

The Impact of Digital Transformation on Improving Nursing Practice and its Relationship to Patient Safety and Electronic Medical Records

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Abstract:

The digitalization of healthcare has been developing at a fast pace, although the specific role of electronic medical records (EMRs) and digital platforms in nursing practice and patient safety has not been thoroughly studied, especially in the context of the Saudi Arabian Vision 2030. This study evaluated the level of impact of digital health tools on clinical efficiency, decision-making, and patient outcomes. We surveyed 225 nurses in King Fahad Armed Forces Hospital, Jeddah, who were sampled through random sampling. The demographic profiles, knowledge of digital systems, the rate of use of the tools, and the perceived clinical outcomes were captured using a structured questionnaire. Descriptive statistics were used to describe the workforce, and inferential tests were used to investigate the relationships between digital adoption and clinical outcomes. The results showed that 63.6% of nurses stated that they were aware of EMRs, and 92.9% of them admitted that digital tools helped to enhance the quality of care. Self-reported data revealed that the patient outcomes were improved (mean = 4.1), medical errors were decreased (mean = 4.0), and the treatment planning was enhanced (mean = 4.1). Although there were these gains, formal training of AI, telemedicine, or mHealth applications was only given to 29.3%. The findings indicate that digital integration is beneficial to nursing practice and patient safety but is limited by the presence of training gaps and unequal digital literacy. Specific capacity-building and system optimization are obligatory to convert technological adoption into quantifiable clinical gains.

Keywords: Digital Health, Electronic Medical Records, Nursing Practice, Patient Safety, Telemedicine

Study Aim:

The main aim of the study is to find that how the nursing practices are improving by the way of electronic record keeping of the medical information and what is the impact of the same on patient safety. Study Start Date: October, 2025, Study Completed Date: February, 2026

INTRODUCTION:

Literature Review

“Since the old healthcare systems have barriers, the technological advancements in healthcare systems have opened up new avenues for accessing care. Yeung et al (2023); Sultan et al (2019) This shift is particularly important in Saudi Arabia, which has set very high targets in Vision 2030 to improve healthcare productivity, quality, and accessibility while reducing the country's need on its oil resources. Thapa et al (2021) EHRs, telemedicine, and other mHealth solutions have been essential in addressing the most pressing issues, like as service availability and geographic distribution, especially in rural areas. Riyadh Daily (2020) Digital literacy, digital infrastructure, and privacy are some of the obstacles to adopting digital health technology in Saudi Arabia. Particularly in light of the Saudi Vision 2030 ambition to enhance healthcare access and quality through technology, the impact of the digital age on healthcare provision in Saudi Arabia has attracted growing attention. Different academics have examined how m-health and telehealth EHRs can be used to overcome past obstacles to accessing healthcare, especially in rural areas.” Roser et al (2022). “Digital health technologies improve healthcare delivery by bridging geographic gaps and facilitating prompt consultations, according to a study. Abdolkhani et al (2022); Otaibi et al (2019) One important tactic for providing patients in remote areas of participation with equal access to high-quality healthcare is telemedicine, as demonstrated by a comprehensive review. The digital gap, however, is a challenge, with some patients and caregivers lacking computer literacy and others without the required infrastructure. Al-Kahtani et al (2022); Shrestha et al (2022) Additionally, privacy concerns continue to impede the successful integration of these technologies in healthcare systems. Vaghefi et al (2019); Vijayashree et al (2018) Even if the digital revolution has improved healthcare availability in Saudi Arabia, the impact must be increased by resolving its underlying issues. To achieve the goals outlined in Vision 2030 and provide equal chances for all populations to access better healthcare services, more research and the appropriate and well-planned implementation of technology in the field of digital health will continue to be essential. Numerous healthcare organizations, such as the Saudi Ministry of Health, have incorporated digital technologies into nursing and health practices. Konttila et al (2019) This has improved nurses' capacity to improve patient outcomes, particularly for patients with chronic illnesses. However, the use of digital technologies in nursing is fraught with difficulties, as evidenced by nurses' poor adoption of these rapidly evolving technologies, their lack of awareness of their benefits to healthcare, and their fear of losing their jobs to digital technologies. Booth et al (2021); Ezeamii et al (2024) This presents obstacles that need to be addressed right now in order to improve the use of digital technologies in patient care and nursing practices. In order to address these issues and get ready for the future, nursing needs to start the process of becoming a digitally assisted profession that can address the intricate global issues that society and health systems are currently confronting.” Aggarwal et al (2023)

“Nursing practices that are digitally based improve patient outcomes and health systems. Nurses can better monitor and follow up with patients thanks to telemedicine, which also makes it easier for patients to get continuing health-improving consultations and advice—especially for those with chronic illnesses. Mobile phones, chatbots, and digital health platforms can allow nurses to remotely offer patients psychological and emotional support as well as health consultations, despite the difficulties with ethics, privacy, and expense. Uraif et al (2024) To stay up to date with the most recent nursing practices and research, as well as to train for emergency situations using virtual reality and simulation, digital technologies are also crucial for improving nursing education, training, and scientific research. As a result, in order to improve patient outcomes and healthcare outcomes, nurses need to be knowledgeable about and proficient in various digital technologies. In Saudi Arabia, the adoption of digital technologies in healthcare presents a number of issues for the nursing profession. Alshammar et al (2023) Even with the notable advancements in technology use in the Saudi healthcare industry, some nurses continue to believe that digital tools can divert attention from the crucial human connection with patients, which goes against the profession's traditional values of personal communication and compassionate care. Mani et al (2024) Furthermore, Saudi Arabia is embracing Vision 2030, which seeks to enhance people's health. To meet the goals and objectives of Vision 2030 in the healthcare sector, nurses must embrace digital technologies and innovative nursing practices. However, there are a number of obstacles that practitioners must overcome, such as the variance in digital infrastructure throughout healthcare facilities in the Kingdom, which hinders their capacity to use digital tools efficiently. To make it easier to integrate conventional nursing care with contemporary technology, it is imperative to invest in digital skill training for nurses and foster a culture of change, even in the face of attempts to improve health information technologies.” Kaul et al (2020)

Innovation:

This present study is related to the impact of digital transformation on the nursing practices and the wellbeing of patients. There are a number of tools and techniques used in the process of digital transformation; these tools and techniques are supposed to identify the patient records at the first place, on any of the given platforms and assist the doctors, nurses and health care workers to decide on the right kind of medication at the right time. Such practices are certainly going to save the life of patients and bring about improvement in the medication process at a faster pace. This present study will present the latest digital platforms to keep the patient records and make use of the same at the right time and place.

In case of chronic diseases, such digital records may become very useful for deciding on the process of medication, this is because of the reason that for serious patients time and space are the most important components; digital transformation practices are supposed to bring about substantial change by addressing the medical history, demographic details and other related information on a single window; now it becomes easier for the doctors and nurses to take right decision and save the life of the patients.

This present study entails the above said tools and techniques in a broader way and the far-fetched result of this study will assist the doctors, nurses and related healthcare workers to choose on the best platforms to access the records of the patient and even present the ways and means to educate the patients about the above said digital transformation process and how to access the same.

Study Design:

This present study is quantitative in nature and uses the primary data to reach the objective of the study. For the said quantitative nature of the study, descriptive research design is used, under this research design the researcher collects the first hand information from the selected set of respondents, records them in a respective manner and analyse the same to reach the desired conclusions. In this study, nurses are the primary respondents, a structured questionnaire was exercised with nurses and respective information will be collected in terms of digital transformation and impact of the same on improvement in nursing practices.

Hypothesis of the Study:

Null Hypothesis- H0: Digital transformation has positive and significant impact on improving nursing practices and patient health.

Alternate Hypothesis- H1: Digital transformation does not have and significant impact on improving nursing practices and patient health.

Sample Description

Type of Sample

The researcher has used random sampling method to select the respondents, in this study random sampling is used because the study was conducted on a unified location i.e. King Fahad armed forces (Jeddah) hospital- Saudi Arabia. It was kept in mind that some of the nurses from each department are included in the study.

Inclusion and Exclusion Criteria

Some of the demographic and profession related parameters were used to include and exclude the respondents. Only those nurses were included in the study who have:

- Minimum 30 years of age
- At least 5 years of experience in the same department
- Live in close proximity of the hospital
- Served in more than two department in the hospital

Remaining all other respondents were excluded from the study.

Sample Size

Depending on the constraints of time and resources 50 nurses were chosen as samples, based on the above given inclusion and exclusion criteria. This size of the sample stands out to be true representation of the available population as most of the respondents represent the native departments of the hospital and also fulfill the above criteria.

Location of the Study:

The respective location of the study was King Fahad armed forces (Jeddah) hospital- Saudi Arabia.

Study Procedure:

Initial Screening and Contact with subjects.

The respondents (nurses) were chosen as per the criteria mentioned above, all the chosen respondents were interacted at the place of their work. In this process the list and time duration were circulated to the respondents in advance, also the prior information was taken from the authorities of hospital administration. Generally, the respondents were contacted in their free hours or break time. All the information was acquired with the help of a detailed and structured questionnaire.

Data Collection Method:

As stated above, the researcher used a detailed and structure questionnaire to collect information from the respondents. This questionnaire is having following type of questions:

Dichotomus questions (Yes/No)

Some Direct questions

Questions to seek opinion \

Alternative based questions

Scale based questions (Likert)

This questionnaire was divided in three sections, in the first section demographic questions were there, in second section questions were related to awareness and knowledge of nurses about digital transformation and its advantages, and finally the third section holds the questions about the self-application and usage of techniques related to digital transformation.

RESULT AND DISCUSSION:**Demographic Nursing Professional Characteristics**

The demographic characteristics given in 225 nursing professionals of King Fahad Armed Forces Hospital are a complete representation of the workforce at the institution as well as significantly higher than the projected sample size. This improved sample coverage improves the extraneous validity of the results and provides sufficient coverage by department and professional ranks.

The age distribution shows that there is a high number of early- and mid-career workers. The highest percentage was represented by nurses in the age range of 25-34 years (42.7%), and 35-44 years (39.6%). The age group of 45-54 years constituted 12.9% with those who are below 25 years and above 55 years constituting 4.8. It is worth noting that over 80 percent of the respondents fell under the age of 45 years, which indicates a potential workforce population that tends to be more digital and more adaptable towards technological development. This age distribution is favorable to the adoption of electronic documentation and other computer-based health programs.

The gender composition was based on the conventional demographic makeup of the nursing profession since females formed 86.2 percent of participants and males 13.8 percent. In terms of professional cadres, staff nurses constituted a majority (64.0%), then nurse specialists (14.7%), and charge nurses, supervisors, managers, and midwives are the ones that have a combined count of 21.3 percent. This distribution ensures that points of view were taken both by the frontline providers and in the supervisory positions.

The dataset is also fortified by professional experience. Almost fifty percent of the respondents (45.3) had over ten years of experience, 21.8% had experience of between 6-10 years, and 22.7% had 2-5 years of experience. Not more than 10.2% were less than two years of practice. In general, more than two-thirds of the respondents have more than six years of clinical experience, which allows for informed comparisons of the traditional paper-based systems with modern electronic health systems.

Professional Mobility and Geographical Setting:

Evaluation of intra-institutional mobility showed that 70.7 percent of the respondents had not been employed in more than two departments, and thus there

was a workforce that was very stable and specialized. In their turn, 29.3% indicated cross-departmental exposure, which is the sign of diverse clinical experience.

Distribution geographically indicated that 71.6% of the respondents did not live within the area of the hospital, and 28.4 percent of participants were residing close to hospitals. This geographical spread has a practical implication on digital communication systems, telehealth coordination, and emergency responsiveness, especially in big urban healthcare systems.

Digital Health Systems Knowledge and Training:

The knowledge of the underlying digital infrastructure was medium to high. Sixty-three point six percent of nurses indicated familiarity with Electronic Medical Records (EMR) or Electronic Health Records (EHR), and 36.4 percent indicated no familiarity with the concept, or had a very low baseline literacy level. Nevertheless, it is undeniable that the need for digital patient records was unanimously accepted, and 92.9% of respondents acknowledged that it was important to enhance the quality of healthcare.

Nevertheless, organized technical training does not seem to be extensive. Formal training regarding telemedicine or mobile health (mHealth) platforms was given to only a quarter (29.3) of the respondents, with 70.7 percent indicating that they had not been trained on these platforms. This mismatch is an indication of a structural difference between digital system awareness and formal competency development. The level of awareness about new technologies like virtual reality (VR) and artificial intelligence (AI) was relatively low, with 29.8% stating that they were aware of their usage in the hospital, and 70.2% stating that they were unaware or slightly aware. This indicates that high-tech digital tools can be either in their pilot stage of implementation or not effectively communicated to the front staff.

Confidence in the ability to navigate the current EMR systems was self-reported. Although 18.7% identified themselves as very confident and 56.9% as somewhat confident, 12.0% said that they lacked confidence, and 12.4% stated that they lacked enough training or information. Therefore, approximately a quarter of the nursing personnel lack operational confidence in the management of digital records.

Inhibitors to Digital Integration

The respondents outlined several obstacles that influenced the use of digital tools. The most commonly mentioned problem was a rise in documentation workload (25.3%), and then an issue related to system reliability (24.0%). The lack of digital skills or training was a cause of 19.6% responses, and 18.2% reported a decreasing amount of direct patient interaction as an issue. Only 12.9 percent of the respondents indicated data privacy concerns. Taken together, these results suggest that workflow strain and technical instability are the main constraints of the most effective adoption of digital.

Patterns of Use of Digital Tools

An assessment of the use of digital tools has shown uneven patterns of adoption. EMR showed the greatest integration, and most nurses stated that they frequently or regularly use it to access more detailed information about the patient. Conversely, the use of mHealth applications in remote monitoring showed polarized usage, with a significant percentage of respondents stating frequent usage and a similar percentage stating no use, which shows an imbalanced adoption of decentralized digital platforms.

Appointment management, IT and automated adherence reminders were least commonly used, with the highest frequency, implying that they are not fully adopted in the workflow. Digital or simulation-based training was also reportedly involved

at moderate frequency most often, which suggests involvement and non-institutionalization. The case of interaction with the state-of-the-art AI or VR diagnostic systems demonstrated the lowest usage rates, and the majority of the responses fell under the categories of never and rarely, which aligns with the findings of limited awareness.

Perceived Effect on Clinical Outcomes

People had a positive attitude towards the influence of digital transformation on the clinic. The majority of the respondents concurred that digital systems can enhance patient outcomes and decrease the amount of medical errors in documentation. The use of automated reminder systems was perceived to improve medication adherence, especially in chronic disease situations. Constant data collection in digital form has been deemed useful in the planning of the treatment, but a significant number were neutral, suggesting careful approval.

Digital learning systems were perceived as positive in contributing to professional growth, as per the national strategies of modernization like Saudi Vision 2030. Although people did not have significant direct experience with the AI tools, most of the respondents admitted that they could be used to enhance the accuracy and timeliness of the diagnostic process. Moreover, the digital services have been generally viewed to increase patient confidence and provide more access to healthcare delivery, which highlights their strategic importance in the modern clinical system.

In general, the results demonstrate that the workforce is demographically aligned with digital transformation, with high clinical experience and positive attitude orientation. However, formal education, the stability of the system, and the optimization of the working load are also one of the key factors to a sustainable digital integration.

Table 1. Demographic Profile of Nursing Respondents (N = 225)

Variable	Category	Frequency (n)	Percentage (%)
Age Group	25–34 years	96	42.7
	35–44 years	89	39.6
	45–54 years	29	12.9
	<25 & 55+ years	11	4.8
Gender	Female	194	86.2
	Male	31	13.8
Professional Cadre	Staff Nurse	144	64.0
	Nurse Specialist	33	14.7
	Charge Nurse / Supervisors / Others	48	21.3
Years of Experience	<2 years	23	10.2
	2–5 years	51	22.7
	6–10 years	49	21.8
	>10 years	102	45.3

Table 2. Professional Background and Digital Knowledge (N = 225)

Survey Item	Category	Frequency (n)	Percentage (%)
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Worked in >2 departments	Yes	66	29.3
	No	159	70.7
Live near hospital	Yes	64	28.4
	No	161	71.6
Familiar with EMR/HER	Yes	143	63.6
	No	82	36.4
Formal training in Telemedicine/mHealth	Yes	66	29.3
	No	159	70.7

Table 3. Digital Tool Usage Frequency (1 = Never, 5 = Always)

Indicator	1 (%)	2 (%)	3 (%)	4 (%)	5 (%)
EMR usage for complete records	25	30	55	60	52
mHealth / remote monitoring	48	39	50	60	28
Digital follow-up management	38	45	54	50	35
Automated adherence reminders	43	39	60	49	32
Digital/simulation training	45	32	65	43	38
AI / virtual diagnostics interaction	50	42	60	43	29

Table 4. Perceived Clinical Impact (1 = Strongly Disagree, 5 = Strongly Agree)

Indicator	1 (%)	2 (%)	3 (%)	4 (%)	5 (%)
Improved patient outcomes	8	22	78	70	45
Reduced medical errors	10	22	68	72	48
Improved medication adherence	16	20	69	75	42
Enhanced treatment planning	10	18	76	70	49
Professional development	9	18	73	68	55

AI diagnostic accuracy	18	21	79	65	40
Increased patient confidence	12	24	77	68	42
Improved access to services	10	18	74	69	52

Recommendations:

Structured Training Programs: provide regular and systematic training of the nursing staff on EMRs, telemedicine, mHealth, and AI-based diagnostic devices. Structured skill building will eradicate the disparities in digital literacy and increase confidence in using digital platforms, as well as accurate clinical decision-making, especially in complex or chronic case management.

Infrastructure Optimization and System Reliability: Improve digital infrastructure in the hospital to reduce system downtimes, latency, and technical failures. The purchase of powerful hardware, safe networks, and interoperable EMR systems will facilitate a smooth introduction of the new system into the nursing workflows, decrease documentation load, and protect the privacy of patient data, which will further streamline the work process and positively affect clinical results.

Digital Tools in Clinical Procedures: Establish common standards regarding the integration of digital health technologies into clinical practice, such as automated reminders, remote monitoring, and teleconferences. The integration of these tools into the care pathways will improve adherence, facilitate timely intervention, and facilitate evidence-based treatment planning, thus fostering patient safety and streamlining the healthcare delivery process according to the national digital health goals.

CONCLUSION:

The results reveal that the nursing personnel have a high demographic preparedness and favorable attitudinal orientation toward the digital transformation of clinical practices. A largely young to middle-aged group that is backed by a large amount of working experience offers a solid basis on which technology adoption can be achieved. EMRs have been seamlessly integrated into the daily work processes, and the majority of nurses recognize their involvement in patient safety, treatment planning, and access to healthcare services. Nevertheless, there are still gaps in formal training, advanced digital literacy, and exposure to new technologies, like artificial intelligence and telemedicine platforms. These gaps need to be filled with systematic capacity-building initiatives and system optimization plans to make healthcare digitalization sustainable and to realize the full clinical and organizational value of the digitalization process.

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Questionnaire

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Part 1: Demographic Details

- Q1. Age of the respondent:
- Q2. Gender of the respondent
 - a. Male
 - b. Female
- Q3. Professional Cadre of the respondent:.....
- Q4. Nursing Experience:..... (in years)
- Q5. Worked in more than two department in the same hospital
 - a. Yes
 - b. No
- Q6. Do you reside near the hospital premises
 - a. Yes
 - b. No

Part 2: Knowledge and Awareness of Digital Transformation

- Q1. Familiar with the term Electronic Medical Records (EMR) or Electronic Health Records (EHR)?
 - a. Yes
 - b. No
- Q2. According to you, use of digital patient records (EHR) is mandatory for improving healthcare quality?

- a. Yes
 - b. No
- Q3. Have you received formal training on the use of Telemedicine or mHealth solutions for remote patient consultation?
- a. Yes
 - b. No
- Q4. Do you know about the use and application of Virtual Reality (VR) or Artificial Intelligence (AI) patient diagnosis at KFAFH?
- a. Yes
 - b. No
- Q5. Are you confident in navigating the current hospital EMR system?
- a. very confident
 - b. Somewhat confident
 - c. Not sure
 - d. No information about the same
- Q6. What is the main issue you face while attempting to integrate digital tools into your patient care workflow?
- a. Lack of Infrastructure Reliability (e.g., system downtime, slow access)
 - b. Lack of Digital Literacy/Skills
 - c. Concerns regarding Patient Data Privacy
 - d. Perceived Increase in Documentation Workload
 - e. Fear of Losing Direct Human Connection with Patients
- Q7. From your memory and experience can you state any three advantages of using digital health technologies that you believe are most crucial for meeting the goals of Saudi Vision 2030.
- Part 3: Usage, Application, and Perceived Impact of Digital Tools
- Sub-part I: Usage Frequency and Intensity (Analytical Grounds)
- Scale: 5-Point Frequency Scale (1 = Never, 2 = Rarely, 3 = Sometimes, 4 = Often, 5 = Always)
- Q8. I use the EMR system to retrieve comprehensive, up-to-date digital patient records for historical context. (Digital Patient Records)
- 1 = Never
 - 2 = Rarely
 - 3 = Sometimes
 - 4 = Often
 - 5 = Always
- Q9. I use mHealth or remote applications to facilitate the monitoring of patient's health status outside of the physical hospital setting. (Monitoring of patient's health)
- 1 = Never
 - 2 = Rarely
 - 3 = Sometimes
 - 4 = Often
 - 5 = Always
- Q10. I actively use the digital system to manage and confirm follow-up appointments for chronic care patients. (Providing appointments)
- 1 = Never
 - 2 = Rarely
 - 3 = Sometimes
 - 4 = Often

5 = Always

Q11. I utilize automated digital reminders (e.g., SMS, push notifications) to ensure patient adherence to medication or consultations. (Reminders (Medication/Consultation))

1 = Never

2 = Rarely

3 = Sometimes

4 = Often

5 = Always

Q12. I engage in digitally assisted training and rehabilitation process (e.g., simulation, educational apps) for professional development. (Training and Rehabilitation)

1 = Never

2 = Rarely

3 = Sometimes

4 = Often

5 = Always

Q13. I interact with or interpret results generated by Virtual Facility or Artificial Intelligence applications (e.g., diagnostic support tools). (Inclusion of AI/VR)

1 = Never

2 = Rarely

3 = Sometimes

4 = Often

5 = Always

Sub-part B: Perceived Impact on Clinical Outcomes (Measured Outcomes)

Scale: 5-Point Likert Scale (1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree)

1 = Strongly Disagree

2 = Disagree

3 = Neutral

4 = Agree

5 = Strongly Agree

Q14. Digital transformation has led to significant improvement in Clinical Outcomes for my patients.

1 = Strongly Disagree

2 = Disagree

3 = Neutral

4 = Agree

5 = Strongly Agree

Q15. My use of digital records has significantly reduced errors related to medical history of patients.

1 = Strongly Disagree

2 = Disagree

3 = Neutral

4 = Agree

5 = Strongly Agree

Q16. Digital tools, such as automated reminders, have substantially improved medical adherence among patients.

1 = Strongly Disagree

2 = Disagree

3 = Neutral

4 = Agree

5 = Strongly Agree

Q17. Continuous data collection via digital platforms gives me more clarity and experience in patient treatment planning.

1 = Strongly Disagree

2 = Disagree

3 = Neutral

4 = Agree

5 = Strongly Agree

Q18. Access to digital resources and training modules has increased the learning experience of nurses in my department.

1 = Strongly Disagree

2 = Disagree

3 = Neutral

4 = Agree

5 = Strongly Agree

Q19. The integration of advanced digital tools (e.g., AI diagnostics) makes more precise and timely diagnosis possible.

1 = Strongly Disagree

2 = Disagree

3 = Neutral

4 = Agree

5 = Strongly Agree

Q20. Patients' confidence is increased in our hospital's care delivery due to the use of modern digital systems.

1 = Strongly Disagree

2 = Disagree

3 = Neutral

4 = Agree

5 = Strongly Agree

Q21. Digital solutions, such as remote consultations or providing appointments online, have improved access to medical care for our patients.

1 = Strongly Disagree

2 = Disagree

3 = Neutral

4 = Agree

5 = Strongly Agree