

Electronic Health Records (EHRs): Effectiveness to Health Care Outcomes and Challenges of Health Practitioners in Saudi Arabia

Aimee M. Amponin, PhD^{1*}, Myra Cusi Britiller, PhD²

¹Assistant Professor, Department of Nursing, Alghad International Colleges for Applied Medical Sciences, Tabuk Campus, CG5X+67V, 15, Al Faisaliyah, Ashamaliyah, Tabuk 47315, Kingdom of Saudi Arabia

²Assistant Professor, Department of Nursing, Mohammed Al Mana College for Medical Sciences, P.O. Box No. 3195, As Safa, Dammam 34222, Kingdom of Saudi Arabia

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*Corresponding author: Aimee M. Amponin

Assistant Professor, Department of Nursing, Alghad International Colleges for Applied Medical Sciences, Tabuk Campus, CG5X+67V, 15, Al Faisaliyah, Ashamaliyah, Tabuk 47315, Kingdom of Saudi Arabia

Abstract

Recently, Electronic Health Records (EHRs) were regarded as an important factor implicating the majority of health care facilities. This study identified the effectiveness of electronic health records to health care outcomes and determined the challenges experienced by health practitioners while putting EHRs into practice. The research was descriptive and cross-sectional. The study was conducted in selected government and private hospitals throughout Saudi Arabia's regions. A sample of three hundred twenty (N = 320) health practitioners who are members of the medical department, nursing department, and paramedical department were the participants of the study. A self-structured questionnaire, which included questions about the effectiveness of EHRs in five categories: quality of patient care, patient engagement, support team-based care, workload, data liquidity; and challenges in the implementation of electronic health records, was the tool utilized for data collection. Data were analyzed with the mean, standard deviation, Mann-Whitney and Kruskal-Wallis's tests, and Spearman's rho. The study revealed that EHRs are moderately effective in improving health care outcomes. Age, place of work, and years of experience with the use of EHRs are critical indicators of effectiveness, but health practitioners' discipline is not a factor in determining the effectiveness of EHRs use. Health practitioners who apply EHRs to improve health care outcomes particularly to support team-based care face more challenges in their implementation.

Keywords: Electronic Health Records, EHRs, Health Care Outcomes, Quality of Patient Care, Patient Engagement, Support Team-Based Care, Workload, Data Liquidity, Challenges, Saudi Arabia.

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INTRODUCTION

It is widely assumed that the ability to electronically share and exchange health information, such as through the use of electronic health records (EHRs), should improve the quality and efficiency of health care.

Electronic health records (EHRs) are real-time, patient-centered records that provide immediate and secure information to authorized users. EHRs typically contain a patient's medical history, diagnoses and treatment, medications, allergies, immunizations, as well as radiology images and laboratory results (WHO, n.d.).

EHRs are sometimes referred to as Electronic Medical Records (EMRs). Healthcare organizations

often confuse electronic health records (EHRs) and electronic medical records (EMRs) frameworks because they both perform the same essential purpose in a compliance and operational environment that is always changing (Bonderud, 2021), thus, the term EHRs and EMRs are often used interchangeably in healthcare (Janvier, 2021). This study likewise uses both of them interchangeably.

The health care industry is regarded as one of the most important sectors with a significant impact on society (Sayed, 2021). Recently, EHRs were regarded as an important factor implicating the majority of the health care facilities. Systematic reviews performed by Gatiti *et al.*, (2021) summarized that EHR improves patient safety and ensures effective, efficient, timely, equitable, and patient-centered treatment, all of which

have a major beneficial impact on healthcare quality. Practice management, communication, documentation or data input, medication management, decision support capabilities, computerized drug prescription, electronic nursing documentation, and electronic management records are some of the EHRs features that help provide high-quality healthcare. However, several studies claimed otherwise (Ajami and Bagheri-Tadi, 2013; Quinn *et al.*, 2019; Vos *et al.*, 2020). These studies suggested that EHRs contributed greatly to the challenges experienced by health care professionals in their practice. Aside from the discrepancies of the system itself, EHRs were associated with the health providers' certain characteristics (e.g., age, field of work) and ability (e.g., computer literacy) to use and adopt its features to their usual practice. Thus, warrants further need to examine EHRs effectiveness in enhancing health care outcomes.

In Saudi Arabia, the Ministry of Health (MOH) introduced the electronic health system in 1988 with the goal of improving the country's health-care system (Hasanain *et al.*, 2014). Hazazi and Wilson (2021) stated that EHR use in Saudi Arabia's hospitals and primary healthcare centers has advanced significantly in recent years. The MOH's 2011 National E-Health Strategy, which was created to make it easier for the healthcare industry to shift from a paper-based to an electronic platform in order to improve the quality of healthcare services, is what motivates the adoption of EHRs in Saudi Arabia. AlSadrah (2020) determined that significant effort has been made to adopt EMR systems in healthcare facilities of Saudi Arabia. Even though there has been some progress, the current evaluation has brought to light several unfavorable opinions and a number of obstacles to fully achieving this aim, such as low computer literacy, a lack of IT staff support, and a lack of customization to meet the demands of every hospital system. Alharbi (2023) specified that both Saudi and non-Saudi healthcare professionals in Saudi Arabia exhibit high rates of knowledge and utilization.

Despite the fact that numerous researches have examined changes in quality attributable to electronic healthcare systems, health care outcomes connected with the introduction of EHRs are still not fully documented. The adoption of an EHRs should be done with the intention of improving the institution's efficiency in providing healthcare. A well-designed EHRs might be implemented, but if probable problems and obstacles aren't addressed, the system might not be used correctly, failing to deliver the desired results. It is crucial to keep in mind that the administration, medical and nursing staff, and other health care employees all need to be fully on board with and supportive of the implementation of any kind of electronic health record (WHO, 2006).

Based on the aforementioned factors, the objective of this study was to identify the effectiveness of electronic health records to healthcare outcomes and determine the challenges experience by health practitioners while putting EHRs into practice. The following questions were addressed to answer this objective:

1. Is the implementation of the current EHRs in the health care facilities in Saudi Arabia effective as to: (1) quality of patient care; (2) patient engagement; (3) support team-based care; (4) workload; and (5) data liquidity?
2. What are the challenges in the implementation of the EHRs?
3. Is there a significant difference of the responses of the participants on the effectiveness and challenges of EHRs to health care outcomes when grouped according to their profile?
4. Is there a significant relationship between the effectiveness of EHRs to health care outcomes and the challenges in the implementation of EHRs?

MATERIAL AND METHODS

The research was descriptive and cross-sectional. The study was conducted in selected government and private hospitals throughout Saudi Arabia's regions, which were identified as the eastern region, western region, northern region, southern region, and central region. These hospitals, where the participants work, were the basis for selecting the setting of the study.

Through the convenience sampling technique, a sample of three hundred twenty (N=320) health practitioners who are members of the medical department, nursing department, and paramedical department were the actual participants of the study. The sample size was based on an effect size of 0.25, a power probability of 0.95, and an alpha level of 0.05 using G*Power 3.1.9.2. The actual participants from the medical department were general medicine and specialized physicians, nurses were those assigned in different units of the hospitals, and paramedical were safety and emergency officers, physiotherapists and radiographers.

The participants of the study were selected using the following inclusion criteria: (1) they were users of electronic health records who have at least basic knowledge of their use; (2) they were hospital staff from the medical department, nursing department, and paramedical department of the selected government and private hospitals in the identified regions of Saudi Arabia; and (3) they have been using the EHRs for at least one year. Those who do not meet these criteria were excluded from the study.

A self-structured questionnaire based on journals, published researchers, and other related materials was the primary data gathering tool of the study. This researcher-made questionnaire was composed of two parts. The first section included a series of questions about the effectiveness of EHRs in Saudi government and private hospitals in five categories: quality of patient care, patient engagement, support team-based care, workload, and data liquidity. The second part was about the challenges in the implementation of electronic health records. Included in the questionnaire were items certain to profile variables of the participants such as age, place of work, department, and years of experience in using the EHRs.

The questionnaire was validated in terms of its content by three experts, one who specialize in informatics, a health care professional who directly uses the EHRs and an experienced training officer implementing the EHRs. Modifications were made to the questionnaire to include the recommendations given by the experts. On the other hand, the reliability of the questionnaire was measured through Cronbach's alpha coefficient, which ranges from > 0.7 (*acceptable*) to > 0.9 (*excellent*). Using the test-retest reliability method, the questionnaire yielded the following results: quality of patient care (0.888, *Good*); patient engagement (0.856, *Good*); support team-based care (0.905, *Excellent*); workload (0.841, *Good*); data liquidity (0.932, *Excellent*); and challenges in EHRs implementation (0.869, *Good*). The test-retest was carried out on the pilot sample of health practitioners who are comparable to those who met the inclusion criteria on two separate occasions, with a short time gap between each administration. Based on the obtained results of the Cronbach's alpha coefficient, the questionnaire was considered reliable and ensured high internal consistency.

After approval from the appropriate authorities, the questionnaire was shared electronically through a link with the study participants. The purpose of the study was explicitly stated and explained through a cover letter. From January to March 2023, the data were collected and tabulated. For the first part of the questionnaire, participants rated themselves on a 4-point Likert scale ranging from 1 (*not effective*) to 4 (*highly effective*). For the second part of the questionnaire, the same scale of measurement was used, ranging from 1- (*strongly disagree*) to 4- (*strongly agree*). After data collection and tabulation, they were analyzed with the Statistical Package for the Social Sciences (SPSS) Version 28 software.

To determine the effectiveness and challenges of EHRs to health care outcomes, mean and standard deviation were used, whereas Mann-Whitney & Kruskal-Wallis's test was used to determine the differences in the effectiveness and challenges of EHRs when grouped according to the profile variables. On the other hand, Spearman's rho was used to examine the relationship between EHRs effectiveness to health care outcomes, as well as the challenges of EHRs implementation.

The researchers sought approval from appropriate authorities before proceeding with data collection. To ensure confidentiality and anonymity, numbers were assigned to the responses and a cover letter was presented to the participants to confirm their willingness and provide their consent to take part in the study.

RESULTS AND DISCUSSION

This study included three hundred twenty (N = 320) health practitioners who are using electronic health records (EHRs) in their area of work.

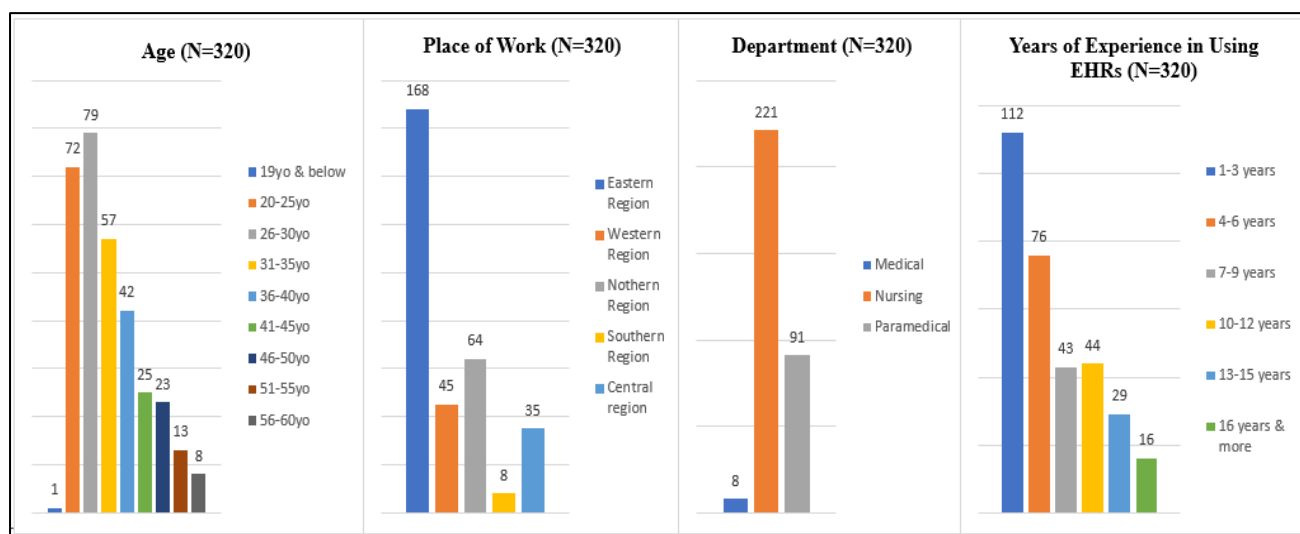


Figure 1: Profile Distribution of the Participants

Presented in Figure 1, majority of participants (24.7%) are between the ages of 26 to 30, and work in the Eastern region (52.5%). They were mostly from the nursing department (69.1%) with 1-3 years of experience in using the electronic health record (35.0%).

On the other hand, Table 1 summarizes the effectiveness of the EHRs in terms of quality of patient care, patient engagement, support for team-based care, workload, and data liquidity.

According to the health practitioners who took part in the study, the EHRs were moderately effective in enhancing health care outcomes. Among these factors, data liquidity indicated a higher extent of effectiveness than other EHRs categories. Enhancing access and retrieval of data (3.20 ± 0.880) was recognized by the participants as more effective than other items under data liquidity. Whereas, providing central system and storage of data (3.18 ± 0.882), facilitating regulatory compliance (3.17 ± 0.871), ensuring privacy and security of data (3.14 ± 0.892) and allowing data analyses and compare trends of data for research processes (3.13 ± 0.880) were moderately effective.

The results showed that EHRs enhance data retrieval and access. Hanks (2017) argued that recovering and analyzing medical records permits

facilities and providers of healthcare quick access to crucial patient and demographic data. Every component of the health care system, from patient intake and diagnosis to treatment plans and billing procedures, is impacted by the numerous data retrieval and analysis tasks. According to Westra *et al.*, (2015) as cited in Cho *et al.*, (2018), large amounts of clinical data are now accessible due to the quick adoption and integration of EHRs data into clinical data repositories. Ehrenstein *et al.*, (2019) stated that EHRs is used to collect and store patients' medical information. Healthcare systems gather different types of patient-level variables such as demographics, diagnoses, problem lists, medications, vital signs and laboratory data to manage clinical workflows. Hazazi and Wilson (2021) claimed that EHRs has many benefits in terms of efficiency, such as accurate patient documentation and accessibility to patient information. Further, EMRs makes it simpler to locate specific information in patient records, examine patients' concerns, review current medication, submit daily notes, and retrieve findings from laboratory analyses, x-ray, ultrasound, or CT examinations, review currently received medication, and enter daily notes (Al Otaybi *et al.*, 2022). Even Upadhyay and Hu (2022) attested that clinician's perceived ease of use in terms of accessing patient's data and perceived usefulness as to providing alerts and reminders were keys to their acceptance to EHR.

Table 1: Effectiveness of the EHRs to Health Care Outcomes

Items	Mean	*Std.
Quality of Patient Care		
1. Facilitate planning and continuity of care	3.08	0.901
2. Enhance patient safety and reduction of medical errors	3.11	0.887
3. Reduce waiting times and delays in care	3.08	0.884
4. Show progress of treatments for fast recovery and decrease length of hospital stay	3.03	0.883
5. Address patient's complex needs	3.05	0.904
	*3.07(ME)	0.759
Patient Engagement		
1. Facilitate patient's understanding of medical records and information	3.03	0.856
2. Improve relationship with health care professionals	3.05	0.898
3. Enhance compliance to medications and treatments	3.12	0.883
4. Encourage awareness and proper self-care	3.04	0.854
5. Assist in understanding information which facilitate informed consent and medical decisions	3.08	0.849
	*3.06(ME)	0.753
Support Team-Based Care		
1. Help coordinate patient care	3.13	0.871
2. Afford joint clinical decisions based on shared data	3.08	0.882
3. Allow flexibility in multidisciplinary collaboration (e.g., managing referrals)	3.02	0.890
4. Improve efficiency and quality of documentation among care Providers	3.12	0.859
5. Enhance communication between health professionals	3.07	0.905
	*3.08(ME)	0.793
Workload		
1. Ensure efficiency of clinical processes	3.11	0.878
2. Lessen mental workload and burnout	3.08	0.882
3. Reduce repetitive work	3.02	0.937
4. Limit cost and resources for health care	3.02	0.920
5. Save time and reduce the necessity for face-to-face communication	3.01	0.917

Items	Mean	*Std.
	*3.05 (ME)	0.770
Data Liquidity		
1. Enhance access and retrieval of data	3.20	0.880
2. Provide central system and storage of data	3.18	0.882
3. Allow data analyses and compare trends of data for research purposes	3.13	0.880
4. Ensure privacy and security of data	3.14	0.892
5. Facilitate regulatory compliance	3.17	0.871
	*3.16 (ME)	0.772

*Composite Mean (Verbal Interpretation-VI): 3.50 – 4.00 = Highly Effective (HE); 2.50 – 3.49 = Moderately Effective (ME); 1.50 – 2.49 = Fairly Effective (FE); 1.00 – 1.49 = Not Effective (NE); * Std (Standard deviation)

In terms of supporting team-based care, the participants reported that EHRs are moderately effective in helping them coordinate patient care (3.13 ± 0.871). They suggested that EHRs improve efficiency and quality of documentation among care providers (3.12 ± 0.859), afford joint clinical decisions based on shared data (3.08 ± 0.882), enhance communication between health professionals (3.07 ± 0.905), and allow flexibility in multidisciplinary collaboration (3.02 ± 0.890).

The participants reported that EHRs helped them coordinate patient care. Through EHRs, data concerning patients' diagnoses and treatments are available and easily accessed by any member of the care team. Since the patient's records are electronic, coordination of care is fast because they can be shared immediately with the care team or other specialists when needed. The Agency for Healthcare Research and Quality (2018) stated that care coordination involves deliberately organizing patient care activities and sharing information among all of the participants concerned with a patient's care to achieve safer and more effective care. This implies that the patient's needs and preferences are known and communicated at the right time to the right people, and that this information is used to guide the delivery of safe, appropriate, and effective care. This was also attested to by Heath (2016) and Aldosari (2017), claiming that EHRs improved clinical staff performance and clinician efficiency by reducing the amount of duplicative testing and allowing clinicians to share information with one another. However, Vos et.al (2020) explained that although EHRs help health practitioners coordinate patient care on an informed basis at any time and in any place, it only allows asynchronous patient record use and specialty- and discipline-specific user-interfaces constrain mutual understanding of data. Moreover, not all relevant information can be easily shared across specialties and outside the hospital.

Also, EHRs were moderately effective as to the quality of patient care. According to the participants, EHRs enhance patient safety and reduce medical errors, (3.11 ± 0.887). Similarly, EHRs facilitate planning and continuity of care (3.08 ± 0.901) and reduce waiting times and delays in care (3.08 ± 0.884). Moreover, it addresses the patient's complex needs

(3.05 ± 0.904) and shows the progress of treatments for fast recovery and decrease length of hospital stay (3.03 ± 0.883).

The participants indicated that EHRs improve patient safety and reduce medical errors. They feel satisfied and safe in rendering care because of the use of EHRs. These results were confirmed by Tubaihat (2019); Larsen *et al.*, (2018); Saraswata and Hariyati (2021). According to Sayed (2021) and Al Otaybi *et al.*, (2022), EHRs are effective tools for increasing the quality and effectiveness of the care provided in the health care sector. Such as Adane *et al.*, (2019), stressed that computerized physician order entry applications and having decision-support fields in EHRs reduce avoidable medical errors. The automatic notification alert signals of EHRs enable appropriate and timely intervention that ensures safer and more efficient health care. Equally, EHRs can enhance patient safety by detecting missed diagnoses, producing diagnostic error alerts to prevent misdiagnosis, and assisting the practitioner in gathering and synthesizing patient information (Forjuoh *et al.*, 2013, as cited in Tanner *et al.*, 2015).

Conversely, EHRs, in terms of patient engagement, can enhance compliance to medications and treatments (3.12 ± 0.883). It assists in understanding information which facilitates informed consent and medical decisions (3.08 ± 0.849). EHRs were likewise rated moderately effective in regards to improving relationships with health care professionals (3.05 ± 0.898), encouraging awareness and proper self-care (3.04 ± 0.854), and facilitating patients' understanding of medical records and information (3.03 ± 0.856).

EHRs can enhance compliance with medications and treatments. EHRs assist health practitioners so they may be capable of presenting information that is easy for various patients to understand. With EHRs, doctors, nurses, and other key health providers can facilitate the explanation of complex treatments and communication of procedures to patients, thus enhancing compliance with care. Moll and Rexhepi (2020) and Sanders *et al.*, (2020) attested that the use of EHRs reported improved communication

and involvement of patients in care, as well as adherence to interventions.

Workload was the last category influencing EHRs effectiveness. Nonetheless, participants claimed that EHRs moderately ensure efficiency of clinical process (3.11 ± 0.878). They further indicated that EHRs lessen mental workload and burnout (3.08 ± 0.882), reduce repetitive work (3.02 ± 0.937), limit cost and resources (3.02 ± 0.920), and save time and reduce the necessity for face-to-face communication (3.01 ± 0.917).

Based on the results, EHRs can ensure clinical process efficiency. Alzghaibi and Hutchings (2022), revealed that the benefits such as data accessibility, time savings, cost reduction and improved productivity were the things that end users liked about the EHRs. End users of EHRs gave positive feedback about data accessibility, accuracy, improved productivity and time

savings as a result of the system. Reeves *et al.*, (2020) proposed that EHRs is a useful tool to enable rapid deployment of standardized processes and served as an essential tool in supporting the clinical needs of a health system. As an example, during the COVID-19 pandemic, EHRs supported outbreak management, including scripted triaging, electronic check-in, standard ordering and documentation, secure messaging, real-time data analytics, and telemedicine capabilities. In contrast, Vos *et al.*, (2020), revealed that even the reduce necessity for face-to-face communication saves time, EHRs is experienced as hindering collective responsibility for a smooth workflow. Worthy to note, Almulhem *et al.*, (2021) elaborated that health information technology related stress especially with the use of EHRs adds frustration to the daily work, and claimed as a predictor for burnout among health practitioners.

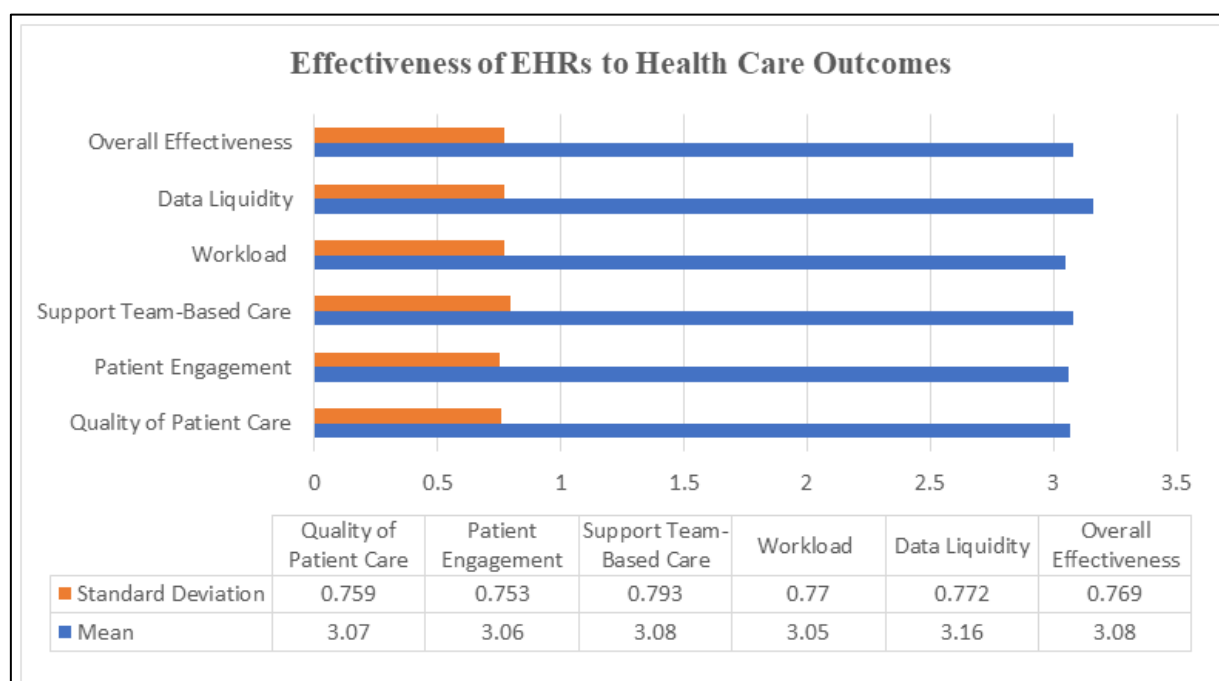


Figure 2: Summary of the Effectiveness of EHRs to Health Care Outcomes

Overall, the use of EHRs to enhance health care outcomes was moderately effective (3.08 ± 0.769). Figure 2 shows the effectiveness of each category, respectively as (1) data liquidity (3.16 ± 0.772); (2)

support for team-based care (3.08 ± 0.793); (3) quality of patient care (3.07 ± 0.759); (4) patient engagement (3.06 ± 0.753); and (5) workload (3.05 ± 0.770).

Table 2: Challenges in the Implementation of the EHRs

Items	Mean	*Std.
1. Lack of confidence in the use of EHR	*2.41(D)	0.959
2. Unable to access evidence-based tools that can be used to make decisions about patient care	2.46(D)	0.909
3. Failure to update one’s professional knowledge to keep pace with the current EHR based standard	2.44(D)	0.908
4. Facilitating structured communication among health professionals	2.64(A)	0.952
5. Computer consumes more time that paper-based system	2.37(D)	1.002
6. Probable security breaches	2.57(A)	0.961
7. Poor computer language and skills	2.38(D)	0.936
8. Complexity of technology	2.43(D)	0.973

Items	Mean	*Std.
9. Resistance to changing work habits	2.41(D)	0.997
10. Unreliable internet and network connectivity	2.47(D)	1.091
	2.46(D)	0.778

*Mean, Verbal Interpretation (VI): 3.50 – 4.00 = Strongly Agree(SA); 2.50 – 3.49 = Agree(A); 1.50 – 2.49 = Disagree(D); 1.00 – 1.49 = Strongly Disagree(SD); *Std=Standard Deviation

Table 2 reveals the challenges that health practitioners face when implementing EHRs. They agreed that facilitating structured communication among health professionals (2.64 ± 0.952) and preventing probable security breaches (2.57 ± 0.961) were major challenges for EHRs to enhance health care outcomes. However, poor computer language and skills (2.38 ± 0.936) and computers consuming more time than paper-based systems (2.37 ± 1.002) are least among these challenges.

Challenges in the implementation of EHRs were identified as facilitating structured communication among health professionals and preventing probable security breaches. In terms of the first one, facilitating structured communication among health care professionals, the results provided a rather unclear perspective on whether or not EHRs can help in the effective coordination of care, as revealed in the findings in terms of supporting team-based care (Table 1), since EHRs still pose a challenge in facilitating communication among health practitioners. This result further affirmed the findings of the study by Vos *et al.*, (2020), that EHR will both facilitate and constrain collaboration among specialties and disciplines. It likewise implies that although EHRs are effective in providing organized information and immediate data sharing, they are still considered challenging in some aspects of health care. Quinn *et al.*, (2019) proposed that existing communication technologies and EHR-based data sharing processes were perceived as barriers to diagnosis. In particular, reliance on communication technologies such as paging systems and a lack of face-to-face communication among clinicians created obstacles to sustained thinking and discussion of diagnostic decision-making. On the other hand, the second challenge, preventing probable security breaches, suggests that health practitioners feel unsecured when using EHRs. El Mahalli (2015), Gesulga *et al.*, (2017), and Al Otaybi *et al.*, (2022) appealed that data security and privacy are predominant barriers to EHRs use. The results further imply that the participants placed high regard on securing information and ensuring privacy and confidentiality among their patients. According to Almaghrabi and Bugis (2022) confidentiality and privacy are critical components of a reliable EHR system. EHR confidentiality has a

significant impact on maintaining patient safety and security, thus enhancing patient care in Saudi Arabia. But, Ajami and Bagheri-Tadi (2013), argued that providers have concerns that EHRs generates new issues on patient's privacy and confidentiality and that it was a reason that hamper their desire to use EHRs.

Identified as least challenging in EHRs implementation were poor computer language and skills, and computers consuming more time than paper-based systems. The majority of the participants are young EHRs users aged 26–30 years old (Figure 1). Computer literacy are among the discernable skills of this age group. In addition, the current health care system requires health care providers to not only be technically skilled in their field but computer literate as well. Shaker and Farooq (2013), Alasmay *et al.*, (2014), and Ramukumba and El Amouri (2017) found similar findings. These studies emphasized the high level of self-reported digital literacy among health practitioners. In addition, Ngusie *et al.*, (2022) noted that younger-aged groups were more ready for such technology. In contrast, findings from the studies of Abramson *et al.*, (2012), Habibi-Koolaei *et al.*, (2015), Ahmed *et al.*, (2022), and Alharbi (2023) suggested that training programs are still necessary to improve computer skills and digital health literacy among health practitioners. In regards to computers consuming more time than paper-based systems, this means that health practitioners would spend less work time if computers were used. This supports the result in terms of workload (Table 1) that EHRs were effective in ensuring clinical process efficiency, as more time is saved and extra time can be given to other tasks. Mkalira Msiska *et al.*, (2017) posited that health workers still found EMRs to be quicker, more secure, and more accurate in aiding patient management compared to paper-based records. Electronic record-keeping enabled clinicians to consult with more patients within a short period of time compared to paper records. EMRs also reduced healthcare staff workload, as less time was spent retrieving paper records. Hence, the quality of nursing documentation in the electronic system was significantly better than that of paper-based documentation systems (Mohammadi Firouzeh *et al.*, 2017).

Table 3: Difference of Responses on the Effectiveness of the Electronic Health Records to Health Care Outcomes when grouped according to Profile

Age	λ^2_c	*p-value	Interpretation
Quality of Patient care	33.816	0.000	Highly Significant
Patient Engagement	21.394	0.006	Significant
Support Team-Based Care	12.703	0.122	Not Significant
Workload	27.012	0.001	Highly Significant
Data Liquidity	33.07	0.000	Highly Significant
Place of Work			
Quality of Patient care	4.616	0.329	Not Significant
Patient Engagement	8.33	0.080	Not Significant
Support Team-Based Care	18.552	0.001	Highly Significant
Workload	7.374	0.117	Not Significant
Data Liquidity	6.561	0.161	Not Significant
Department			
Quality of Patient care	1.891	0.389	Not Significant
Patient Engagement	0.654	0.721	Not Significant
Support Team-Based Care	4.477	0.107	Not Significant
Workload	0.532	0.767	Not Significant
Data Liquidity	0.257	0.879	Not Significant
Years of Experience in Using Electronic Health Record (EHR)			
Quality of Patient care	9.986	0.076	Not Significant
Patient Engagement	8.28	0.141	Not Significant
Support Team-Based Care	10.084	0.073	Not Significant
Workload	11.304	0.046	Significant
Data Liquidity	12.385	0.030	Significant

*Significant at p -value < 0.05

Table 3 compares responses on the effectiveness of EHRs to health care outcomes when grouped according to profile. It was observed that there was a significant difference when groups were formed according to age, except for support team-based care ($p = 0.122$). This was noticed since the obtained p -values, data liquidity ($p = 0.000$); quality of patient care ($p = 0.000$); workload ($p = 0.001$); patient engagement ($p = 0.006$), were less than the alpha level, thus the responses differ statistically. According to the results of the post-hoc test, those aged 46 to 50 rated the EHRs as more effective. Also, in terms of years of experience in using EHRs, there was a significant difference in workload ($p = 0.046$) and data liquidity ($p = 0.030$) since the computed p -values were less than the alpha level. The results reveal that the responses vary significantly, as was observed for those who have had 1 to 3 experiences using EHRs. As to the place of work, there was a significant difference in support team-based care because the resulting p -value of 0.001 was less than the alpha level. This significant difference was observed for those whose place of work was in the southern region. Lastly, among all profile variables, the department of the participants was not significant for all five categories of the EHRs based on the p -value scores greater than 0.05 level of significance ($p = 0.389, 0.721, 0.107, 0.767, 0.879$).

It was observed that there was a significant difference between the effectiveness of EHRs and when health practitioners were grouped according to age,

except for support team-based care. This infers that health practitioners across age groups hold the same views about how effective EHRs are in improving health care outcomes. Their approaches to utilizing and implementing EHRs in meeting the needs of patients or performing their jobs produce the same result. Young professionals may tend to provide care effectively through EHRs by complementing it with their diverse ability in the use of digital technology, while senior professionals may tend to use EHRs coupled with their extensive experience. These findings were similarly highlighted by Bae and Encinosa (2016) and Razmak *et al.*, (2021). The results further revealed that those aged 46 to 50 rated the EHRs as more effective. This age group, are mostly the ones with the desire to maintain their current work but also more open to adopt to changes, so they can be the most flexible group to accept the implementation of EHRs in their practice. Dall (2014) suggested that improved perceptions of the benefits of technology is significantly and positively correlated with nurses' personal skill rating. Also, younger nurses less than 35 years old were more likely to highlight the pitfalls of technology than their older counterparts.

In addition, significant difference in workload and data liquidity were observed with the findings. The results revealed that the responses vary significantly for those with 1 to 3 years of experiences in using EHRs. Health practitioners with lesser experience may require more time to implement the EHRs than those who have

routinely used the system for years. Kaihlanen *et al.*, (2020) posited that nurses in their first year of practice takes up considerable amount of working time in the use of EHRs. Also, Frogner *et al.*, (2017) found out that nurses and medical staff with fewer years of EHRs experience showed lower productivity versus more years of experience. Moreover, Jamoom et al. (2016) proved that physicians with longer experience with EHRs improves perceptions about EHRs use. Additionally, with lesser experience in EHRs use, health practitioners may tend to question the reliability of the system in ensuring effective health care outcomes particularly in preventing security breaches as previously discussed in the challenges.

On the other hand, the participants' department was not significant for all five categories of EHRs. Based on the findings, the department to which the participants belong was not a factor in determining the

level of effectiveness of EHRs. This implies that no particular health department or area of discipline is exempt from EHR implementation. Doctors, nurses or paramedical who uses the EHRs have similar perceptions towards its effectiveness to health care outcomes. Veenstra *et al.*, (2022) affirmed that health care professionals' perceptions of their work characteristics were changed after EHR implementation, and that these experiences were relatively similar for physicians, nurses and allied healthcare professional. But Kaipio *et al.*, (2020) posed contradiction to this finding as their study presented notable difference between nurses and physicians' experiences on usability of EHRs. Likewise, Upadhyay and Hu (2022) found that clinicians' have ambivalent assessments towards EHRs. Nurses were positive in improving efficiency with EHRs while others regarded EHRs as time consuming.

Table 4: Difference of Responses on the Challenges in the Implementation of the EHRs when grouped according to Profile

Items	χ^2_c	*p-value	Interpretation
Age	14.391	0.072	Not Significant
Place of Work	20.939	0.000	Highly Significant
Department	4.908	0.086	Not Significant
Years of Experience in Using Electronic Health Record (EHR)	11.578	0.041	Not Significant

*Significant at p-value < 0.05

Table 4 shows that there was a significant difference when grouped according to the place of work. This means that the challenges encountered differ significantly since the resulting p-value of 0.000 is less than the alpha level. According to the pairwise comparison, those in the southern region encountered more problems with EHRs implementation.

The effectiveness of EHRs in terms of supporting team-based care was observed to have a significant difference for those participants whose place of work is in the southern region. Health care is diverse and may vary greatly depending on the demographics of the patient population as well as its geographical implementation. The findings of this study confirmed that any program or system, such as EHRs, may be

affected by multiple factors, such as the place where it was implemented and the health care professionals who used it. This is particularly true in Saudi Arabia, as health care disparity is experienced between the rural and urban areas in relation to trained health care personnel and hospital infrastructures to usher the adoption of EHRs. This makes rural places such as the southern regions as critical challenges in the implementation of EHRs (Khoujah, 2015). To add more, results in Table 4 strongly supported these findings, as the same results claimed that those in the southern region encountered more problems with EHRs implementation. However, this study is limited to prove such implications since the number of study participants in the southern region is noticeably low (Figure 1) compared to other regions.

Table 5: Relationship between the Effectiveness of the EHRs to Health Care Outcomes and the Challenges in the Implementation of the EHRs

Items	Rho	*p-value	Interpretation
Quality of Patient care	0.008	0.883	Not Significant
Patient Engagement	0.034	0.545	Not Significant
Support Team-Based Care	.930**	0.000	Highly Significant
Workload	0.046	0.412	Not Significant
Data Liquidity	0.06	0.284	Not Significant

*Significant at p-value < 0.05

Table 5 displays the relationship between the effectiveness of the EHRs to health care outcomes and the challenges experienced in the implementation of EHRs. The results depicts that there was a very strong

direct correlation between support team-based care and the challenges in its implementation. This means that there is a significant relationship since the p-value of 0.000 is less than the alpha level. In this case, the more

effective the use of EHRs as to support team-based care, the more problems are encountered with its implementation.

The results depicted that there was a very strong direct correlation between support team-based care and the challenges in EHRs implementation. This implies that more effective the use of EHRs as to support team-based care, the more problems are encountered with its implementation. As previously mentioned, Vos *et al.*, (2020) affirmed that EHRs both facilitate and constrain collaboration among specialties and disciplines. To cite more, Asan *et al.*, (2018) elaborated that EHRs do not adequately support teamwork of oncology providers which could lead to potential hazards in the care of the patients with cancer. The same inference was attested by Quinn *et al.*, (2019), as EHRs created data overload and data fragmentation, making integration for diagnosis difficult, and as advances in health information technology evolve, challenges in the way clinicians share information during diagnostic process will rise.

With the results and discussions forwarded, the limitations of this study were the smaller number of health practitioners who participated in the medical department and in the southern regions of Saudi Arabia. Further investigations to explore the use of EHRs by physicians and determine the extent of EHRs effectiveness to health care outcomes in rural areas are recommended to have a solid generalization of the study's findings.

CONCLUSION

Electronic Health Records (EHRs) are moderately effective in enhancing health care outcomes. It can moderately improve health care respectively through data liquidity, support team-based care, quality of patient care, patient engagement, and workload. EHRs support health practitioners to enhance data retrieval and access, help coordinate patient care, improve patient safety and medication errors, increase compliance with medications and treatments, and promote clinical process efficiency. With EHRs implementation, health practitioners are challenged with facilitating structured communication and preventing probable security breaches. Contributing to effectiveness of EHRs implementation are the computer literacy of health practitioners and the reduced time spend on computers compared to paper-based systems. Age, place of work, and years of experience with the use of EHRs are critical indicators of effectiveness. Older health practitioners with less experience in EHR use and who work in rural areas have the most impact on EHR effectiveness. However, health practitioners' discipline is not a factor in determining the effectiveness of EHRs use. Health practitioners who apply EHRs to improve health care outcomes particularly to support team-based care, face more challenges in their implementation.

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