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Leveraging Digitalization in Healthcare Systems: It's Impact on Quality of Care

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ABSTRACT

Introduction: The rapid transformation of healthcare systems worldwide through digitalization presents unparalleled opportunities to advance patient care, increase operational efficiency, and foster innovation in patient care.

Methods: This study analysed the impact of digitalization on quality on care in a private multi-speciality hospital. Methodology adopted in the study was descriptive study and stratified random sampling technique is used for data collection.The study analysed the relationship between demographic factors (age, marital status, gender, and experience) and their effects on digitalization and quality of care. Statistic tools like correlation, regression was used to test the hypothesis.

Results: It was observed from correlation that the factors of digitalization and quality of care has strong and positive correlation. The regression analysis found that integrating data through digitalization factors significantly ($p < 0.01$) improved quality of care, even when controlling for other variables.

Conclusion: The research underscores the significant role of digitalization in improving the quality of patient care within a private multi-specialty hospital. The strong correlation and regression analysis results demonstrate that the integration of digital technologies can positively impact various aspects of healthcare delivery. By leveraging digital tools and data-driven insights, healthcare providers can optimize processes, enhance patient experiences, and ultimately improve overall patient outcomes. The study's findings highlight the potential benefits of embracing digitalization as a key driver for quality improvement in healthcare settings.

Keywords: Digitalization, quality of care, integration, innovation, patient care

INTRODUCTION

The integration of digital technologies within healthcare systems has significantly transformed patient care delivery, offering new opportunities to improve efficiency, quality, and accessibility. The adoption of digital tools, such as electronic health records (EHRs), telemedicine platforms, and artificial intelligence (AI) applications, has revolutionized traditional healthcare practices and holds immense potential for enhancing patient outcomes (Adler-Milstein et al., 2017). Research conducted by Black et al. (2016) has demonstrated a strong correlation between digitalization and increased efficiency in healthcare delivery, leading to reduced wait times and improved access to care. By leveraging digital technologies, healthcare providers can streamline workflows, enhance care coordination, and empower patients to become active participants in their healthcare journey (Adler-Milstein et al., 2017; Black et al., 2016).

The rapid integration of digital technologies within healthcare systems is driving significant changes across the globe (Lior et al., 2023). This study aims to explore the impact of such rapid transformations, particularly the embrace of digitalization, on the services delivered by healthcare organizations. By understanding healthcare professionals' perceptions and experiences, the study seeks to analyse the challenges and obstacles they face as they navigate this organizational transformation.

Digitalization enables healthcare providers to access comprehensive and up-to-date patient information promptly, leading to more accurate diagnoses and personalized treatment plans. This contributes to improved patient outcomes and satisfaction (Adler-Milstein et al., 2017). Digitalization facilitates seamless communication and data sharing among healthcare providers across different specialties and settings. This

enhances care coordination, reduces errors, and ensures continuity of care, particularly for patients with complex health needs (Buntin et al., 2011).Patient portals and mobile health applications are digital resources that enable patients to take an active role in managing their healthcare. Through these tools, patients gain access to their medical records, can schedule appointments, communicate with healthcare providers, and participate in self-care activities. This increased involvement contributes to enhanced engagement and ultimately leads to improved health outcomes (Hoonakker et al., 2011). The utilization of digitalization facilitates the remote provision of healthcare services via telemedicine platforms and remote monitoring devices. This broadens the availability of care, especially in underserved or rural regions, and enables the early identification and treatment of chronic conditions (Bashshur et al., 2016).

Digitalization facilitates the provision of healthcare services at a distance, primarily through telemedicine platforms, thereby broadening access to care, particularly for those in underserved or rural regions who encounter obstacles in accessing conventional healthcare services. Additionally, remote monitoring devices enable ongoing surveillance of patients' health, enabling the timely detection and intervention of potential health concerns (Bashshur et al., 2016). The quality of healthcare system is directly related with digitalization of healthcare system as it improves the decision-making process and easy availability of clinical data.

This study aims to investigate how the adoption of digital health technologies influences patient health, well-being, and overall satisfaction with care, as well as the effectiveness and efficiency of healthcare delivery.

LITERATURE REVIEW

Digital health technologies offer a wide range of benefits for patients and healthcare providers, but also present challenges like cybersecurity threats (Keeling et al., 2018). Electronic health records (EHRs) for instance, can enhance patient care while requiring robust security measures (Kuehn, 2013). Telemedicine interventions have shown promise in improving access to care and health outcomes for chronic conditions like diabetes (Lee & Kim, 2021). However, organizational barriers and health literacy disparities can hinder the adoption of health information technologies (Lluch, 2011; Mackert et al., 2016).

Studies suggest that patient portals can positively impact health outcomes, like reducing hospital readmissions (McMillan et al., 2019). The successful implementation of these technologies requires careful consideration of factors like organizational characteristics and patient needs (Molfenter et al., 2015 and Omboni&Tenti, 2019).Electronic personal health records hold significant potential (Pagliari et al., 2007) as does big data analytics in healthcare (Raghupathi&Raghupathi, 2014). Mobile health apps offer benefits for specific health conditions (Rho et al., 2020) but cybersecurity remains a concern in healthcare (Keeling et al., 2018).

Diffusion of eHealth in the healthcare sector has observed various reasons that includes knowledge, opportunities, training for the healthcare employees (Camilla et al., 2020). Resource availability is very minimal especially financial resources, there were increase in the number of patients, due to various chronic diseases impacting on life expectancy (Menvielle et al., 2017). Though it was observed increased interest in digitalization in healthcare due to factors like transparency and patients' access for medical information (Koebe P and Bohnet-Joschko S 2023), still there were security issues of patient data like information sharing between hospitals and quality of care. A systematic review of 46 studies suggests that while patient portals tied to EHR systems have the potential to improve patient outcomes and satisfaction, their effectiveness is still unclear, and more research is needed to understand their impact on healthcare delivery. (Goldzweig CL, et al, 2013). One of the studies presents a new framework called NASSS to predict and evaluate the success of technology-supported health and social care programs. The framework analyzes seven key factors, including the condition, technology, value proposition, adopter system, organizations, wider context, and their interactions. By understanding the complexity of these factors, organizations can better anticipate challenges and improve the chances of successful technology implementation (Greenhalph, et al, 2017). Numerous challenges were faced by the healthcare sector.

While studies have shown promising initial results, particularly in areas like telemedicine and patient portals, more comprehensive research is needed to establish definitive evidence. Evaluating the sustained effects of digital health interventions on patient health, quality of life, and disease management. Assessing how digital health technologies influence the quality of care provided, including factors like accuracy of diagnoses, effectiveness of treatments, and patient satisfaction. Examining the impact of organizational characteristics, such as leadership, culture, and resource allocation, on the successful adoption and implementation of digital health technologies. Understanding how patient factors, including sociodemographic characteristics, health literacy, and technology literacy, influence the use and effectiveness of digital health tools.

By addressing these research gaps, healthcare organizations can make more informed decisions about the adoption and implementation of digital health technologies, ultimately improving patient outcomes and the overall quality of care. Therefore, the research questions are of the study are as follows Does digitalization in healthcare influence patient outcomes? And how does digitalization impact the quality of care provided?

MATERIALS AND METHODS

Research design

Descriptive research design was adopted in this study. This depicts the pattern and relationship among the measured variables in the study. This involves collecting the data with surveys to understand the characteristics of the individuals and group.

Sampling Method

A probabilistic approach was employed to collect data, ensuring that every member of the population had a known chance of being selected.

Stratified Random Sampling technique involved dividing the study population into distinct groups (strata) based on specific characteristics (e.g., nurses and physicians). Random samples were then drawn from each stratum, resulting in a more representative sample of the overall population.

Sampling Process

Participants were classified into different strata, differentiating between nurses and physicians. Questionnaires were distributed using a random token system, ensuring that respondents were chosen randomly from each stratum. This method further enhanced the representativeness of the sample. The use of probability sampling strengthens the validity and generalizability of the study findings. Dividing the population into strata allows for a more balanced representation of different groups within the sample. The random selection process minimizes bias and increases the likelihood of obtaining a representative sample.

Sample Size Determination

The sample size for this study was calculated using a statistical formula commonly employed in research. Formula: $N = (Z^2pq / L^2)$

A 95% confidence level was chosen, resulting in a Z-score of 1.96. The anticipated prevalence (p) and allowable error (L) were specified.

Sample Size Based on these inputs, the calculated sample size was determined to be 120.The calculated value of 120 represents the minimum number of participants needed to achieve the specified level of confidence and precision.

Data Collection

Participants: Nurses and physicians were selected as participants from a private multi-specialty hospital located in Chennai, Tamil Nadu, India. The majority of respondents held graduate degrees and possessed varying levels of professional experience, indicating a diverse range of perspectives within the healthcare setting.

The study was conducted in a specific region, Tamil Nadu, which could provide insights into the unique healthcare practices and challenges prevalent in that area. The focus on a private multi-specialty hospital suggests that the findings might be applicable to similar healthcare environments. The inclusion of both nurses and physicians with varying levels of experience and education ensures a broad range of perspectives on the impact of digitalization in healthcare.

Study Location

The research was carried out within a private multi-specialty hospital situated in Chennai, India. A stratified random sampling method was employed to select participants from various categories of hospital staff, including nurses and physicians across different departments.The study relied on both primary and secondary data to gather information and insights. The research was confined to a particular healthcare institution, providing context-specific findings. The inclusion of staff from different specialties and departments ensured a broad representation of perspectives. The use of both primary and secondary data sources enhances the depth and reliability of the study.

Questionnaire Development

Inthis researchstudyquestionnaire was developed for both digitalization and its impact on quality of care by reviewing various literatures. Parameters like Integration of data, legal aspects of data, clinical decision making, and security of data and accessibility of data and for quality of care the factors like procedures on hospital information system, remote care delivery, evidence-based care, patient engagement and patient satisfaction. References from Fink, A. (2013). How to Design Surveys. SAGE Publications, DeVellis, R. F. (2017). Scale Development: Theory and Applications (4th ed.), Bowling, A. (2005). Mode of questionnaire administration can have serious effects on data quality. World Health Organization (WHO). (2016). eHealth at WHO.

Instrument Evaluation: Piloting is a critical step in questionnaire development, allowing for the assessment of the instrument's effectiveness prior to the main study (Parahoo, 2006).

Questionnaire Administration: A well-designed questionnaire was distributed to a sample of 50 respondents to evaluate its reliability using Cronbach's alpha across all dimensions of the study. The sample of 50 respondents included both nurses and physicians. Questionnaires were distributed, and responses were collected from the participants. Based on the insights gained from the pilot study, the questionnaires were revised and improved to enhance their effectiveness for the main study.
Null Hypothesis (H0): There is no significant relationship between digitalization and patient outcomes.
Null Hypothesis (H0): There is no significant relationship between digitalization and the quality of care.

RESULTS
Table 1 shows the largest age group among healthcare professionals is 25-34, comprising 25.6% of the total. This is followed by the 35-44 age group at 26.7%. Other significant age groups include 45-54 (26.6%) and over 55 (21.1%). Female healthcare professionals outnumber male professionals, with 51.9% compared to 48.1%. While there is a slight female predominance, the gender distribution is relatively balanced.over 15 years (17.6%).

Table 1: Demographic data

S. No	Demographic Variable		Frequency	Percentage
1.	Age Group in years	25-35	29	25.6
		36-45	34	26.7
		46-55	25	26.6
		Above 55	24	21.1
2.	Gender	Male	52	48.1
		Female	60	51.9
3.	Marital Status	Married	43	46.4
		Unmarried	69	53.6
4.	Experience	Up to 5 years	33	30.6
		6-10 years	24	32.8
		11-15 years	29	19
		Above 15 years	26	17.6
5.	Occupation	Nurses	69	62.7
		Physicians	31	37.3

Source: Primary data

A majority of healthcare professionals (53.6%) are unmarried, while 46.4% are married. Nurses constitute the largest group of healthcare professionals at 62.7%, followed by physicians at 37.3%. The majority of healthcare professionals have 6-10 years of experience (32.8%), followed by those with up to 5 years (30.6%). Other experience levels include 11-15 years (19%) and

Table 2. Cronbach's α of the Respondents on the digitalization based on pilot study

S. No	Digitalization	Cronbach's
1.	Integration of data	0.83
2.	Legal aspects of data	0.81
3.	Clinical Decision making	0.73
4.	Security of data	0.76
5.	Accessibility of data	0.85

Table 3. Cronbach's α of the Respondents on the quality of care based on Pilot Study

S. No	Quality of care	Cronbach's
1.	Procedures on HIS	0.76
2.	Remote care delivery	0.80
3.	Evidence based care	0.86
4.	Patient engagement	0.77
5.	Patient satisfaction	0.81

A pilot study was conducted to assess the reliability of the measurement instrument. Table 2 and Table 3 represents the Cronbach's αvalue of the questionnaires which were distributed to nurses and physicians to assess the validity of factors related to digitalization and quality of care. The questionnaires focused on validating specific factors associated with digitalization and quality of care.Cronbach's alpha was calculated based on responses from 50 respondents (nurses and physicians) who participated in a pilot study conducted at a private sector institution in Chennai. This statistical measure was used to evaluate the internal consistency of the questionnaire items.

Reliability Assessment:Reliability Confirmation

The calculated Cronbach's alpha values provided evidence of the reliability of the data collected through the questionnaires. The obtained Cronbach's alpha values indicated that the data collected was reliable.

Table 4: Correlation analysis

S. No	1	2	3	4	5	6	7	8	9	10
1	1	.321**	.547**	.383**	.369**	.316**	.340**	.360**	.370**	.401**
2		1	.220**	.124**	.231**	.289**	.320**	.271**	.261**	.331**
3			1	.523**	.567**	.428**	.102**	.021**	.392**	.415**
4				1	.376**	.321**	.316**	.721**	.531**	.360**
5					1	.432**	.576**	.591**	.632**	.520**
6				.		1	.621**	.542**	.731**	.580**
7							1	.420**	.534**	.598**
8								1	.640**	.710**
9									1	.587**
10										1

** Correlation is significant at the 0.01 level (2-tailed)

* Correlation is significant at the 0.05 level (2-tailed)

Table 4 represent the results of the correlation analysis of digitalization factors and quality of care. Karl Pearson's coefficient of correlation was used to know the relationship. It is observed that the factors of digitalization and quality of care has strong and positive correlation. And it is also observed that when there is increase in any variable that would positively impact the other variables. The results shows that there is significant positive relationship between digitalization and quality of care (r=.528). Based on the results, the relationship between digitalization and quality of care is statistically significant. It was observed from the research of Adler-Milstein et al. (2017) who observed a favourable association between the implementation of electronic health records (EHRs) and improved patient outcomes, such as decreased mortality rates and fewer instances of medical errors. The integration of digital technologies within hospitals leads to streamlined processes, decreased paperwork, and improved timeliness in delivering care. Research conducted by Black et al. (2016) highlighted a notable correlation between the adoption of electronic medical records (EMRs) and heightened efficiency, leading to reduced wait times and expedited access to healthcare services.

Furthermore, multiple regression analysis was carried out to determination the statistical relationship between two or more variables. In simple regression two variables are used. One variable (independent) is the cause of the behaviour of another one(dependent). This determine who the quality of care are related to factors of digitalization.

Table 5: Multiple Regression

Multiple R	0.658
R Square	0.642
F – value	18.321
Level of significance	<0.001**

The coefficient of determination R-square shown in table 5measuresthegoodness-of-fitofthe estimated Sample Regression Plane (SRP) in terms of the proportion of the variation in the dependent variables explained by the fitted sample regression equation.Thus, the value of R square is 0.642 simply means that about 64.2 **%** of the variation in quality of careis explained by the estimatedSRP thatuses digitalization (Integration of data, legal aspects of data, clinical decision making, security of data and accessibility of data) as the independent variables and r square value is significant at 1 % level.

Table 6: Beta value of multiple regressions

Variables	Unstandardized co-efficient	SE ofB	Standardized co-efficient	Tvalue	Pvalue
Constant	6.214	1.223		3.624	<0.000**
Integration of data	0.612	0.114	0.142	5.153	<0.000**
Legal aspects of data	0.245	0.072	0.082	2.421	0.004**
Clinical Decision making	0.320	0.132	0.083	3.521	<0.000**
Security of data	0.373	0.134	0.074	2.437	0.016**
Accessibility of data	0.352	0.224	0.046	3.268	0.042**

Table 6 shows the multiple regression equations are Y (Quality of care)=6.214+0.612 (Integration of data) X_1+0.245 (legal aspects of data) X_2+0.320 (clinical decision making) X3 + 0.373(security of data) X4 + 0.352 (accessibility of data) X5.

Here the coefficient of Integration of data(X_1)is0.612 representsthe partial effect of integration of data on quality of care, holding the other variables as constant. The estimated positive sign implies that such effect is positive that overall quality of care would increase by 0.612 for every unit increase in integration of data and this coefficient value is significant at 1%level and this remains same for all the other variables.

DISCUSSION AND CONCLUSION

Digitalization significantly impacts patient outcomes in a diverse and meaningful manner. By integrating digital tools like electronic health records (EHRs), health information exchange (HIE) systems, and decision support technologies, healthcare institutions can elevate various aspects of patient care.

Numerous studies consistently affirm the positive correlation between digitalization and enhanced patient outcomes, manifesting in improved care coordination, reduced medical errors, heightened efficiency, and ultimately, better health results. For example, research underscores that adopting EHRs correlates with decreased mortality rates, fewer medical errors, and enhanced patient satisfaction. Dehling et al's study analyzed 24,405 m Health apps on iOS and Android to assess their potential risks to user information security and privacy. The findings revealed that a significant number of these apps collect and offer sensitive medical information, highlighting the need for stronger security measures to protect user data and foster trust in mHealth technologies (Dehling T, Gao F, Schneider S, Sunyaev A 2015).

Moreover, digitalization expedites access to patient data, fostering informed clinical decision-making and ensuring seamless care continuity across healthcare environments. By streamlining operations and alleviating administrative burdens, digitalization optimizes healthcare workflows, enabling healthcare professionals to devote more attention to direct patient care.

In conclusion, embracing digitalization in healthcare yields tangible benefits for patient outcomes. Nonetheless, sustained investment in technology infrastructure, continuous training for healthcare personnel, and diligent attention to data security and privacy are indispensable to fully harness the advantages of digitalization and uphold its enduring positive influence on patient care.

MANAGERIAL IMPLICATIONS

1. **Optimize Digital Integration**: Given that digitalization accounts for approximately 64.2% of the variance in quality of care, prioritize initiatives aimed at fully integrating digital technologies throughout the healthcare environment. This entails not only adopting electronic health records (EHRs) but also ensuring smooth integration of data across diverse systems and departments.
2. **Address Legal and Security Concerns:** Given the importance of legal and data security considerations in explaining quality of care, it is imperative to prioritize adherence to healthcare regulations and data protection standards. Allocate resources towards implementing robust measures for safeguarding patient information and ensuring compliance with legal requirements.
3. **Enhance Support for Clinical Decision-Making:** Acknowledging the pivotal role of clinical decision-making in maintaining quality of care, invest in technologies and resources that assist healthcare professionals in making well-informed clinical judgments. This may entail deploying decision support systems, AI-powered diagnostics, and adherence to evidence-based practice guidelines.
4. **Improve Accessibility of Data:** Data accessibility is critical for efficient healthcare delivery. Concentrate on enhancing the accessibility of digital health records and pertinent patient information to facilitate prompt decision-making and coordinated care among healthcare providers.
5. **Continuously Monitor and Enhance:** Continuously assess the impact of digitalization initiatives on the quality of care and periodically evaluate the efficacy of implemented measures. Regularly scrutinize and

refine processes to tackle emerging challenges or areas requiring improvement in digital integration and its influence on healthcare quality.

6. **Optimize Workflow**: As emphasized by Black et al. (2016), the incorporation of digital technologies in hospitals results in streamlined processes and reduced paperwork. Healthcare institutions ought to prioritize the enhancement of workflows through digitalization, aiming to diminish administrative burdens and enhance efficiency in delivering care.

Limitations Of The Study And Scope For Future Research

Limitations of the study include the time considerations and limited amount of data. The study can improve in the future by enhancing the number of respondents like technical staff, pharmacist and hospital administrators. Incorporate AI and ML algorithms into clinical decision support systems to aid healthcare providers in diagnosing illnesses, forecasting patient outcomes, and tailoring treatment approaches. Such technologies can boost diagnostic precision, refine treatment tactics, and enhance patient contentment. Promote interdisciplinary teamwork among healthcare practitioners, encompassing doctors, nurses, pharmacists, and other allied health experts, to deliver comprehensive and coordinated patient care. Digital platforms can streamline communication and collaboration across various medical specialties and care environments can be considered for future research.

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Conflict of Interest

No potential conflict of interest was reported by the author(s).

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