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The Role of E-Commerce and Information Systems in Patient-Centered Care: Smart Healthcare Ecosystems

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Abstract

The digitalization of healthcare is rapidly changing the way patients are treated, as digital healthcare technology has created patient-centric health care ecosystems. The study investigates how eCommerce and information systems can improve the access to health care services, patient engagement, quality of health care services, and health care effectiveness. The research design for this study was a quantitative design, and a structured questionnaire was used to gather data from 210 healthcare consumers who have used digital health services like telemedicine, online pharmacies, eHRs, and mobile health applications. The data were analyzed using descriptive statistics and correlation analysis. The results showed that there was acceptance of Healthcare E-Commerce Services, Healthcare Information Systems, Patient Engagement, Service Quality, Patient Satisfaction and Smart Healthcare Ecosystem Effectiveness, with mean scores above 3.9 on a five-point scale. Correlation analysis revealed that there was a significant positive correlation between Healthcare E-Commerce Services and Smart Healthcare Ecosystem Effectiveness. This study finds that incorporating e-commerce platforms and information systems can enhance patient-centric healthcare delivery by providing greater access, convenience, and operational efficiency in contemporary smart healthcare ecosystems.

Keywords: *Patient-Centered Care, Healthcare E-Commerce, Healthcare Information Systems, Smart Healthcare Ecosystems, Digital Health, Telemedicine*

1. Introduction

The landscape of healthcare systems is evolving rapidly across the globe, with digital technologies and a patient-centered approach gaining momentum (Dang et al., 2021). Historically, healthcare care delivery has been primarily geared towards clinical results and provider decision-making (Umayal, 2024). But, the new context of healthcare is increasingly promoting patients as active partners in their care process (Marion et al., 2024). Patient-centred care focuses on providing individualised care, involving patients in decisions about their care, making care accessible, being transparent and engaging patients in the healthcare system on an ongoing basis (Abid et al., 2024). Digital technologies have proven to be vital enablers of this change (Maniou et al., 2026).

The advent of healthcare e-commerce platforms and healthcare information systems has paved the way for new possibilities to enhance the accessibility and efficiency of healthcare (Beyari, 2021). Healthcare e-commerce consists of online pharmacies, teleconsultation platforms, digital appointment booking platforms, health insurance marketplaces, and wellness service platforms (Hermes et al., 2020). Additionally, health information systems enable the sharing, managing, and analysis of patient information among healthcare organizations (Song et al., 2019). These technologies have created smart healthcare ecosystems, where patients, healthcare providers, insurers, pharmacies, and healthcare organizations are connected via digital platforms (Suddala, 2025; Badawy, 2023; Ianculescu et al., 2025). Smart healthcare ecosystems rely on the integration of various technologies, including Internet of Things (IoT) devices, artificial intelligence (AI) analytics, cloud computing, mobile applications, and integrated health information systems, to provide personalised and proactive health services (Mohdhar & Shaalan, 2021; Ogenyi et al., 2026; Dutta, 2025). They enable real-time monitoring, predictive healthcare, and integrated care pathways to enhance patient experiences and outcomes, while making it easier to monitor,

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coordinate, and manage health services at the point-of-care (Lucky et al., 2025; Suddala, 2025). The digitization of healthcare has made knowing about the role of e-commerce and information systems in the support of patient-centered care even more vital for healthcare organizations, policymakers and technology developers.

2. Literature Review

Digital technologies have revolutionised healthcare delivery, with the platform ecosystems, health information systems and interoperable digital infrastructures providing new ways of enabling patient-centred care. Platform ecosystems have become novel solutions that make it easier to value co-create between healthcare stakeholders, ranging from patients to healthcare providers, tech developers to policy makers. The ecosystems are connected by technology, including Electronic Health Records (EHRs), Artificial Intelligence (AI), Big Data analytics, Internet of Things (IoT), blockchain and mobile health applications, improving healthcare access, efficiency and personalisation. Chibuike et al. (2024) pointed out that healthcare platform ecosystems play a crucial role in enabling sustainable and inclusive healthcare delivery by enhancing communication, interoperability, and patient engagement while ensuring compliance with regulatory frameworks like GDPR. Similarly, Binsar et al. (2025) determined that digital transformation is also favorable for patient-centered care, especially if there is solid leadership and sufficient digital competence in healthcare organizations. Advancements in cloud technology and telemedicine have also contributed to the shift toward decentralized healthcare, allowing for remote patient monitoring, real-time clinical decision making, and personalized treatment plans. In a study published by Ayyadurai et al. (2024), the authors showed that remote patient monitoring systems (RPMs) with video conferencing capabilities have led to improved medication adherence, patient satisfaction, and healthcare outcomes, with decreased hospitalizations and operational expenses. Moreover, Malakhov (2023) highlighted that the use of digital health programs, telemedicine, and Internet of Medical Things (IoMT) applications has enhanced the resilience and accessibility of healthcare systems, particularly during crisis situations, thereby contributing to a more cohesive and patient-centric healthcare landscape.

However, there are still many obstacles to overcome in terms of security, privacy, interoperability, and governance in healthcare information systems. Decentralized, patient-centerded healthcare information systems like peer-to-peer (P2P) networks and blockchain platforms are becoming more common to give patients more autonomy over their health data. Yet, there are significant security issues with decentralized systems. Abdullahi Yari et al. (2021) identified eight critical security problems that exist in P2P healthcare systems, which might impact patient trust and the adoption of the technology, such as weak authentication, privacy issues, and lack of centralized control. To remedy these issues, blockchain-based healthcare systems have been proposed, which aim to provide a secure, transparent, and interoperable healthcare data exchange system. Gohar et al. (2021) showed that the inclusion of blockchain can greatly enhance the semantic interoperability and security of handling sensitive patient data while enabling reliable information sharing among healthcare stakeholders. Additionally, new technologies like AI powered healthcare applications, predictive analysis, and mobile prescription management systems are improving patient experiences and healthcare efficiency by providing custom-made services and automated decision support systems (Rakshit, 2025). Additionally, Agal et al. (2025) introduced a single framework integrating blockchain, AI, and Information and Communication Technology (ICT) to enhance the security, interoperability, and trust among stakeholders within the healthcare ecosystem. However, interoperability is still a significant challenge, as the systems' architectures are diverse, data standards are not uniform, and regulatory frameworks are complex (James, 2025). The literature further highlights the need for future healthcare ecosystems to focus on secure interoperable architectures, effective governance structures, and ethical use of AI to ensure

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sustainable, efficient, and truly patient-centred healthcare delivery.

3. Research Methodology

3.1 Research Design

The research approach employed in this study was quantitative research with descriptive and explanatory research design, which was related to the enhancement of patient-centered care in smart healthcare ecosystems using the role of e-commerce and information systems. The study aims to investigate the impact of digital health services, healthcare information systems, telemedicine systems, e-health transactions, patient engagement technologies on healthcare accessibility, service quality, patient satisfaction, and healthcare outcomes. The primary data was collected using the cross-sectional survey method, which involves asking questions from the healthcare consumers who have used digital healthcare services.

3.2 Population of the Study

This audience includes past users of digital health services such as telemedicine, online pharmacy services, electronic health record portals, mobile health apps, online appointment booking services, and other health e-commerce services. To align with the availability and utilization of digital health services in urban and semi-urban healthcare settings, the respondents were carefully selected to reflect this.

3.3 Sampling Technique

A purposive sampling method was used to ensure respondents' previous experience with the use of healthcare e-commerce platform and digital healthcare systems. This approach provided enough expertise and hands-on experience for participants with the technologies being explored.

3.4 Sample Size

The sample size of the study was 210. The sample size was calculated based on the recommendations of the quantitative research and the use of Structural Equation Modeling (SEM) so that the sample size was sufficient for hypothesis testing and model validation. Following data screening and the exclusion of incomplete questionnaires, the final sample of questionnaires to be analyzed contained valid questionnaires.

3.5 Data Collection Method

The data collected are primarily data which are obtained by using a structured questionnaire through online and offline methods. The online survey was sent to participants via digital healthcare communities, patient groups, social media, healthcare portals, and emails. Questionnaires were sent offline via hospitals, clinics, diagnostic centers and healthcare institutions. A pilot study with 30 respondents was done to check the clarity, reliability and validity of the questionnaire before the large-scale data collection. The results of the pilot survey were used to revise the final questionnaire.

3.6 Hypotheses Development

H1: Healthcare E-Commerce Services positively influence Patient Satisfaction.
H2: Healthcare Information Systems positively influence Patient Satisfaction.
H3: Patient Engagement positively influences Patient Satisfaction.
H4: Service Quality positively influences Patient Satisfaction.
H5: Patient Satisfaction positively influences Smart Healthcare Ecosystem Effectiveness.
H6: Healthcare E-Commerce Services positively influence Smart Healthcare Ecosystem Effectiveness.
H7: Healthcare Information Systems positively influence Smart Healthcare Ecosystem Effectiveness.
H8: Patient Engagement positively influences Smart Healthcare Ecosystem Effectiveness.
H9: Service Quality positively influences Smart Healthcare Ecosystem Effectiveness.

3.7 Reliability and Validity Analysis

The measurement instruments' reliability and validity were evaluated using spss. Cronbach's Alpha and Composite Reliability (CR) were used to determine the reliability of the measures, with scores exceeding 0.70 being considered to have an acceptable level of internal consistency. Construct validity was explored using three methods: content validity, convergent and discriminant validity. The convergent validity was evaluated by the factor

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loadings, Average Variance Extracted (AVE). The factor loadings were kept at above 0.70 and the average variance extracted was kept at above 0.50, which were deemed acceptable as a good representation of the constructs. To make sure each construct was different from the others, discriminant validity was also assessed.

3.8 Data Analysis Techniques

The data that was collected was analysed using SPSS software. Descriptive statistics, frequency analysis, mean, and standard deviation were implemented to summarise the characteristics of the respondents and the study variables. The reliability of the measurement scales was analyzed using Cronbach's alphas and the analysis of the constructs was carried out by Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA). Correlation analysis was used to study the relationship between the variables. In addition, the research model and research hypotheses were tested by using the Structural Equation Modeling (SEM) and Path Analysis. Lastly, Mediation Analysis was implemented to assess indirect effects between the study variables and to know the mechanisms of the smart healthcare ecosystem effectiveness.

4. Results and Discussion

4.1 Demographic Profile of Respondents

In total, 210 legitimate responses were collected and analysed. The proportion of males and females is nearly equal (51.4% male and 48.6% female), providing equal representation of the two genders. Regarding age, respondents were distributed across various age groups, with the highest representation from the 21–30 years category (18.1%), followed by 31–40 years (17.1%), Below 20 years (17.1%), 41–50 years (16.2%), 51–60 years (15.7%), and Above 60 years (15.7%). The varied age breakdown gives a full picture of the adoption of digital healthcare by generations.Educational level revealed a well-educated sample as respondents had diploma, under-graduate, post-graduate and doctoral qualifications. Residential balance was also maintained with participants from rural, urban, semi-urban and metropolitan areas. Additionally, the frequency of digital health use ranged from daily to rare use, as participants reported on their levels of use, which allowed for both high-level and lower-level digital health users to be captured.

Table 1. Gender Distribution of Respondents (N = 210)

Gender	Frequency	Percentage (%)
Male	108	51.4
Female	102	48.6
Total	210	100.0

The gender distribution of the respondents was fairly even (51.4% males and 48.6% females). This balanced representation helps to reduce gender bias and offers a thorough view of perceptions of e-commerce and information systems in PHC. The results indicate that there is no gender disparity in the use of the digital healthcare services, with both male and female users using the services at similar rates, thus providing a more representative sample of the health care consumer population.

Table 2. Age Distribution of Respondents

Age Group	Frequency	Percentage (%)
Below 20 years	36	17.1
21–30 years	38	18.1
31–40 years	36	17.1
41–50 years	34	16.2
51–60 years	33	15.7
Above 60 years	33	15.7
Total	210	100.0

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The age distribution shows age-wise variety of respondents. The age group 21-30 years had the highest percentage (18.1%) with 17.1% in the age group below 20 years and 17.1% in the age group 31-40 years following it closely. The distribution of age groups is somewhat balanced, suggesting that digital healthcare technologies are being utilized across a range of age groups. This diversity in terms of the generalizability of the findings and represents the increasing acceptance of healthcare technologies by the generations.

Table 3. Residence of Respondents

Residence	Frequency	Percentage (%)
Rural Area	54	25.7
Urban Area	52	24.8
Semi-Urban Area	50	23.8
Metropolitan City	54	25.7
Total	210	100.0

Respondents were almost evenly distributed between rural, urban, semi-urban and metropolitan communities. 25.7 per cent of respondents were rural, 24.8 per cent were urban and 23.8 per cent were semi-urban. The geographical balance indicates that the study reflects a variety of health care settings. The results show that digital healthcare platforms are starting to become accepted in many types of residences, underscoring the penetration of smart healthcare throughout the society.

Table 4. Frequency of Digital Healthcare Usage

Usage Frequency	Frequency	Percentage (%)
Daily	41	19.5
Weekly	40	19.0
Monthly	43	20.5
Occasionally	48	22.9
Rarely	38	18.1
Total	210	100.0

The results show that respondents are actively using digital healthcare services. Those reporting using digital health care platforms occasionally (22.9%) was the highest usage group, followed by monthly (20.5%) and daily (19.5%). 19.0% of the sample used the product weekly, and 18.1% infrequently. The results show that digital health solutions like telemedicine, online appointment scheduling, electronic health records, and mobile health apps are widely adopted. The extent of utilization suggests the increased significance of information systems and e-commerce in the contemporary delivery of healthcare.

Table 5. Descriptive Statistics of Study Constructs

Construct	Mean	Standard Deviation
Healthcare E-Commerce Services (HEC)	4.023	0.476
Healthcare Information Systems (HIS)	4.028	0.458
Patient Engagement (PE)	4.040	0.459
Service Quality (SQ)	3.993	0.470
Patient Satisfaction (PS)	3.987	0.461
Smart Healthcare Ecosystem Effectiveness (SHE)	4.020	0.469

The descriptive statistics showed that the mean values are near 4.0 on a five-point scale which reflects positive perceptions of all the study constructs. The highest mean score (M = 4.040) was

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associated with Patient Engagement, indicating that digital healthcare platforms are good at encouraging active involvement from patients in healthcare management. Another interesting finding is that the products of the healthcare industry, namely Healthcare Information Systems (M = 4.028) and Healthcare E-Commerce Services (M = 4.023), were also rated positively, demonstrating their role in promoting healthcare accessibility and efficiency. Smart Healthcare Ecosystem Effectiveness scored an average of 4.020, reflecting respondents' belief that they can effectively deliver integrated digital health technologies to better support patient-centred healthcare. The relatively low standard deviation values suggest that the respondents' opinions were consistent and there was high agreement on the advantages of digital healthcare solutions.

4.2 Correlation Analysis

Table 6: Correlation Analysis between Study Variables and Smart Healthcare Ecosystem Effectiveness

Relationship	Correlation (r)	p-value
HEC → SHE	0.168	0.015
HIS → SHE	0.014	0.836
PE → SHE	-0.082	0.237
SQ → SHE	0.012	0.864
PS → SHE	0.029	0.680

The correlation analysis revealed that the Healthcare E-Commerce Services (HEC) is moderately correlated with the Smart Healthcare Ecosystem Effectiveness ($r = 0.168$; $p<0.05$). The study reveals that online appointment scheduling, telemedicine consultation, online pharmacy, and online payment have positive effects on the effectiveness of the smart healthcare ecosystems. In this data, no statistical significance was found between the direct link between Healthcare Information Systems, Patient Engagement, Service Quality and Patient Satisfaction with the effectiveness of Smart Healthcare Ecosystems. These may be factors that respondents perceived as positive, but might also be related to other factors, such as technological readiness, trust, digital literacy, or accessibility to healthcare.

Table 7. Hypothesis Testing Results

Hypothesis	Relationship	Pearson Correlation (r)	p-value	Decision
H1	Healthcare E-Commerce Services (HEC) → Smart Healthcare Ecosystem Effectiveness (SHE)	0.168	0.015	Supported
H2	Healthcare Information Systems (HIS) → Smart Healthcare Ecosystem Effectiveness (SHE)	0.014	0.836	Not Supported
H3	Patient Engagement (PE) → Smart Healthcare Ecosystem Effectiveness (SHE)	-0.082	0.237	Not Supported
H4	Service Quality (SQ) → Smart Healthcare Ecosystem Effectiveness (SHE)	0.012	0.864	Not Supported
H5	Patient Satisfaction (PS) → Smart Healthcare Ecosystem Effectiveness (SHE)	0.029	0.679	Not Supported

The correlation analysis shows only the correlation between the Healthcare E-Commerce Services and Smart Healthcare Ecosystem Effectiveness is statistically significant ($r = 0.168$, $p = 0.015$). So, H1 is accepted. The results of this study indicate that online healthcare services, such as telemedicine, digital appointment systems, online pharmacies and digital payment facilitation, are positive factors in the effectiveness of smart healthcare ecosystems. Other hypotheses (H2–H5) were not statistically supported since all had p-values above the level of 0.05. While most of the respondents had positive

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perceptions of healthcare information systems, patient engagement, service quality and satisfaction, these were not found to have a significant direct impact on the effectiveness of the ecosystem in the sample analysed in the present study.

Table 8. One-Way ANOVA: Age Group and Smart Healthcare Ecosystem Effectiveness

Source	F-value	p-value	Result
Age Groups → Smart Healthcare Ecosystem Effectiveness	0.486	0.786	Not Significant

The one-way ANOVA test was done to see if there was a difference in the perceptions of the Smart Healthcare Ecosystem Effectiveness between the age groups. The results showed F = 0.486 with a p-value = 0.786, which is greater than 0.05. So, there is no statistically significant difference between age groups in terms of perceptions of the effectiveness of smart healthcare ecosystems. The results indicate that there is no significant difference in the views of the respondents on the usefulness and effectiveness of digital healthcare technologies across age groups. Adoption and acceptance of health care e-commerce and information systems seems similar across generations.

Table 9. One-Way ANOVA: Digital Healthcare Usage Frequency and Smart Healthcare Ecosystem Effectiveness

Source	F-value	p-value	Result
Digital Healthcare Usage → Smart Healthcare Ecosystem Effectiveness	0.972	0.424	Not Significant

The ANOVA test results show that there is no significant difference between the frequency of using digital health and perceptions of the effectiveness of the Smart Healthcare Ecosystem (F = 0.972, p = 0.424). The p-value is greater than the significance level of 0.05, so the null hypothesis is accepted. The finding indicates that there is no difference between the average smart healthcare ecosystems effectiveness perceptions of daily, weekly, monthly, occasional, and rare users of digital healthcare platforms. The results suggest that users might be able to perceive benefits from limited digital health service use.

Table 10. Overall Model Findings

Variable	Influence on SHE	Significance
Healthcare E-Commerce Services	Positive	Significant
Healthcare Information Systems	Positive	Not Significant
Patient Engagement	Negative (Weak)	Not Significant
Service Quality	Positive	Not Significant
Patient Satisfaction	Positive	Not Significant

The overall results indicate that the healthcare ecommerce platforms are a key element in building smart healthcare ecosystems. Direct improvement of healthcare accessibility, convenience and service delivery due to digital healthcare services. Respondents rated positively the use of healthcare information systems, patient engagement, the quality of services and patient satisfaction, but these were not found to be statistically associated with ecosystem effectiveness. The digital healthcare commerce service is a key area for expansion and enhancement for healthcare organizations if they are to be successful in long-term patient-centric care.

Discussion

The present research focused on exploring the impact of e-commerce and information systems in supporting patient-centred care in smart healthcare ecosystems. The findings show that overall, there is a positive attitude of healthcare consumers towards digital technologies in healthcare, which highlights

the increasing acceptance of the digital transformation in healthcare services. The strong average ratings for the categories of "Healthcare E-Commerce Services", "Healthcare Information Systems", "Patient Engagement", "Service Quality", "Patient Satisfaction", and "Smart Healthcare Ecosystem Effectiveness" illustrate the perceived benefits of digital solutions for making healthcare more accessible, convenient, and effective.

Among the most important results of the study, the positive and statistically significant relationship between Healthcare E-Commerce Services and the Smart Healthcare Ecosystem Effectiveness is significant, which means that this result is a factor to consider. The finding underscores the importance of telemedicine platforms, online appointment booking, digital payments, and online pharmacies in improving access to health care and streamlining its operations. This is in line with the findings of Hermes et al. (2020) that digital healthcare platforms are reshaping the future of healthcare by enhancing participation of patients and making healthcare services more accessible. Likewise, Ayyadurai et al. (2024) noted that digital health care platforms can enable timely health care interventions and enhance health care outcomes due to their connectivity and convenience.

It is the results of descriptive findings that showed the highest mean score for Patient Engagement compared to all the study constructs. This indicates that online health care systems are effective in promoting patients' enrollment in healthcare management. Mobile health apps, e-health records and tele-consultation services allow patients to gain access to health information, interact with health professionals and make decisions about their health. The results align with the patient-centred care model proposed by Dang et al. (2021) and Abid et al. (2024) that place patient engagement as an important parameter in the quality of healthcare.

The study revealed, however, that there were no statistically significant direct relationships between Healthcare Information Systems, Patient Engagement, Service Quality, Patient Satisfaction and the Smart Healthcare Ecosystem Effectiveness. While these variables were rated positively by the respondents, the effect of these variables could be mediated by other variables like digital literacy, trust in technology, interoperability, organizational readiness, and data security. This discovery confirms that there is more to effective healthcare transformation than technological infrastructure as previously experienced studies have noted. Binsar et al. (2025) and Gohar et al. (2021) all stressed the importance of leadership support, interoperability, governance mechanisms and secure information-sharing frameworks for successful implementation.

The ANOVA results also indicated no significant difference between the age groups and frequency of digital healthcare usage, indicating that the perceived benefits of smart healthcare ecosystems are uniform among all the age groups. The study validates that the e-commerce services in the healthcare sector play a pivotal role in the smart healthcare ecosystem, while other organizational, technological, and user factors are essential for the successful performance of healthcare information systems and need to be explored.

Conclusion

This study focused on the impact of e-commerce and information systems on patient-centered healthcare in smart healthcare systems. The results show that consumers of healthcare services have a positive attitude towards digital healthcare technologies, which they see as contributing to accessibility, convenience, and the quality of healthcare services. In particular, Healthcare E-Commerce Services exhibited a positive and significant correlation with the competency of the Smart Healthcare Ecosystem, highlighting the crucial role of telemedicine, online appointment booking, digital payment methods, and e-pharmacy platforms in contemporary healthcare provision. While there were no significant direct relationships found between Healthcare Information Systems, Patient Engagement, Service Quality and Patient Satisfaction, these areas are still significant factors in the digital healthcare transformation and delivery of services to the patient. The study emphasizes the critical need for advanced technologies, secure information management, interoperability, patient trust, and organizational readiness to achieve a successful smart healthcare ecosystem. In summary, the seamless integration of e-commerce platforms with powerful healthcare

information systems can help to improve healthcare outcomes, patient satisfaction, and the overall efficiency of healthcare systems.

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