the Boolean operator (AND) on the terms listed as independent ideas in the research question combined with EHR, Such as (EHR) and clinical performance, EHR and financial performance, EHR and staff Communication, and replacement of EHR with electronic health record.

Inclusion criteria

1. Only articles that have undergone a formal peer-review process will be considered.
2. The articles written in English were considered to be included.
3. Studies that employ quantitative research methods or a combination of quantitative and qualitative methods were included.
4. Articles published between the timeframe of 2015 to 2023 were considered for inclusion.
5. Studies describing the implantation and pros and cons of EHR in healthcare sectors were included.

Exclusion criteria

1. Articles that have not undergone peer review will be excluded from the study.
2. Articles published in languages other than English

were not included.

3. Studies that are primarily qualitative, systematic reviews, scoping reviews, literature reviews, or case studies were excluded.

4. Articles published before 2015 were not considered for inclusion in the study.

5. Articles focusing on EHR implementation in sectors other than healthcare were excluded from the study.

6. Duplicate studies were excluded.

RESULTS AND DISCUSSION

The initial search for publications concerning the significance of implementing electronic health records in healthcare sectors to improve the organisation's efficiency yielded 9880 articles found using the Science Direct and Cinahl databases. However, 1822 duplicate articles were removed, and 7617 papers were eliminated after the title and abstract had been assessed. A total of 440 items are excluded following full-text screening. Finally, 26 publications were selected for the systematic review, with preference given to those published during the last eight years (See the PRISMA Flow Diagram), which displays the many stages of the systematic review applied in identifying studies.

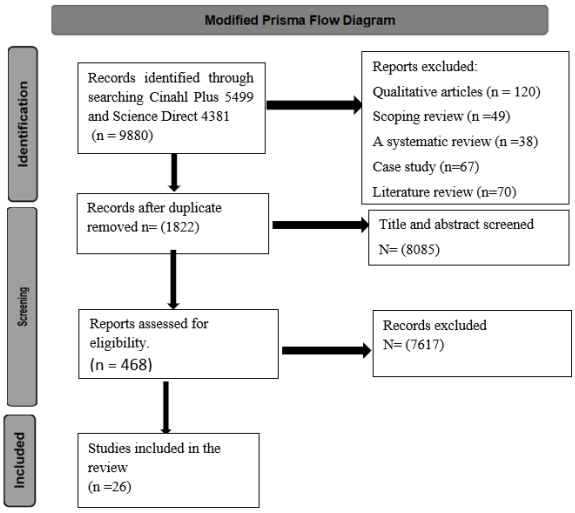

Figure 1: PRISMA Flow Diagram. (Figure's author's data from (Tsang *et al.*, 2022).

Narrative Analysis

For the past two decades' the impact of EHR has been a debatable topic on both clinically and financially. Some researchers suggest that using EHR can improve the quality of treatment and physician productivity. While other argue that there is no any connection between usage of EHR with treatment quality and physician output (Tsai *et al.*, 2020). Some studies indicate that hospitals are getting financial benefit by implementing EHR system. (Meyerhoefer *et al.*, 2016). Although some researchers disagree with this, Studies over the last eight years were analysed using PRISMA flow diagrams to examine the evolution of the EHR era. Techniques for maximising efficacy were proposed. Three articles were not included in the review because they dealt specifically with Electronic Medical Records (EMR), a comprehensive electronic record of patient health information originating from encounters in various care delivery settings, and EMR, a digital adaptation of traditional paper-based medical records (WHO, 2006).

Table 1: Characteristics of included studies

Reference	Aim	Participant	Setting	Methods	Results	Outcome	Other notes
(Bookman *et al.,* 2017)	The effects of an EHR-integrated CDS tool on the overall uptake of three specific expensive imaging, brain, C-spine and PE (Pulmonary embolism) on the workflow and quality of care.	Resident and advanced practice provider	Eds in 5 hospitals	Longitudinal-study Pre-post intervention design	6% decrease in utilisation of CT brain, CT spine use of CT PE also decreased but was not significant	Integrating CDS into the provider workflow promotes the usage of validated tools across providers, which can standardise the delivery of care and improve compliance with evidence-based guidelines	The study was limited to the ED patient
(Melnick *et al.,* 2021)	a study of ambulatory physicians' turnover across an ambulatory care delivery network over 2 years to	nontrainee ambulator physicians n=314	ambulator department	Retrospective cohort study	The turnover rate was 5.1%/year (32 of 314 physicians)	Physician productivity and EHR use metrics were associated with departure affecting clinical and financial performance	the primary outcome physician department did not include a reason
(Downing *et al.*, 2019)	To evaluate EHR-integrated sepsis alert system improves care performance outcomes.	patients from the health delivery system (n=1123) 595 intervened, 525 controlled	Medical and surgical inpatient units	Randomised evaluative design	Primary outcome (35% vs 37%, p=0.53 There was no difference in secondary outcomes of in-hospital mortality at 30 days	An EHR-based severe sepsis alert did not result in a statistically significant improvement in several sepsis treatment performance measures	the study excludes ICU patients.
(Low *et al.*, 2019)	Investigate the EHR as a predictor tool for adverse acute kidney Injury (AKI) outcomes. In addition prediction of renal replacement therapy (RRT) and mortality rate	AKI patients aged>18 n=3333	hospital	Longitudinal study	-392 patients (12%) died - 174 (5%) received RRT	The EHR clinical models that have been developed for the prediction of adverse outcomes are highly accurate, especially for RRT prediction.	In the study on a single centre, most of the patients were Asian -Inclusion only of Unique AKI episodes

(Lin *et al.*, 2018)	understanding of the impact of EHR adoption by identifying how the relationships differ by hospital characteristics? Results from this study can help inform hospitals about how to approach EHR adoption to obtain greater performance gains.	3249 hospitals	Acute care hospitals	Longitudinal study	-baseline adoption a 0.11 percentage-point higher rate per function - Maturation stage 0.09- percentage-point reduction in mortality rate per year per function -new function adoption 0.21- percentage-point reduction in mortality rate per year per function.	-EHR adoption affects performance improvement through multiple pathways and that when EHR adoption is measured, the baseline level, the maturation effect of baseline functions, EHR adoption is associated with Moderate improvements in mortality rates, and small and nonteaching hospitals lag behind large and teaching hospitals in EHR Adoption.	
(Salleh *et al.*, 2021)	evaluate several quality predictors' effects based on the effective use of EHR systems in healthcare providers' performance in a post-implementation stage.	primary health care providers (specialists, medical officers, and nurses)	hospital	Random sampling	Quality had the highest score for predicting performance and had a large effect size, whereas system compatibility was the most substantial system quality component.	Care providers, knowledge quality and EHR system quality positively affected the effective use and exhibited the most substantial positive effect on performance among the estimated relationships.	-Few specialists participated in this study -No probability sampling
(Lammers et al., 2016)	- To test EHRs to enable physicians in ambulatory care settings to better manage complex clinical information, particularly for patients with chronic conditions who are at risk for greater utilisation of inpatient services. - to study the correlation between EHR adoption and hospital admission and readmission	14.9 million patients aged 65 or older	Hospital	Cross-sectional study	statistically significant decline of 1.06 of ambulatory care sensitive condition (ACSC) admissions per 10,000 beneficiaries.'	adoption of physician EHR is significantly correlated with the observed decline in ACSC admissions, controlling for the average trend nationwide and other market characteristics. but it is found no such correlation between EHR penetration and readmission rates	-The study does not capture variation in the use of specific EHR features.

(Selvaraj et al., 2018)	To determine whether implementation of EHR was associated with improved quality of care and reduced mortality during hospital admission as well as the lower 30-day risk of readmission or mortality in patients with Heart failure (HF)	HF patients -N=21 to assess the relation between EHR and quality metrics. -N=8421, the mean age was 71 years, and 49% were women. The relation between EHR adoption and 30 days mortality rate	Hospital	-Cross-sectional study -	-multivariable-adjusted logistic regression (P>0.05 for all comparisons) -there was no association between EHR status and 30-day mortality, readmission	-the EHR may not be sufficient to improve HF-related outcomes	This study is limited to hospital HF participants.
(Bae & Encinosa, 2016)	To study the effect of EHR use on overall primary care physician workloads regarding patient visits per week and time spent per visit. Also, to examine how these effects vary across younger and older physician	-37,962 patient visit -1470 primary care physicians -	(NAMCS)	Cross section study	adopting EHR, there would be 37,600 additional patient visits per week in the U.S., the equivalent of adding 500 more primary care physicians to the U.S. workforce	This study was associated with 1.5 extra hours spent on patient face time per week for each physician, with no change in the overall number of visits per week. Furthermore, older physicians have higher workload productivity under EHR use, whereas younger physicians, less experienced,	-findings have limited generalisability and may not apply to non-U.S., -the study did not account for physician's years of experience with EHR
(Agbese & Ikonne, 2021)	to investigate the influence of electronic health records and use on quality healthcare delivery by physicians	390 physicians	Tertiary Hospital of Federal Capital	Cross-sectional study		The findings revealed a significant positive influence of electronic health records on quality healthcare delivery.	The study just on one hospital
(Mennemeyer et al., 2016)	To utilise Bass diffusion models and federal EHR adoption data that encompasses the MU period to assess the programme's impact on EHR uptake	nonfederal office-based physicians, excluding radiologists, anesthesiologists, and pathologists	Ambulatory Medical Car	Cross-sectional	EHR system may have increased by as much as 7 percentage points above the level predicted in the absence of the MU subsides	expected gains in convenience and productivity are driving the adoption of EHRs, But this study finds weak evidence of the impact of the MU programme on EHR uptake	-aggregate national data over relatively short periods of 2001–2013 and 2006– 2013.

(Flatow et al., 2015)	To evaluate the key quality of care indicators before and after the implementation of an EHR, performing a retrospective cohort study in a surgical intensive care unit (SICU), where efficient quality control is mandatory for the extensive resource demands.	Patients =1247 (2009-2010) before EHR N=1229(2012-2013) after EHR	Hospital	Retrospective study	-The rate of central line-associated bloodstream infection (CLABSI) per 1,000 catheter days was lower after EHR implementation (2.16 vs. 0.39, Relative Risk [RR], 0.18;	EHR implementation was statistically associated with lower CLABSI and SICU mortality.	The study is in one hospital, so it is not generalisable.
(Zhu et al., 2019)	To present a method for identifying virtual care teams for surgical colorectal cancer patients and measuring EHR-based Communication in these teams using EHR access-log data and social network analysis (SNA)	surgical colorectal cancer patients n=100	Academic medical Centre	Cross-sectional	The distributions of conditional uniform graph quantiles suggested that the network construction technique captured meaningful underlying structures that were different from random, unstructured networks.	Results showed that the proposed methods captured salient communication patterns in care teams that were associated with patients' clinical differences and identified key members of the care team.	-This study only examined EHR-based Communication. -one method to measure communication linkages based on the average time
(Watterson et al., 2020)	examining whether improved relational coordination (RC) among primary care team members is one of the mechanisms through which EHRs can produce better patient outcomes	Primary care providers N-304	Hospital	Cross-sectional study	Ease of EHR use (mean = 3.5, SD = 0.6, range: 0–4) and RC were high (mean = 4.0, SD = 0.7, range: 0–5) but differed by occupation.	The positive association between ease of EHR use and RC identifies a potential mechanism for how EHRs might improve outcomes of care	-cross-sectional nature. -Second, the data are from primary care team members- - unable to collect information on the frequency with which the primary care team members interacted with the EHR

(Reicher & Reicher, 2016)	To Explore two impacts of radiologist utilisation of certified EHR technology: the impact on interoperability with referring clinicians' EHRs and the impact on patient engagement.	healthcare organisation		Retrospective study	The availability of radiology reports online was strongly associated with increased system usage, with a likelihood ratio of 2.63	The usage of MU-compliant EHR technology and Direct messaging in radiology practice allows for the Communication of patient information and radiology results with referring clinicians. It increases patient use of patient portal technology supporting bidirectional radiologist-patient Communication.	
(Anderson et al., 2018)	to explore the implementation and impact of an Electronic Health Record (EHR) tool designed to enhance team communication and facilitate early patient mobility in the intensive care unit	All the medical staff in ICU	ICU	Retrospective study	Statistically significant increases were found for staff satisfaction with mobility-related Communication (P < .001) and communication frequency (P = .02) but not for staff knowledge (P = .28)	Combining routine educational reviews and an electronic health record communication tool may improve patient and system outcomes for intensive care unit early mobility programme patients.	Not generalisable
(Beauvais et al., 2021)	To evaluate the association between the top 3 EHR vendors and hospital financial and quality performance measures.	Hospitals N=2667	Hospitals in the USA	Retrospective study	None of the EHR systems were associated with a statistically significant financial relationship in our stud	pertaining to financial outcomes were somewhat interesting in that no single EHR demonstrated a significant and positive association with net income.	The single year of data drawn from the 2018 data p
(Wang et al., 2018)	to examine the associations between health information technology expenditures, intermediate business processes, hospital financial performance and productivity.	N = 8000 hospitals	hospital	Cross-sectional study	positive direct financial performance of IT investments in hospitals.	that hospitals' health information technology investments involving intermediate business processes are associated with positive financial performance and productivity following the implementation of the Health Information Technology for Economic and Clinical Health Act.	The healthcare dataset does not represent panel data; each hospital has only one observation.

Milstein et al., 2015)	To assess whether, 5 years into the HITECH programmes, national data reflect a consistent relationship between EHR adoption and hospital outcomes across three important dimensions of hospital performance between Electronic Health Record (EHR) adoption and hospital performance over time, specifically focusing on the time-related effects.	nonfederal, acute-care hospitals	Hospital	Longitudinal study	. Higher levels of EHR adoption were associated with better performance on process adherence (0.147; $p < .001$)	The study advances the understanding of the nature of the relationship between EHR adoption and key hospital outcomes by identifying consistent positive benefits from EHR adoption associated with two types of time-related effects.	-Adherence to the process measures was high across hospitals. -
(Edwardson et al., 2017)	To evaluate the final net gains (or losses) after EHR implementation, but ought to focus specifically on how and where an EHR can leverage an organisation's financial performance.	57 providers across 32 practices		Longitudinal study	The introduction of the EHR is associated with a significant increase in charges and collections.	Findings suggest that despite the varying starting points (intercepts in our model) of different payer mix affiliations, EHRs benefit all physician types.	-The nature of the data set has very few variables to hold constant, increasing the likelihood of omitted variable bias.
(Suess et al., 2019)	to evaluate the association between auto-documentation of infusion-therapy start and stop times provided by smart pump–EHR interoperability and the infusion therapy billing claims submissions at a community hospital	Patients N = 7 8 2 4 1 (Edwardson et al., 2017) pre-documentation N=80138 post documentation	Hospitals	Retrospective cohort study	The corresponding billing claim dollar value increased by $US1,147,652 (13.5%).	This study addresses the gap by generating evidence supporting the value of smart pump–EHR interoperability in improving hospital financial performance through its association with charge capture and billing compliance.	-data from the two study groups were matched by month of the year. Data were not matched by demographic or treatment characteristics, which may affect submitted billing claims

(Redd et al., 2015)	to identify whether information gathering needs and EHR usage patterns are different between specialists and generalists, and if so, to characterise their precise nature.	Physician N=654 350 specialists and 304 primary care providers	hospital	Longitudinal study	Specialty physician p<0.01 Primary care physician p=0.05	The outcome clearly demonstrates several differences between primary care and specialty fields with respect to which elements of the EHR are considered most important when gathering clinical information and achieving Meaningful Use criteria, with large potential impacts on reimbursement	the response rate is on the low-normal end for similar surveys of this nature. -Not all EHR systems were represented in our study

Table author's data from (Popay et al., 2006)

Mapping

Effective EHR implementation in hospitals involves: training, accuracy, and impact adoption. Documentation comes first, followed by Communication and the shared principles that lead to effective employee cooperation and improved hospital performance (Lin *et al.*, 2018). However, other elements influencing hospital performance will impact the care process, such as the age of the physician, as (an older doctor may be more effective than a younger one (Bae & Encinosa, 2016). Distinct medical specialities have distinct EHR requirements; thus, suppliers must design their systems to work with all types of specialities. Consequently, physician productivity will impact the delivery of care, which is essential for good clinical performance (Anderson *et al.*, 2018).

The Communication between medical professionals and patients is affected by clinical performance and vice versa, ultimately impacting financial success (Melnick *et al.*, 2021). Clinical performance and Communication will be affected by hospitals' lack of investment in EHR development with vendor collaboration and physician training (Wang *et al.*, 2018). The diagram in Figure (2) provides an overview and a flow chart of the factors informing and influencing EHR uptake and adoption.

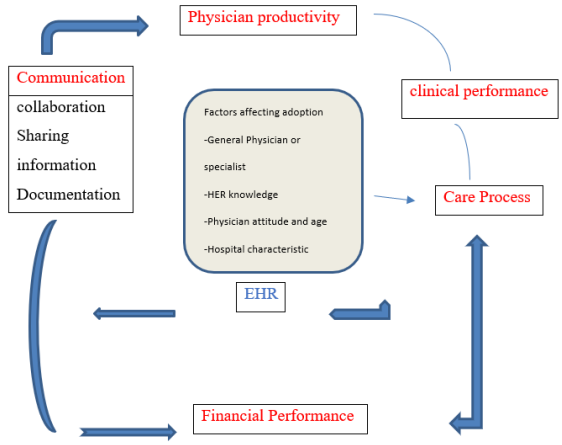

Figure 2: Factors affecting physician's productivity and financial performance.

Limitation of synthesis

Several studies mentioned in Table 1 are restricted to a single hospital, while others are limited to hospitals in the USA, making it impossible to generalise results to different demography. In addition, a few studies in this narrative synthesis involve multiple EHR systems.

Thematic analysis

• After reading the mixed research by Meyerhoefer *et al.*, 2016 , the author developed the initial coding and then established sub-coding for the primary topic (Meyerhoefer *et al.*, 2016). Integrated EHR Implementation in all the departments of hospitals

• Accurate and good documentation needs training and will increase the value of the EHR system.

• Sharing information and Communicating well with different departments create a circle of information (coordination).

• Good Communication and coordination lead to a good quality of care.

• According to the quantitative analysis, a significant decline in productivity occurred after the initial installation of the ambulatory EHR system at the primary care sites, which was partially reversed during stage 2 but occurred again during stage.

EHR advantages such as promotes clinical performance and improves communication, patient outcomes. While on the other hand the obstacles like interoperability problem, insufficient training. These were the focus and theme of research.

RESULTS AND DISCUSSION

In this study, the author conducted a systematic review of the literature on the effects of EHR adoption on hospital administration, highlighting: clinical performance, financial performance and staff communication, to examined the EHR's impact on clinical performance. The efficacy of the clinical decision support (CDS) tools used to analyse the quality of care and the admission, readmission, and mortality rates. Furthermore, explaining how EHR communication affects the hospital's overall performance. Finally, find the relation between clinical performance and Communication and the impact of EHR on financial outcomes.

Based on study observation that using EHR-integrated CDS tools in various hospital departments has diverse results, the uptake of three costly images the brain, spine, and Pulmonary Embolism (PE) can standardise the provision of treatment and increase adherence to evidence-based recommendations. Other studies show numerous sepsis treatment performance measures did not see a statistically significant improvement due to the EHR-based severe sepsis warning. On the contrary, the well-established EHR clinical models are highly accurate in predicting Acute Kidney Injury's adverse outcomes, especially concerning Renal Replacement Therapy (RRT) prediction. According to Lin *et al* (Lin *et al.*, 2018). mortality rates performed poorly at the baseline level of EHR adoption. In contrast, maturation level and adoption of additional functions improved mortality rates.

In 2016, Lammer and others (Lammers *et al.*, 2016) found a correlation between recent increases in ambulatory care physicians' use of (EHRs) and declining Ambulatory Care Sensitive Condition (ACSC) admission rates in an elderly population with four common chronic conditions. In another study, (Selvaraj *et al.*, 2018) identified no correlation between the implementation of EHR and patient-level quality indicators or in-hospital outcomes. Furthermore, no relationship has been found between the EHR status and 30-day event rates, which include readmission, mortality, and combined outcomes. A study found a statistical correlation between the usage

of EHRs and lower death rates in surgical intensive care units (SICUs) and central line-associated bloodstream infections (CLABSI) (Flatow *et al.*, 2015). The findings of Salleh *et al.* showed that the usage of EHR had a good impact on the doctors' tasks in a critical care unit by allowing them to spend more time on clinical evaluation with numerous doctors at once and less time on administrative and paperwork work (Salleh *et al.*, 2021).

Additionally, EHR improves nurses' ability to communicate with patients and capture their data (Salleh *et al.*, 2021) The findings of Agbese *et al.*,2021, suggest that since electronic health records have had such a positive impact on the quality of healthcare provided by physicians in tertiary hospitals which consequently increases physician ability to provide better care quality (Agbese & Ikonne, 2021). On the other hand, the studies must be comprehensive to all hospital departments with good interoperability, good training to the staff with documentation sharing information, and knowledge of how to develop Clinical CDS tools in other departments to ensure EHR effectivity.

Physician productivity and EHRs are still highly debated topics. EHR can increase productivity and efficiency in primary care physicians' workloads, according to (Bae & Encinosa, 2016). Additionally, the improvement brought about by the implementation of EHRs differs with physician ages. Contrary to popular belief, older doctors have better workload productivity using EHRs. In contrast, younger doctors, who are less experienced but more adept at using information technology, have lower workload productivity. However, the problem is that the Meaningful Use (MU) programme encouraged the adoption of inferior technologies that physicians had already rejected because the requirement for a certified EHR may have slowed technological advancements by encouraging system vendors to focus on compliance rather than research and development.

The patient referral process to specialists is time-consuming and challenging for patients, which impacts medical staff collaboration. However, the EHR system used as a communication tool makes it easier for radiologists, medical laboratories, and physicians to share information, encouraging staff collaboration and enhancing clinical outcomes. Every study in Table 1 on the effect of EHR on Communication finds a positive relationship that aids workflow, increases physician productivity, and improves patient care.

Over the past two decades, much discussion and attention has been placed on the return on investment (ROI) and outcomes related to EHRs. The financial outcomes findings by (Beauvais *et al.*, 2021) were quite surprising in that no single EHR system showed a significant and favourable correlation with net income. Whereas Wang *et al.*,2018, discovered that hospitals' investments in Health IT related to intermediary business processes are linked to improved financial performance and productivity after the passage of Health IT, Including (EHR) for clinical and economic Health (Wang *et al.*, 2018). In a study conducted by Edwardson *et al.* (2017), it was found that charges and collections significantly increased after the EHR was implemented (Edwardson *et al.*, 2017). By linking the interoperability of smart pumps and electronic health records to charge capture and billing compliance, Suess *et al.* (2019) have asserted in their study the empirical evidence supporting the enhancement of hospital financial performance through the utility of smart Pump-Electronic Health Record (EHR) interoperability (Suess *et al.*, 2019). Specialists and generalists perceive the most crucial EHR components and how effectively these systems are adapted to show clinical information differently. As per the findings by Redd *et al.* (2015), rectifying these discrepancies could potentially impact the hospital's clinical productivity and financial performance (Redd *et al.*, 2015). Thus, the author noted that even the most current research cannot agree on how advantageous EHR is to financial success.

Hospital performance is an iterative process; the EHR's impact on hospital management is influenced by workflow and is aided by competent EHR vendors and their training for the medical and administrative staff. Along with the attitude of the physicians, the clinical outcomes are also influenced by the physician's age and IT knowledge. The care process, is also impacted by the communication-integrated EHR. As a result, hospital administrators must consider all of the variables to achieve the success of EHR deployment.

CONCLUSION

EHR deployment had showed to improve clinical outcomes and financial performance, but its impact on hospital performance remains unclear. To evaluate the implementation of a new system, vendors should use validated tools to analyse specific difficulties and ensure the system has access to all integration tools. Physician training should cover EHR use, its harmony with clinical work, and psychological education to help physicians accept it. Training sharing information and Communication through EHR between medical staff can ease workflow and save time, significantly improving treatment processes and physician productivity. The EHR system should be included in all teaching hospitals to prepare the next generation of doctors. However, seeing a positive financial impact from EHR implementation will take time, as most studies were completed in less than two years.

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APPENDICES

EHR: Electronic Health Record
EHRS: Electronic Health Record System
WHO: World Health Organisation
MU: Meaningful Use
e-HEALTH: Electronic Health
EMR: Electronic Medical Record
CNMOs: Communication for Non-Medication Orders
IEEE Xplore: Institute for Electrical and Electronic Engineers Xplore
PRISMA: Preferred Reporting Items for Systematic Study
CDS: Clinical Division Support
PE: Pulmonary Embolism
AKI: Acute Kidney Injury
RRT: Renal Replacement Therapy
ACSC: Ambulatory Care Sensitive Condition
CLABSI: Central Line-Associated Blood Stream Infection
SICU: Surgical Intensive Care Unit