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HOSPITAL DIGITALIZATION EFFECTS ON PATIENT OUTCOMES MEDIATED BY USABILITY PATHWAYS

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ABSTRACT: This study examines how administrative and patient service digitization influence patient satisfaction and loyalty in hospital settings. It advances digital health literature by demonstrating that hospital digitalization effects on patient outcomes are mediated by usability pathways rather than direct technological deployment, while also revealing the contingent role of digital literacy across service domains. Using a PLS-SEM approach with a sample of 196 patients, the findings indicate that digitalization does not directly enhance satisfaction or loyalty but operates through perceived ease of use, whereas perceived usefulness remains non-influential. Digital literacy strengthens the impact of administrative digitization on satisfaction but weakens the effect of patient service digitization. Satisfaction emerges as the primary driver of patient loyalty. These findings imply that hospital digital transformation strategies should prioritize usability optimization and tailor digital services to patient capability levels.

Keywords: Healthcare Digitization, Patient Satisfaction, Patient Loyalty, Digital Literacy, PLS-SEM

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INTRODUCTION

Digital transformation has reconfigured healthcare delivery into a more efficient, data-driven, and patient-centered system, where technologies such as telemedicine and electronic health records (EHR) shape clinical and administrative interactions (Stoumpos et al., 2023). In practice, however, this transition exposes structural disparities in institutional readiness and patient capability. Many healthcare providers still operate fragmented and non-integrated systems, while patients exhibit uneven digital literacy, producing inefficiencies such as duplicated data entry, delayed access to medical results, and suboptimal user experiences. Evidence shows that system integration and usability critically determine service effectiveness and patient satisfaction (Alshahrani & Alalwan, 2022; Prasetyo & Lestari, 2021), yet hospitals in Bekasi continue to implement partial digital solutions that fail to deliver seamless service. These gaps are not merely technical but behavioral, as patient satisfaction and loyalty increasingly depend on perceived usefulness and ease of use within digital environments (Alalwan et al., 2021; Hu et al., 2025). Consequently, digitalization in healthcare emerges as a paradox: it promises efficiency but risks dissatisfaction when institutional capacity and user readiness are misaligned.

Beyond infrastructure, patient capability becomes a decisive factor. Digital literacy, defined as the technical, cognitive, and social ability to engage with digital systems, shapes how patients interpret and utilize healthcare technologies (Ng, 2022). Empirical evidence indicates that low digital literacy reduces perceived usefulness and ease of use, thereby weakening satisfaction and loyalty outcomes (Norman & Skinner, 2021). In heterogeneous patient populations, particularly among elderly and low-education groups, this limitation creates exclusionary effects that undermine the intended benefits of digital transformation. Prior studies confirm that digital literacy strengthens the relationship between technology use and patient outcomes (Zhou et al., 2022; Kordzadeh et al., 2023; Alhassan et al., 2023), positioning it as a critical moderating variable. Yet, existing research often isolates technology acceptance, service quality, or literacy, failing to integrate these dimensions into a unified behavioral model within hospital settings.

This study advances the literature by developing an integrated framework that simultaneously links administrative and service digitalization with patient satisfaction and loyalty through the mediating roles of perceived usefulness and perceived ease of use, while explicitly positioning digital literacy as a cross-cutting moderating capability. By synthesizing the Technology Acceptance Model (Davis, 1989), SERVQUAL (Parasuraman et al., 1988), and the Digital Literacy Framework (Ng, 2012; UNESCO, 2018), this research moves beyond fragmented perspectives and offers a multidimensional explanation of digital healthcare adoption. The contribution lies in demonstrating that digital literacy does not merely strengthen relationships but fundamentally reshapes the mechanism through which technological perceptions translate into experiential outcomes and loyalty behavior. This integrated approach provides a more precise theoretical model and delivers actionable insight for designing inclusive, patient-centered digital health systems in emerging healthcare markets.

THEORETICAL REVIEW

Digitalization and Satisfaction

Administrative digitalization encompasses the implementation of electronic systems in registration, identity verification, payment, and patient data management. When these systems are designed to be efficient, accurate, and user-friendly, patients experience convenience, speed, and clarity in service delivery. These factors directly contribute to their satisfaction as healthcare service users. Within the SERVQUAL theoretical framework, the dimensions of reliability and efficiency serve as key indicators explaining how administrative digital systems enhance patients' positive perceptions of service quality. Reliability reflects the consistency and accuracy of the system in performing administrative functions, whereas efficiency refers to the speed and ease of processes as perceived by patients.

Research by Lee, Han, and Kim (2020) shows that hospital administrative digitalization emphasizing reliability and efficiency has a direct impact on patient satisfaction. Famor Pratami et al. (2023) found that digital administrative experiences contribute to increased patient

satisfaction. Similarly, Alhassan et al. (2023) emphasized that administrative digitalization enhances patients' positive perceptions of hospital services. Thus, it can be concluded that administrative digitalization has a positive and significant effect on patient satisfaction. When hospital administrative systems are designed to be efficient, accurate, and user-oriented, patient satisfaction increases substantially.

The relationship between patient service digitalization (DLP) and patient satisfaction (KP) can be explained through technology-based service quality and user-behavior approaches. Patient service digitalization involves various forms of direct interaction between patients and healthcare institutions through digital media, such as online consultations, access to laboratory results, application-based health education, and two-way communication with medical staff. Within the SERVQUAL framework, the dimensions of responsiveness, assurance, and empathy serve as the main foundation for explaining patient-centered digital service quality. Studies show that digital services can enhance patient comfort and satisfaction (Alhassan et al., 2023; Chung, Park, & Lee, 2021; Famor Pratami et al., 2023). It can therefore be concluded that patient service digitalization has a positive and significant effect on patient satisfaction. When digital service systems are designed to be responsive, reliable, and empathetic, patients experience higher levels of satisfaction with their hospital experience. This relationship forms the basis for the first and second hypotheses of this study:

H1: Administrative digitalization has a positive and significant effect on patient satisfaction.
H2: Patient service digitalization has a positive and significant effect on patient satisfaction.

Digitalization and Patient Loyalty

The digitization of administration functions not only as a technical tool but also as a strategic mechanism that shapes patient experiences that are consistent, efficient, and trustworthy. When systems such as online registration, data verification, and electronic payment operate smoothly and are easy to use, patients form positive perceptions of the hospital, which, when reinforced over time, develop into loyalty.

According to Oliver (1997), loyalty emerges from profound and repeated satisfaction, encompassing behavioral (repeat visits), cognitive (service awareness), affective (emotional comfort), and conative (sustained intention) dimensions. Efficient and seamless administrative systems strengthen all four dimensions. The study by Alalwan et al. (2021) shows that perceived usefulness (PU) and perceived ease of use (PEU) in digital systems encourage loyalty among users of healthcare applications, a finding relevant to hospital contexts. Famor Pratami et al. (2023) also found that positive administrative digital experiences increase patients' intention to recommend the hospital, reflecting behavioral loyalty.

The relationship between DLP and patient loyalty (LP) can be explained through consumer behavior and long-term loyalty theories. Patient service digitalization includes direct interactions through digital media such as online consultations, access to laboratory results, application-based health education, and two-way communication with healthcare professionals. When services are designed to be responsive, secure, and empathetic, patients not only feel satisfied but also develop emotional attachment and commitment to the institution. Within the Patient Loyalty Theory framework, loyalty arises from consistent and valuable service experiences, reflected in repeat visits, recommendations, and resistance to switching to other providers. High-quality digital services strengthen positive perceptions and foster long-term loyalty.

Research by Lee, Han, and Kim (2020), Famor Pratami et al. (2023), and Chung et al. (2021) confirms that loyalty is influenced not only by clinical outcomes but also by the quality of digital interactions. Thus, the digitization of patient services has a positive effect on loyalty. Systems that are designed to be responsive, reliable, and empathetic are able to form emotional bonds and loyal behavior of patients towards hospitals. This forms the basis for the formulation of the third and fourth hypotheses:

H3: The digitization of administration has a positive and significant effect on patient loyalty
H4: The digitization of patient services has a positive and significant effect on patient loyalty.

Patient Satisfaction and Patient Loyalty

Patient satisfaction (KP) and patient loyalty (LP) form a core relationship within studies of healthcare consumer behavior. Satisfaction reflects an affective and cognitive evaluation of the service experience, both administrative and clinical. When services meet expectations, patients develop positive attitudes that, when experienced consistently, evolve into loyalty. Oliver (1997) explains that loyalty emerges from repeated and deep satisfaction. Satisfaction with digital systems, medical interactions, and the overall service process encourages revisit intention and positive advocacy for the hospital. The model by Dick and Basu (1994) reinforces this view by asserting that loyalty results from an interaction between positive attitudes and actual behavior.

Chung, Park, and Lee (2021) found that satisfaction with digital services directly influences loyalty. Alalwan et al. (2021) further emphasize that satisfaction is a key determinant of loyalty. Famor Pratami et al. (2023) assert that satisfying digital experiences contribute to long-term loyalty, particularly in private hospitals that compete on service quality. Thus, patient satisfaction has been shown to have a positive and significant effect on loyalty. When all aspects of service are perceived as satisfactory, patients tend to demonstrate sustained commitment to the institution. This relationship forms the basis for the fifth hypothesis:
H5: Patient satisfaction has a positive and significant effect on patient loyalty.

Digital Literacy

The Digital Literacy Framework by Ng (2012) explains that digital literacy consists of three main domains: technical literacy (the technical ability to use digital devices), cognitive literacy (the ability to understand and evaluate information), and social literacy (the ability to interact ethically and safely within digital environments). These three domains play an essential role in determining the extent to which patients can optimally utilize administrative digital systems.

Research by Zhou et al. (2022) shows that digital literacy strengthens the relationship between digital systems and user satisfaction, particularly in the healthcare sector. A study by Kordzadeh et al. (2023) also emphasizes that digital literacy functions as a moderating variable that enhances the positive effect of digitalization on perceived service quality. Meanwhile, Alhassan et al. (2023) found that the integration of digital systems accompanied by digital literacy education significantly increases patient satisfaction, especially in hospitals serving populations with diverse educational and age backgrounds.

Digital literacy is a multidimensional competency that includes technical, cognitive, and social skills in using information technology. In the Digital Literacy Framework (Ng, 2012), digital literacy consists of three main domains: technical literacy (the ability to use devices and applications), cognitive literacy (the ability to understand and evaluate information), and social literacy (the ability to interact ethically and safely in a digital environment).

Digital literacy is a multidimensional competency that encompasses technical, cognitive, and social abilities in using information technology. In the Digital Literacy Framework (Ng, 2012), digital literacy consists of three main domains: technical literacy (the ability to use digital devices and applications), cognitive literacy (the ability to understand and evaluate information), and social literacy (the ability to interact ethically and safely in digital environments). When patients possess high digital literacy, they are not only capable of using digital service systems but also able to understand medical information, communicate effectively, and feel confident throughout the service process.

A study by Alhassan et al. (2023) indicates that digital literacy enhances patient comfort and satisfaction toward application-based services, particularly in hospitals serving populations with varying educational backgrounds and age groups. Research by Zhou et al. (2022) further confirms that digital literacy serves as a moderating variable that strengthens the positive effect of digitalization on perceived service quality. Similarly, Kordzadeh et al. (2023) found that patients with high digital literacy exhibit higher levels of satisfaction with digital service systems because they are more capable of accessing, understanding, and utilizing the available features.

In this study, digital literacy functions as a moderating variable that strengthens the influence of both administrative digitalization and patient service digitalization on satisfaction. The positive effect of digitalization is stronger among patients with high digital literacy compared to those with low digital literacy. These findings reinforce that the success of digitalization is not

solely determined by the quality of the system but also by users' readiness and ability to access and operate it. It can thus be concluded that digital literacy moderates the relationship between administrative digitalization and patient satisfaction, where the effect is stronger among patients with higher levels of digital literacy. This relationship forms the basis for the sixth hypothesis in this study:

H6: Digital literacy moderates the relationship between administrative digitization and patient satisfaction, where its influence is stronger in patients with high digital literacy.

H7: Digital literacy moderates the relationship between patient service digitization and patient satisfaction, where its influence is stronger on patients with high digital literacy levels.

Perceived Usefulness and Perceived Ease of Use

Perceived usefulness refers to the extent to which individuals believe that using a digital system will enhance the effectiveness and efficiency of their activities. In the healthcare context, when patients feel that a digital system provides tangible benefits, such as easier access, time savings, and greater convenience, they are more likely to feel satisfied with the services provided. Perceived ease of use refers to the extent to which individuals believe that a digital system can be used easily, without requiring excessive effort. In healthcare settings, when patients perceive a digital system as easy to understand, access, and operate, they tend to feel more comfortable and satisfied with the service process.

According to the Technology Acceptance Model (TAM) developed by Davis (1989), perceived usefulness is one of the primary determinants shaping positive attitudes toward technology and promoting satisfaction and usage intention. Davis also identifies perceived ease of use as a key determinant that influences attitudes toward technology. Ease of use not only affects the intention to adopt digital systems but also has a direct impact on user satisfaction.

Alalwan et al. (2021) found that perceived usefulness acts as a mediator between the adoption of health technology and user satisfaction. When patients perceive that hospital digital systems or applications assist them in managing their health practically and efficiently, their satisfaction with the institution increases. A study by Chung et al. (2021) likewise confirms that perceived benefits of digital systems are a key factor in shaping positive evaluations of hospital services, particularly within the context of extensive digitalization.

Famor Pratami et al. (2023) found that digital experiences providing tangible value to patients contribute to higher satisfaction levels. This suggests that the success of digitalization depends not only on technical features but also on the extent to which patients experience direct and meaningful benefits from the system. Research by Alalwan et al. (2021) also demonstrates that perceived ease of use serves as a mediator between the adoption of health technology and user satisfaction. Meanwhile, Zhou et al. (2022) reaffirm that perceived ease of use is an important factor influencing positive evaluations of digital systems. Thus, it can be concluded that perceived usefulness mediates the effect of digitalization on patient satisfaction. When digital systems provide direct and meaningful benefits to patients, the influence of digitalization on satisfaction becomes stronger.

H8: Perceived usefulness mediates the effect of digitization on patient satisfaction.

H9: Perceived ease of use mediates the effect of digitization on patient satisfaction.

This research hypotheses imply that the success of digitalization depends not only on the quality of the system but also on the readiness and capability of its users. Perceived usefulness (PU) and perceived ease of use (PEU) function as key mediating variables that translate digital system implementation into patient responses. Within the TAM framework, digital features alone do not directly shape satisfaction or loyalty; instead, patients first evaluate whether the system is beneficial and whether it is easy to navigate. PU captures the extent to which digital services meaningfully improve efficiency, accuracy, or access to care, while PEU reflects the level of effort required to operate them. These cognitive assessments form the psychological bridge between digitalization and patient outcomes. When digital systems are perceived as both useful and easy to use, they enhance perceived service quality, raise satisfaction, and ultimately strengthen loyalty. Conversely, if PU and PEU are low, even advanced technologies fail to generate positive behavioral responses, underscoring their central role as mediators.

This model supports a multilevel hypothesis testing approach, ranging from the direct influence of digitalization on perceptions and satisfaction to the moderating effect of digital literacy in strengthening or weakening the relationships between variables. Through this approach, the study has the potential to generate strong theoretical and practical contributions to the development of technology-based healthcare service systems.

RESEARCH METHOD

This study uses a quantitative research approach. According to Sekaran and Bougie (2020), quantitative research is an empirical investigation that collects numerical data, which can be counted and statistically analyzed. The population of this study consists of all adult patients who have utilized digital administrative services and received medical treatment at the Private Hospital of Bekasi (RSBB), either through outpatient care, inpatient care, or the emergency department, within three months prior to the implementation of the study.

A purposive sampling technique was used to determine the sample, ensuring adequate representation of the target population. The minimum required sample size was calculated using the proportion estimation formula (Suliyanto, 2018), with a 95% confidence level ($\alpha = 5\%$) and an error margin of 10%. Based on this calculation, the minimum sample size required is 96 respondents. Primary data were collected through a questionnaire administered via a Google Forms link distributed directly to selected patients at Hospital in Bekasi. The use of a structured questionnaire format aims to minimize misinterpretation of questions and allows clarification of incomplete responses before finalizing the dataset.

The study employs Partial Least Squares–Structural Equation Modeling (PLS-SEM), which is a variance-based analytical technique used to examine relationships among constructs (Sternad Zabukovšek et al., 2022). PLS-SEM is particularly suitable for explaining the influence among latent variables within complex conceptual models. The analysis consists of two main sub-models: the outer model (measurement model), which evaluates the validity and reliability of indicators associated with each construct, and the inner model (structural model), which examines the relationships among constructs. Additionally, hypothesis testing is conducted to assess the significance of the effects among variables within the model.

RESULTS

Data analysis was conducted using Partial Least Squares Structural Equation Modeling (PLS-SEM), beginning with an evaluation of the measurement model (outer model), which included tests of convergent validity, discriminant validity, reliability, and model fit. This was followed by an assessment of the structural model (inner model), comprising analyses of the coefficient of determination (R-square), effect size (f-square), and hypothesis testing for direct, indirect, and moderating effects.

Based on the statistical analysis, all indicators satisfied convergent validity criteria, with outer loadings > 0.70 and AVE values > 0.50. The constructs Patient Satisfaction (0.794), Perceived Usefulness (0.781), and Digital Literacy (0.773) demonstrated excellent internal consistency. Discriminant validity was also achieved, with all indicators loading highest on their respective constructs, and the relational patterns of KP–LD (0.495–0.569) and KP–LP (0.551–0.755) aligned with theoretical expectations. Most constructs exhibited satisfactory reliability with Cronbach's alpha values > 0.70, except for Perceived Ease of Use (0.592), which fell slightly below the recommended threshold. The model fit assessment indicated that the SRMR value of 0.098 met the criteria, while the NFI value of 0.568 remained below the expected benchmark. Overall, the measurement model was deemed valid and reliable for further analysis, although some refinement is still required.

Upon confirming that the measurement model met the necessary requirements, the next step involved evaluating the structural model (inner model). This assessment included the examination of the coefficient of determination (R-square) as in Table 1, and the significance testing of research hypotheses. The results of this analysis provide comprehensive insights into the model's predictive capability and the contribution of each variable in explaining the variance of the endogenous constructs.

Table 1. Model Correlation

Constructs	R-square	R-square Adjusted
KP	0.552	0.525
LP	0.582	0.570
PEU	0.092	0.083
PU	0.380	0.374

Based on the inner model results, the research model demonstrates a reasonably strong predictive capability overall. The R-square value for the Patient Satisfaction (KP) construct is 0.552, indicating that 55.2% of the variance in patient satisfaction is explained by the predictor variables in the model, falling within the moderate to substantial category. Similarly, the R-square value for Patient Loyalty (LP) is 0.582, suggesting that 58.2% of its variance is explained by the model, which reflects strong predictive power.

However, there are striking variations in the explanatory power of the model across constructs. The Perceived Usefulness (PU) construct, with an R-square of 0.380, shows that 38% of its variance is explained by digital administrative processes. In contrast, Perceived Ease of Use (PEU) exhibits a notably lower R-square of 0.092, indicating that digital patient services explain only 9.2% of the variance in perceived ease of use. This implies that other external factors, beyond the scope of the current model, may exert a stronger influence on patients' perceptions of ease of use of hospital digital systems. The model successfully predicted the main outcomes (satisfaction and loyalty) well, but needs improvement, especially for the mediator construct of perceived ease of use as evident in Figure 1.

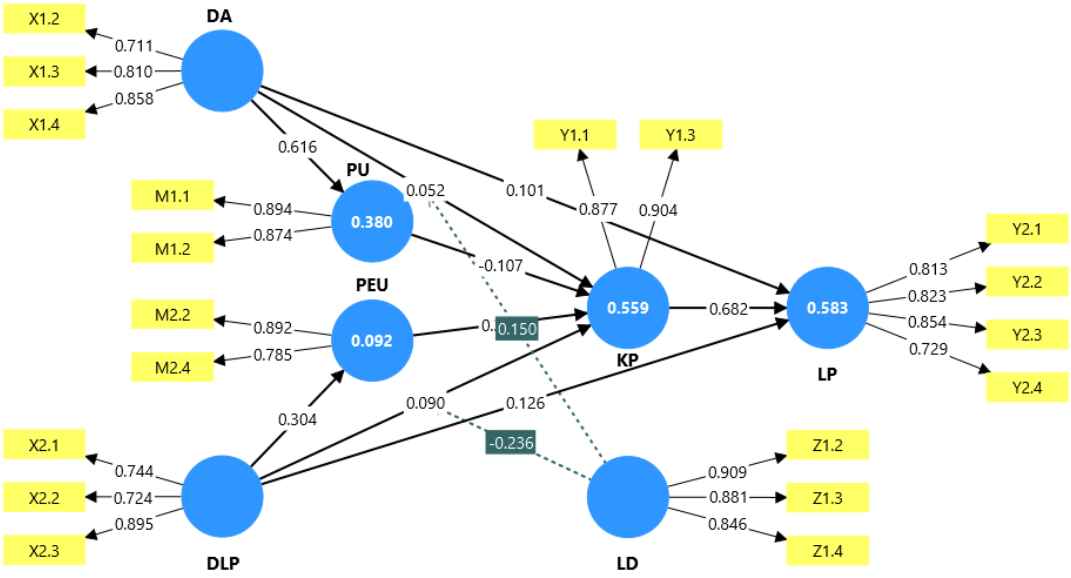

Figure 1. Inner Model

Based on the results of the inner model analysis presented, it can be interpreted that the research model demonstrates varying explanatory capabilities across constructs. The Patient Satisfaction (KP) construct attains an R-square value of 0.552, indicating that 55.2% of the variance in patient satisfaction is explained by the predictor variables in the model, an outcome categorized as moderate and theoretically adequate. Furthermore, the Patient Loyalty (LP) construct records an R-square of 0.582, representing that 58.2% of the loyalty variance is explained by the model, thereby reflecting substantive predictive strength for the final outcome of the study.

There is a significant disparity in the mediator construct. Perceived Usefulness (PU) shows an R-square of 0.380, revealing that administrative digitalization explains 38% of the variance in perceived usefulness—an acceptable proportion, yet one that still leaves room for other explanatory factors. Conversely, Perceived Ease of Use (PEU) attains an R-square of only 0.092, indicating that patient service digitalization contributes merely 9.2% to explaining the variance in perceived ease of use. This finding implies the presence of external factors not included in the

model that may exert a stronger influence on users' perceptions of ease of use in hospital digital systems. Overall, the model provides a solid empirical foundation for predicting behavioral outcomes (satisfaction and loyalty), although further refinement is required, particularly regarding the mechanisms underlying the formation of perceived ease of use.

The effect size provides information on the magnitude of influence exerted by an independent variable on a dependent variable after controlling for other variables in the model. The following presents the results of the effect size analysis, which reveal the relative contribution of each predictor variable in explaining the variance of the endogenous constructs. The effect size calculations are summarized in Table 2.

Table 2. Effect size (F-Square)

Related Constructs	KP	LD	LP	PEU	PU
DA	0.003		0.017		0.613
DLP	0.012		0.026	0.102	
KP			1.016		
LD	0.222				
LP					
PEU	0.244				
PU	0.015				
LD x DA	0.036				
LD x DLP	0.057				

Administrative Digitalization (DA) records a large effect size on Perceived Usefulness (PU), with an f^2 value of 0.613, indicating a substantial influence. Meanwhile, Digital Literacy (LD) demonstrates a medium effect size on Patient Satisfaction (KP), with an f^2 of 0.222, and a small-to-medium effect on Patient Loyalty (LP), with an f^2 of 0.244—reflecting a moderate yet meaningful contribution. On the other hand, most variables exhibit small to very small effect sizes. Patient Service Digitalization (DLP) on Perceived Ease of Use (PEU) records an f^2 of only 0.102, indicating a limited influence. Similarly, the moderating effects of LD × DLP on KP (0.057) and LD × DA on KP (0.036) reflect relatively weak interaction effects. The exceptionally large f^2 value of KP on LP (1.016) confirms the critical role of satisfaction as a precursor to loyalty. Overall, these findings highlight that while some relationships are substantively significant, several pathways require theoretical reconsideration due to their minimal effect sizes.

After evaluating the quality of both the measurement and structural models, the next stage involves testing the research hypotheses as in Table 3. This analysis examines the significance of the direct and indirect relationships among the constructs in the model. Presented below are the results of the hypothesis testing, which confirm the presence or absence of causal influences among the exogenous, mediating, and endogenous variables in accordance with the theoretical propositions developed.

Table 3. Direct Effect

Hypothesis	Paths	Effect	*t*-value	*p*-values	Result
H1	DA -> KP	0.052	0.517	0.303	Not supported
H2	DLP -> KP	0.090	0.942	0.173	Not supported
H3	DA -> LP	0.101	1.189	0.117	Not supported
H4	DLP -> LP	0.126	1.640	0.051	Not supported
H5	KP -> LP	0.682	13.693	0.000	Supported
H6	LD x DA -> KP	0.150	2.238	0.013	Supported
H7	LD x DLP -> KP	-0.236	2.753	0.003	Supported

Based on the results of the direct effects testing, the relationship between Patient Satisfaction (KP) and Patient Loyalty (LP) is found to be highly significant, with a path coefficient of 0.682 ($t = 13.693$, $p = 0.000$). This finding confirms the pivotal role of satisfaction as a key antecedent of loyalty in the context of digital healthcare services. In contrast, the direct effects of Administrative Digitalization (DA) and Patient Service Digitalization (DLP) on both KP and LP are

statistically insignificant, with all p-values above 0.05. These results indicate that digitalization does not directly influence behavioral outcomes without the presence of mediating mechanisms.

The most notable results emerge from the moderation analysis. The interaction between Digital Literacy and Administrative Digitalization (LD × DA → KP) yields a positive and significant effect (β = 0.150, t = 2.238, p = 0.013), indicating that digital literacy strengthens the influence of administrative digitalization on patient satisfaction. However, the interaction between Digital Literacy and Patient Service Digitalization (LD × DLP → KP) reveals a significant negative effect (β = –0.236, t = 2.753, p = 0.003), a counterintuitive finding suggesting that digital literacy weakens the relationship between patient service digitalization and satisfaction. This inconsistent moderation pattern highlights the complexity of digital literacy's role in digital transformation within healthcare services, warranting deeper investigation.

The analysis continued by evaluating indirect effects that explain the mediation mechanism in the research model. Testing these indirect effects aims to confirm the role of mediator variables in transmitting the influence of independent variables on dependent variables. The results of the indirect path analysis are presented in Table 4.

Table 4. Indirect Effect

Hypothesis	Paths	Effect	*t*-value	*p*-value	Result
H8	DA -> PU -> KP	-0.066	1.121	0.131	Not supported
H9	DLP -> PEU -> KP	0.115	2.193	0.014	Supported

Based on the results of the indirect effects analysis, the model exhibits an uneven mediation pattern. The mediation of Perceived Ease of Use (PEU) in the relationship between Patient Service Digitalization (DLP) and Patient Satisfaction (KP) is statistically significant, with an indirect path coefficient of 0.115 (t = 2.193, p = 0.014). This result confirms that patient service digitalization contributes to higher satisfaction through improved perceptions of system usability, a mediation mechanism consistent with the Technology Acceptance Model.

In contrast, the mediation of Perceived Usefulness (PU) in the relationship between Administrative Digitalization (DA) and Patient Satisfaction (KP) is not statistically significant, indicated by an indirect effect of –0.066 (t = 1.121, p = 0.131). The negative coefficient further suggests the presence of a suppression effect, indicating that the proposed mechanism may not operate as initially theorized. This nonsignificant mediation implies that the influence of administrative digitalization on satisfaction may not be transmitted through perceived usefulness, thereby requiring reconsideration of alternative mediating pathways that may be more relevant in digital healthcare settings.

DISCUSSION

The findings position patient satisfaction as the central mechanism through which digital healthcare experiences translate into loyalty, consistent with Expectation-Confirmation Theory (Oliver, 1980). Loyalty does not emerge from digitalization per se but from how patients evaluate the service experience shaped by that digitalization. This aligns with evidence that patient satisfaction and loyalty are key outcomes of successful digital transformation (Hu et al., 2025). In this sense, digital systems function as enablers of experience rather than direct drivers of behavioral outcomes.

The absence of direct effects from digitalization to satisfaction and loyalty challenges the assumption that technological adoption automatically improves patient outcomes. Prior work emphasizes that system integration and usability determine the effectiveness of digital services (Alshahrani & Alalwan, 2022), while perceived usefulness and ease of use shape user responses (Prasetyo & Lestari, 2021; Alalwan et al., 2021). The findings reinforce that digital transformation is a socio-technical process in which technology must align with user perception and experience to generate value.

Digital literacy further refines this relationship by acting as a conditional capability. As conceptualized within the digital literacy framework, it encompasses technical, cognitive, and social competencies in interacting with digital systems (Ng, 2022). Evidence shows that digital literacy strengthens the relationship between technology use and patient outcomes (Zhou et al., 2022; Kordzadeh et al., 2023; Alhassan et al., 2023), and reduces barriers associated with system

complexity (Norman & Skinner, 2021). In administrative contexts, this capability enhances the ability to navigate structured processes, thereby improving perceived service value.

However, digital literacy does not uniformly amplify positive outcomes. Cognitive Load Theory suggests that individuals with higher competence develop higher expectations regarding system performance and clarity. When these expectations are unmet, dissatisfaction may intensify. This explains why digitally capable patients may evaluate patient-facing services more critically, indicating that capability elevates evaluative standards rather than simply facilitating adoption.

The mediating role of perceived ease of use confirms its importance as a mechanism linking digital interaction to satisfaction, as proposed in the Technology Acceptance Model (Davis, 1989). Systems that reduce effort and enhance clarity improve patient evaluation of services. At the same time, administrative digitalization does not generate satisfaction through this pathway alone. Consistent with Herzberg's Two-Factor Theory, such systems operate as hygiene factors: their proper functioning prevents dissatisfaction but does not necessarily create satisfaction.

The findings advance a layered understanding of digital healthcare adoption in which satisfaction mediates behavioral outcomes, while digital literacy and perceived ease of use condition how digitalization is experienced. By integrating Technology Acceptance Model (Davis, 1989), SERVQUAL (Parasuraman et al., 1988), and the Digital Literacy Framework (Ng, 2012; UNESCO, 2018), this study offers a more precise explanation of patient behavior. It demonstrates that digital literacy not only strengthens relationships but reshapes the mechanism through which perceived usefulness and ease of use translate into satisfaction and loyalty, extending prior work on technology-driven patient behavior (Alalwan et al., 2021; Zhou et al., 2022).

CONCLUSION AND FURTHER STUDY

The overall research model meets the required criteria for validity and reliability. Administrative and patient service digitalization do not exert a direct influence on patient satisfaction or patient loyalty; instead, their effects operate through more complex mediation and moderation mechanisms. Perceived Ease of Use significantly mediates the relationship between patient service digitalization and satisfaction, whereas Perceived Usefulness fails to mediate the relationship between administrative digitalization and satisfaction. Digital literacy demonstrates contrasting moderation effects, strengthening the influence of administrative digitalization while weakening the influence of patient service digitalization on satisfaction. The key findings of this study reaffirm that patient satisfaction is the primary determinant of patient loyalty within the context of hospital digital transformation.

Based on these findings, several strategic recommendations are proposed. For hospital management, a differentiated approach to digital transformation is suggested, emphasizing improvements in ease of use for clinical services and the optimization of functional benefits for administrative services. Patient digital literacy programs should be selectively enhanced, prioritized for administrative services, while clinical services should focus on improving system reliability and security. Patient segments with lower digital literacy, particularly elderly users and patients with limited prior exposure to online health platforms, should receive priority in targeted literacy support. Digital features that require immediate prioritization include online registration, digital payment systems, and access to laboratory results, since these introduce the highest friction for patients. Clinical service platforms should prioritize secure login processes, fast-loading interfaces, and clear navigation to ensure reliability for users across all segments. For future research, scholars are encouraged to explore alternative mediators such as perceived efficiency and trust, and to broaden the sample coverage across various types of healthcare facilities. The implementation of these recommendations is expected to optimize the benefits of digital transformation in enhancing the patient experience in a holistic manner.

ETHICAL DISCLOSURE

All research procedures comply with established ethical standards for research involving human participants. Informed consent was obtained from all respondents prior to data collection, and participation was voluntary. All data were treated confidentially and used exclusively for research purposes, with no disclosure of personal identities or sensitive information.

CONFLICT OF INTERESTS

The authors declare that there are no conflicts of interest pertaining to this study.

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