

The Influence of Digital Service Quality on Patient Satisfaction and Patient Loyalty: The Moderating Role of Digital Literacy in Regional General Hospitals

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Abstract

This study aims to analyze the influence of Digital Service Quality on Patient Satisfaction and Patient Loyalty, test the mediating role of Patient Satisfaction, and analyze the moderating role of Digital Literacy in the relationship between variables in the context of digital healthcare services. The study used a quantitative approach with a survey design, with data collected through questionnaires from 205 patients who had used digital services at a regional general hospital in North Halmahera in the last six months. A purposive sampling technique was applied, and data analysis was performed using Partial Least Squares Structural Equation Modeling (PLS-SEM) to test models involving direct relationships, mediation, and moderation. The results of the analysis showed that Digital Service Quality had a positive and significant effect on Patient Satisfaction ($\beta = 0.378$; $p = 0.015$) and Patient Loyalty ($\beta = 0.371$; $p = 0.000$). Patient Satisfaction also significantly influences Patient Loyalty ($\beta = 0.333$; $p = 0.000$) and partially mediates the relationship between Digital Service Quality and Patient Loyalty ($\beta = 0.126$; $p = 0.038$), confirming its role as an important mechanism in translating digital service experiences into loyal behavioral intentions. Digital Literacy does not moderate the effect of Digital Service Quality on Patient Satisfaction ($\beta = -0.031$; $p = 0.242$), but is proven to significantly strengthen the effect of Digital Service Quality on Patient Loyalty ($\beta = 0.289$; $p = 0.004$). The results of the Importance Performance Map Analysis (IPMA) identified Digital Service Quality as the most crucial strategic factor in increasing Patient Loyalty, although its performance level is relatively suboptimal. These findings emphasize the importance of continuous improvement of Digital Service Quality and strengthening patient digital literacy as a key strategy in building patient loyalty in regional hospitals.

Keywords: *Digital Service Quality, Patient Satisfaction, Patient Loyalty, Digital Literacy, Regional Hospital.*

INTRODUCTION

The development of digital technology is driving hospitals to transform towards faster, more efficient, and patient-experience-oriented digital healthcare services. In many developing countries, digital health

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has been shown to improve access and Digital Service Quality (Erku et al., 2023). However, digitalization has also given rise to new competition among healthcare facilities, competing to offer easier, faster, and more accurate digital services. This competition has resulted in a decline in patient loyalty for hospitals that are unable to provide stable and responsive digital services. This phenomenon is also experienced by the Regional General Hospital (RSUD) in North Halmahera, which has begun implementing online registration, digital queues, and electronic medical records, but still faces complaints regarding slow access, inaccurate information, and obstacles to using the application. This condition indicates a service gap that can weaken the patient experience amidst the increasing choice of digital services from other facilities in the surrounding area.

In the context of Digital Service Quality, various studies have shown that service quality is a key driver of patient satisfaction and loyalty (Nguyen et al., 2021; Shie et al., 2022). Clear, consistent, and user-friendly services play a direct role in building loyalty (Phonthanakitithaworn et al., 2020), while poor digital services can accelerate patient switching to other providers. Changing patient preferences, which are now more sensitive to digital convenience, also reinforce the urgency of improving Digital Service Quality in hospitals. Recent studies confirm that the local environment, including infrastructure readiness and responsiveness of digital services, significantly determines patient engagement and loyalty (Aljafari et al., 2023). This is a crucial concern for the Regional General Hospital (RSUD) in North Halmahera, which operates in an archipelago with diverse network and digital literacy challenges.

Patient satisfaction has been shown to be a powerful mediator in determining loyalty. Satisfied patients are more likely to return for treatment and demonstrate long-term loyalty (AlOmari & Hamid, 2022; Rahman et al., 2021). However, satisfaction is strongly influenced by the quality of digital interactions, clarity of information, and ease of service procedures, as evidenced in various outpatient care contexts (Kanwel et al., 2024; Dayan et al., 2021). When digital systems are not functioning optimally, satisfaction will decline, even if overall clinical service is good.

Another important factor that cannot be ignored is patient digital literacy. The ability to understand and use digital technology significantly influences the experience and patient satisfaction of application-based services. Low digital literacy can widen the access gap and reduce the effectiveness of digital services (Campanozzi et al., 2023) and impact patients' ability to follow important health information (Fitzpatrick, 2023). Therefore, digital literacy has the potential to act as a moderator that strengthens or weakens the influence of digital service quality on satisfaction and patient loyalty. Those with low literacy are more susceptible to confusion and frustration when using hospital digital services.

This research gap arises because most previous studies have focused on conventional Digital Service Quality (Nguyen et al., 2021; Shie

et al., 2022), with few examining the complex interactions between Digital Service Quality, Satisfaction, Loyalty, and Digital Literacy, particularly in the context of regional hospitals in island regions. Furthermore, the dynamics of competition among local digital healthcare providers (Aljafari et al., 2023) have not been extensively analyzed in relation to Patient Loyalty in regional hospitals.

Thus, this study is crucial for understanding how Digital Service Quality influences satisfaction and patient loyalty at North Halmahera Regional Hospital amidst increasing competition in the healthcare sector and changing patient expectations. This study also offers a novel contribution by incorporating Digital Literacy as a moderating variable, filling the empirical gap regarding the implementation of digital healthcare services in regional hospitals facing challenges in geography, infrastructure, and user readiness.

LITERATURE REVIEW

Digital Service Quality

Digital Service Quality in the hospital context refers to the extent to which digital technology can provide convenience, speed, clarity, and security in the patient care process. Digital transformation in the healthcare sector has been shown to improve administrative efficiency, information access, and patient convenience, especially when digital service systems are implemented effectively (Kanwel et al., 2024).

Other studies have shown that responsive, user-friendly, and accurate digital systems are important factors in shaping perceptions of service quality in healthcare facilities (Aljafari et al., 2023). Erku et al. (2023) emphasized that digital health interventions not only accelerate services but also improve the overall quality of primary care. Therefore, Digital Service Quality is fundamental to creating a positive service experience and influences how patients assess the overall performance of a hospital.

Patient Satisfaction

Patient satisfaction is an emotional and cognitive evaluation of their experience receiving healthcare services and is consistently considered an important indicator of Digital Service Quality. Nguyen et al. (2021) explain that satisfaction occurs when the Digital Service Quality received meets or exceeds patient expectations, particularly in inpatient care. Other research shows that improving Digital Service Quality, both traditional and digital, can increase trust, comfort, and perceived value, thereby increasing satisfaction (Shie et al., 2022).

In the digital era, ease of navigation, reliable information, and faster administrative processes contribute to a more positive patient experience (Kanwel et al., 2024). Thus, patient satisfaction is a key outcome of Digital Service Quality and plays a crucial role in shaping subsequent patient behavior.

Patient Loyalty

Patient loyalty refers to a patient's willingness to return to a hospital and recommend it to others. Research shows that loyalty is strongly influenced by digital service quality, positive experiences, and previous patient satisfaction (Dayan et al., 2021). Rahman et al. (2021) found that hospitals that provide high-quality services are able to build long-term relationships with patients, thereby increasing loyal behaviors such as repeat visits and recommendations.

Phonthanukitithaworn et al. (2020) also stated that a positive hospital image supported by good digital service quality is a key factor in shaping loyalty. In the context of digital services, practicality and consistency of service contribute to strengthening patient trust and commitment to healthcare facilities. This confirms that loyalty is not only shaped by emotional factors, but also by the performance of the service system perceived by patients.

Digital Literacy

Digital literacy is an individual's ability to access, understand, evaluate, and effectively use digital technology, including digital health applications. Research shows that digital literacy plays a crucial role in ensuring optimal public utilization of digital health services (Campanozzi et al., 2023). Fitzpatrick (2023) emphasized that digital literacy directly impacts patients' ability to understand digital health information and enhance their engagement with services.

Low levels of digital literacy can create gaps in service access and potentially hinder the successful implementation of digital health. In the hospital context, digital literacy determines whether patients can easily navigate queuing applications, online registration, or health information portals. Therefore, digital literacy can moderate the relationship between digital service quality and patient experience.

Digital Service Quality and Patient Satisfaction

Digital Service Quality is becoming a factor that increasingly determines patient satisfaction levels in the modern era, especially as hospitals begin to shift from traditional systems to technology-based services. Kanwel et al. (2024) showed that digital transformation in healthcare services, such as digital registration systems and electronic queue management, can improve efficiency and increase patient perceptions of the digital service quality they receive. This is in line with the findings of Erku et al. (2023) who confirmed that digital health interventions directly improve accessibility and primary digital service quality, thereby contributing to increased patient satisfaction.

Good digital service quality, such as easy navigation, speed of access, and information reliability, create a more comfortable and effective service experience. Empirical evidence from Nguyen et al. (2021) also confirms that improving digital service quality is a key determinant

of patient satisfaction. Therefore, the better the digital service quality provided, the higher the resulting patient satisfaction level.

H₁: Digital Service Quality has a positive and significant effect on Patient Satisfaction.

Digital Service Quality and Patient Loyalty

Patient loyalty in the digital era is heavily influenced by digital service quality delivered through a hospital's digital platform. A good digital experience increases perceived value and trust, ultimately encouraging patients to continue using the same healthcare service in the future. Dayan et al. (2021) emphasized that digital service quality is a strong predictor of loyalty, as consistent and accessible services foster long-term patient relationships.

Other research indicates that image and digital service quality are crucial factors in building patient loyalty in the healthcare context (Phonthanakitithaworn et al., 2020). With the advancement of healthcare technology, patients tend to value fast, accurate, and reliable digital services. Erku et al. (2023) also stated that effective digital systems drive higher patient engagement, ultimately strengthening patient loyalty. Therefore, superior digital service quality will encourage patients to continue choosing the same hospital.

H₂: Digital Service Quality has a positive and significant effect on Patient Loyalty.

Patient Satisfaction and Patient Loyalty

Patient satisfaction has long been recognized as a key determinant of patient loyalty in the healthcare context. Rahman et al. (2021) demonstrated that satisfied patients are more likely to return to a hospital and recommend it to others. This relationship was also confirmed by AlOmari and Hamid (2022), who found that patient satisfaction plays a significant mediating role in increasing patient loyalty and compliance.

Shie et al. (2022) emphasized that positive patient experiences, including trust and comfort during service interactions, are crucial foundations for strengthening long-term loyalty. In the context of digital services, satisfaction is also influenced by ease of access, speed, and reliability of the technology supporting the service experience. Therefore, consistently high levels of satisfaction increase patient commitment to remain loyal to hospital services.

H₃: Patient Satisfaction has a positive and significant effect on Patient Loyalty

Patient Satisfaction in the Relationship Between Digital Service Quality and Patient Loyalty

Good Digital Service Quality not only directly impacts loyalty but also creates positive experiences that enhance Patient Satisfaction as a mediating pathway. Nguyen et al. (2021) explain that quality service

experiences shape patients' perceptions of value and comfort, which then influence their loyalty.

Satisfaction, a mediator, is further supported by the findings of Al Omari and Hamid (2022), who state that satisfaction is a crucial mechanism in linking Digital Service Quality with loyalty behavior. When patients are satisfied with the ease of access, responsiveness, and effectiveness of digital systems, they will be more likely to trust and feel connected to the hospital in question. Kanwel et al. (2024) also emphasize that service digitalization increases positive patient perceptions, leading them to demonstrate higher levels of satisfaction. Thus, Patient Satisfaction acts as a bridge that strengthens the relationship between Digital Service Quality and Patient Loyalty.

H₄: Patient Satisfaction mediates the influence of Digital Service Quality on Patient Loyalty

Digital Literacy in the Relationship Between Digital Service Quality and Patient Satisfaction

Digital literacy is a crucial factor in determining how patients utilize and perceive a hospital's digital service quality. Patients with high levels of digital literacy are better able to navigate applications, understand digital information, and utilize service features, making it easier for them to experience the benefits of quality digital services. Campanozzi et al. (2023) emphasize that digital literacy is a crucial prerequisite for optimal access to digital healthcare services.

Fitzpatrick (2023) reinforces this view by stating that digital literacy contributes to a better understanding and utilization of health information, ultimately improving health outcomes. When a high-quality digital service system is confronted by patients with low digital literacy, perceived benefits are reduced, resulting in lower satisfaction levels. Conversely, high digital literacy strengthens the relationship between digital service quality and satisfaction, making it a relevant moderating variable.

H₅: Digital Literacy moderates the influence of Digital Service Quality on Patient Satisfaction

Digital Literacy in the Relationship Between Digital Service Quality and Patient Loyalty

In the context of digital healthcare, patient loyalty is not only influenced by digital service quality, but also by the patient's ability to understand and utilize these services. Patients with high digital literacy are better able to experience the benefits of digital services comprehensively, which ultimately strengthens their commitment to the hospital. Aljafari et al. (2023) showed that patient interactions with digital services are strongly influenced by the environment and level of digital literacy, which determines whether the service increases patient engagement.

Research by Erku et al. (2023) also confirmed that the effectiveness of digital services is highly dependent on the user's ability to utilize them

optimally. Thus, digital literacy strengthens the relationship between digital service quality and loyalty because digitally literate patients tend to have more positive and consistent experiences. Therefore, digital literacy acts as an important moderator that strengthens the influence of digital service quality on patient loyalty.

H₆: Digital Literacy moderates the influence of Digital Service Quality on Patient Loyalty

METHOD

This study uses a quantitative approach with a survey design to test the influence of Digital Service Quality, Patient Satisfaction, Patient Loyalty, and the moderating role of Digital Literacy at North Halmamera Regional Hospital. The population in this study were all patients of the Regional General Hospital in North Halmamera who had used the hospital's digital services, such as online registration, digital queuing system, electronic medical records, and application-based information services. This population was chosen because they have direct experience with Digital Service Quality and are therefore able to provide relevant assessments of Satisfaction and Patient Loyalty. Considering that the exact number of users of the Regional General Hospital's digital services in North Halmamera is not available in detail, this study used a *non-probability sampling technique* with a *purposive sampling approach*, namely only selecting respondents who met the criteria of having used digital services at least once in the last six months.

The sample size was determined based on PLS-SEM analysis recommendations, where the minimum sample size follows the *10-times rule* based on the largest number of relationships leading to a single construct. Modern statistical considerations recommend a minimum of 150–200 respondents for structural models with complex moderation and mediation (Hair et al., 2021). Therefore, this study set a sample size of 200 patients to ensure the reliability of the analysis and the accuracy of the structural model estimates. Data were collected through the distribution of structured questionnaires to patients who had used the hospital's digital services, allowing for direct measurement of variables based on respondents' perceptions.

Data analysis was conducted using the Partial Least Squares Structural Equation Modeling (PLS-SEM) method because the research model encompasses complex relationships, including direct effects, mediation, and moderation. PLS-SEM was chosen because it can handle models with latent variables and multiple indicators and is suitable for predictive and exploratory research with a relatively small sample size (Hair et al., 2021). The analysis procedure included a measurement model evaluation to assess reliability and construct validity, followed by a structural model evaluation to test predictive power and the significance of relationships between variables. Furthermore, mediation and moderation tests were conducted using a bootstrapping approach to enhance estimation accuracy. Using this method, the study is expected

to provide a comprehensive empirical picture of the role of Digital Service Quality and Digital Literacy in shaping Satisfaction and Patient Loyalty.

RESULT

Table 1. Descriptive Analysis Results

	Mean	Median	Scale min	Scale max	Standard deviation
DSQ1	4,317	5	1	5	1,027
DSQ2	4,122	4	1	5	0,926
DSQ3	4,351	5	1	5	0,970
DSQ4	4,283	5	1	5	1,011
DSQ5	4,088	4	1	5	0,954
DSQ6	4,215	4	1	5	1,065
DSQ7	4,263	4	1	5	0,997
DSQ8	4,254	4	1	5	0,980
DSQ9	4,210	4	1	5	0,963
DSQ10	4,317	5	1	5	0,954
DSQ11	4,146	4	1	5	1,016
DSQ12	4,224	4	1	5	0,962
DSQ13	4,239	4	1	5	0,976
DSQ14	4,254	4	1	5	0,970
DSQ15	4,254	5	1	5	1,019
DSQ16	4,215	4	1	5	0,984
DSQ17	4,239	4	1	5	0,971
DSQ18	4,180	4	1	5	0,993
DSQ19	4,254	4	1	5	0,995
DSQ20	4,205	4	1	5	0,996
DSQ21	4,307	5	1	5	1,011
DSQ22	4,224	4	1	5	0,962
DSQ23	4,229	4	1	5	1,013
DSQ24	4,234	4	1	5	0,918
DSQ25	4,288	4	1	5	0,894
PS1	4,390	5	1	5	0,852
PS2	4,341	4	1	5	0,790
PS3	4,395	5	1	5	0,835
PS4	4,351	4	1	5	0,828
PL1	4,351	4	1	5	0,811
PL2	4,322	4	1	5	0,834
PL3	4,405	5	1	5	0,794
PL4	4,346	4	1	5	0,816
PL5	4,400	5	1	5	0,818
DL1	4,341	4	1	5	0,809
DL2	4,390	5	1	5	0,817
DL3	4,366	5	1	5	0,831
DL4	4,259	4	1	5	0,812
DL5	4,415	5	1	5	0,832
DL6	4,400	5	1	5	0,800
DL7	4,356	4	1	5	0,841
DL8	4,405	5	1	5	0,801
DL9	4,366	4	1	5	0,795
DL10	4,293	4	1	5	0,868

DL11	4,366	5	1	5	0.837
DL12	4,288	4	1	5	0.850
DL13	4,346	4	1	5	0.822
DL14	4,405	5	1	5	0.831
DL15	4,327	4	1	5	0.824
DL16	4,356	4	1	5	0.805
DL17	4,356	5	1	5	0.875
DL18	4,273	4	1	5	0.891
DL19	4,376	5	1	5	0.821
DL20	4,420	5	1	5	0.796
DL21	4,317	4	1	5	0.804
DL22	4,410	5	1	5	0.860

The descriptive analysis results show that all indicators in the Digital Service Quality (DSQ), Patient Satisfaction (PS), Digital Literacy (PL), and Patient Loyalty (DL) constructs have relatively high mean values (above 4.00) with a scale range of 1–5. This indicates that respondents generally gave positive assessments to all aspects measured. The standard deviation value in the range of 0.79–1.06 indicates a moderate level of variation in answers, so that respondents' perceptions are relatively homogeneous and do not show extreme deviations.

This research begins with an outer model test, namely a test of the relationship between indicators and variables as follows:

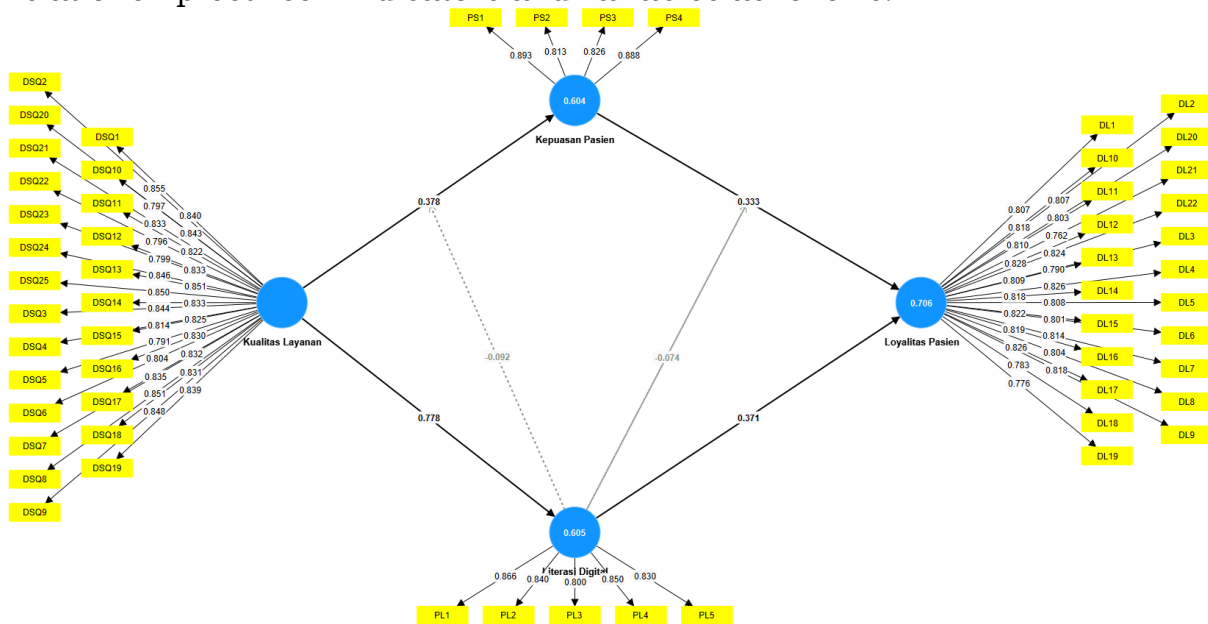


Figure 1. Outer Model

Further results are presented as follows:

Table 2. Outer Loadings Results

	Patient Satisfaction	Digital Service Quality	Digital Literacy	Patient Loyalty
DL1				0.807
DL10				0.818
DL11				0.810
DL12				0.828
DL13				0.809

DL14				0.818
DL15				0.822
DL16				0.819
DL17				0.826
DL18				0.783
DL19				0.776
DL2				0.807
DL20				0.803
DL21				0.762
DL22				0.824
DL3				0.790
DL4				0.826
DL5				0.808
DL6				0.801
DL7				0.814
DL8				0.804
DL9				0.818
DSQ1		0.840		
DSQ10		0.843		
DSQ11		0.822		
DSQ12		0.833		
DSQ13		0.851		
DSQ14		0.833		
DSQ15		0.825		
DSQ16		0.830		
DSQ17		0.832		
DSQ18		0.831		
DSQ19		0.839		
DSQ2		0.855		
DSQ20		0.797		
DSQ21		0.833		
DSQ22		0.796		
DSQ23		0.799		
DSQ24		0.846		
DSQ25		0.850		
DSQ3		0.844		
DSQ4		0.814		
DSQ5		0.791		
DSQ6		0.804		
DSQ7		0.835		
DSQ8		0.851		
DSQ9		0.848		
PL1			0.866	
PL2			0.840	
PL3			0.800	
PL4			0.850	
PL5			0.830	
PS1	0.893			
PS2	0.813			
PS3	0.826			
PS4	0.888			

All indicators had outer loading values above 0.70, indicating that each indicator was able to strongly represent the latent construct. This indicates that convergent validity was met, so no indicators needed to be eliminated from the measurement model.

Table 3. HTMT Results

	Patient Satisfaction	Digital Service Quality	Digital Literacy	Patient Loyalty
Patient Satisfaction				
Digital Service Quality	0.785			
Digital Literacy	0.787	0.828		
Patient Loyalty	0.814	0.801	0.822	

The HTMT values between constructs are below the threshold of 0.90, indicating that each construct has good discriminant validity. Thus, each construct in the model truly measures a distinct concept and does not overlap excessively.

Table 4. Validity and Reliability Constructs

	Cronbach's Alpha	Composite Reliability (rho_a)	Composite Reliability (rho_c)	Average Variance Extracted (AVE)
Patient Satisfaction	0.877	0.877	0.916	0.732
Digital Service Quality	0.981	0.981	0.982	0.689
Digital Literacy	0.893	0.895	0.921	0.701
Patient Loyalty	0.975	0.975	0.976	0.653

The Cronbach's Alpha and Composite Reliability (rho_a and rho_c) values for all constructs were above 0.70, and the AVE values were above 0.50. These results confirm that all constructs have excellent internal reliability and convergent validity.

Table 5. VIF Results

	VIF
DL1	4.137
DL10	3,904
DL11	3,614
DL12	4,331
DL13	3,752
DL14	4,261
DL15	4,873
DL16	4,674
DL17	4,077
DL18	3.136
DL19	3,119
DL2	3,702
DL20	3,287
DL21	3,253
DL22	4,572
DL3	3,576
DL4	4,386
DL5	3,790
DL6	3,949
DL7	3,811

DL8	3,973
DL9	4,976
DSQ1	4,547
DSQ10	4,753
DSQ11	3,675
DSQ12	3,737
DSQ13	4,164
DSQ14	3,796
DSQ15	4,491
DSQ16	3,962
DSQ17	3,957
DSQ18	4,035
DSQ19	3,972
DSQ2	4,288
DSQ20	3,437
DSQ21	4,214
DSQ22	3,818
DSQ23	3,315
DSQ24	4,762
DSQ25	4,778
DSQ3	4,342
DSQ4	3,323
DSQ5	3,238
DSQ6	3,465
DSQ7	3,940
DSQ8	4,074
DSQ9	4,590
PL1	3,711
PL2	3,297
PL3	2,315
PL4	3,478
PL5	3,129
PS1	3,207
PS2	1,752
PS3	1,920
PS4	3,157

All indicators have VIF values below the critical limit of 5.0, indicating that there is no multicollinearity problem in the measurement model. Thus, the parameter estimates can be interpreted stably.

The next stage is to test the inner model, namely the relationship between variables and other variables as follows:

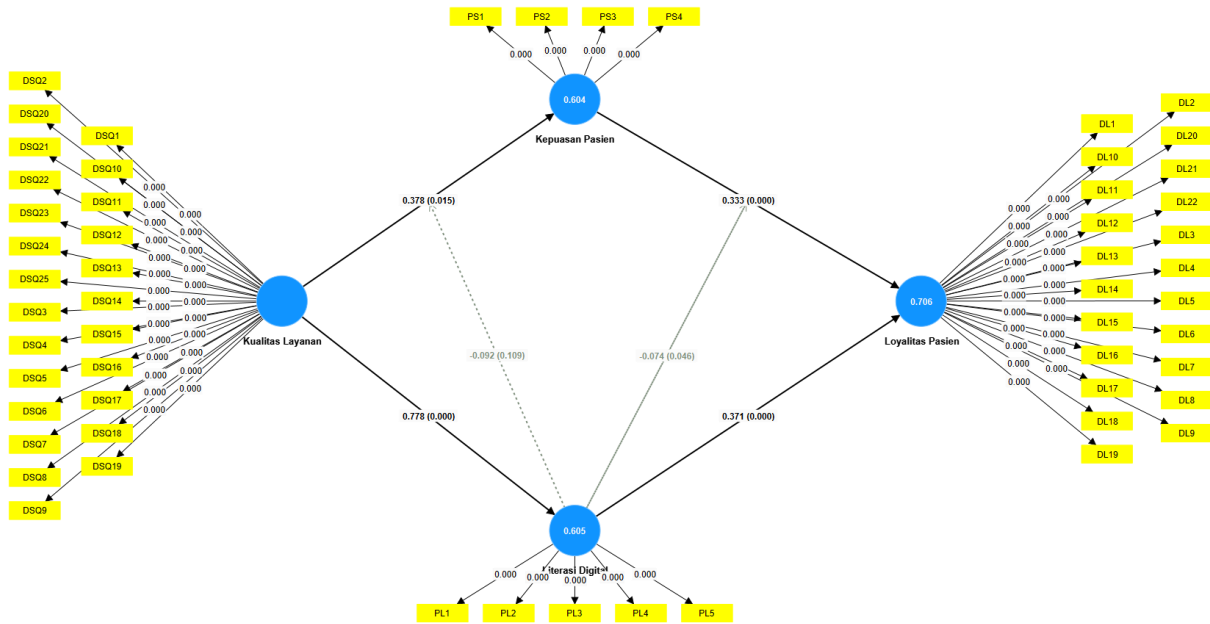


Figure 2. Inner Model

Further results of the inner model are presented as follows:

Table 6. R Square Results

	R-square	R-square Adjusted
Patient Satisfaction	0.604	0.598
Digital Literacy	0.605	0.603
Patient Loyalty	0.706	0.701

The R² value indicates that Patient Satisfaction and Digital Literacy are in the moderate category, while Patient Loyalty has strong explanatory power (R² = 0.706). This indicates that the independent variables in the model are able to explain variations in Patient Loyalty substantially.

Table 7. F Square Results

	f-square
Patient Satisfaction -> Patient Loyalty	0.157
Digital Service Quality -> Patient Satisfaction	0.124
Digital Service Quality -> Digital Literacy	1,532
Digital Literacy -> Patient Satisfaction	0.036
Digital Literacy -> Patient Loyalty	0.190
Digital Literacy x Patient Satisfaction -> Patient Loyalty	0.070
Digital Literacy x Digital Service Quality -> Patient Satisfaction	0.052

The f² results show that Digital Service Quality has a large effect on Digital Literacy, while the influence of Patient Satisfaction and Digital Literacy on Patient Loyalty is in the medium category. The moderating effect of Digital Literacy shows a small to medium effect, indicating a limited but still relevant reinforcing role.

Table 8. Q Square

	Q ² predict	RMSE	MAE
Patient Satisfaction	0.460	0.785	0.426
Digital Literacy	0.582	0.684	0.348
Patient Loyalty	0.535	0.718	0.321

The Q^2 predict values for all constructs are positive (> 0), indicating that the model has good predictive ability. The relatively low RMSE and MAE values indicate an acceptable level of prediction error.

Table 9. Hypothesis Test Results

Code	Hypothesis	Original Sample (O)	t Statistics	p Values	Decision
H1	Digital Service Quality → Patient Satisfaction	0.378	2,425	0.015	Accepted
H2	Digital Service Quality → Patient Loyalty	0.371	3,486	0.000	Accepted
H3	Patient Satisfaction → Patient Loyalty	0.333	3,923	0.000	Accepted
H4	Patient Satisfaction mediates the influence of Digital Service Quality on Patient Loyalty	0.126	2,073	0.038	Accepted
H5	Digital Literacy moderates the influence of Digital Service Quality on Patient Satisfaction	-0.031	1,170	0.242	Rejected
H6	Digital Literacy moderates the influence of Digital Service Quality on Patient Loyalty	0.289	2,880	0.004	Accepted

H1: The test results show that Digital Service Quality has a positive and significant effect on Patient Satisfaction with a coefficient value of 0.378 and a p-value of 0.015. This finding indicates that the better the Digital Service Quality perceived by patients, such as ease of access, system reliability, and speed of service, the higher the level of Patient Satisfaction with the health services received.

H2: The second hypothesis states that Digital Service Quality has a positive and significant effect on Patient Loyalty, and the analysis results support this hypothesis ($O = 0.371$; $p = 0.000$). This indicates that good Digital Service Quality can encourage patients' intention to reuse services, recommend healthcare facilities, and build long-term relationships with service providers.

H3: Testing the influence of Patient Satisfaction on Patient Loyalty shows positive and significant results with a coefficient of 0.333 and a p-value of 0.000. This finding confirms that Patient Satisfaction is a key factor in forming loyalty, where satisfied patients tend to show a higher commitment to healthcare facilities.

H4: The results of the indirect effect test show that Patient Satisfaction significantly mediates the influence of Digital Service Quality on Patient Loyalty ($O = 0.126$; $p = 0.038$). This indicates that Digital Service Quality not only has a direct impact on Patient Loyalty, but also works through increasing Patient Satisfaction as a mediating mechanism that strengthens that loyalty.

H5: Moderation effect testing shows that Digital Literacy does not moderate the influence of Digital Service Quality on Patient Satisfaction, indicated by a coefficient value of -0.031 and a p-value of 0.242. This finding indicates that the patient's level of Digital Literacy does not strengthen or weaken the relationship between Digital Service Quality

and Patient Satisfaction, so that Patient Satisfaction tends to be directly influenced by Digital Service Quality itself.

H6: Conversely, the test results show that Digital Literacy significantly moderates the effect of Digital Service Quality on Patient Loyalty ($O = 0.289$; $p = 0.004$). This indicates that patients with higher levels of Digital Literacy are able to utilize digital services more optimally, thereby strengthening the influence of Digital Service Quality on the formation of Patient Loyalty.

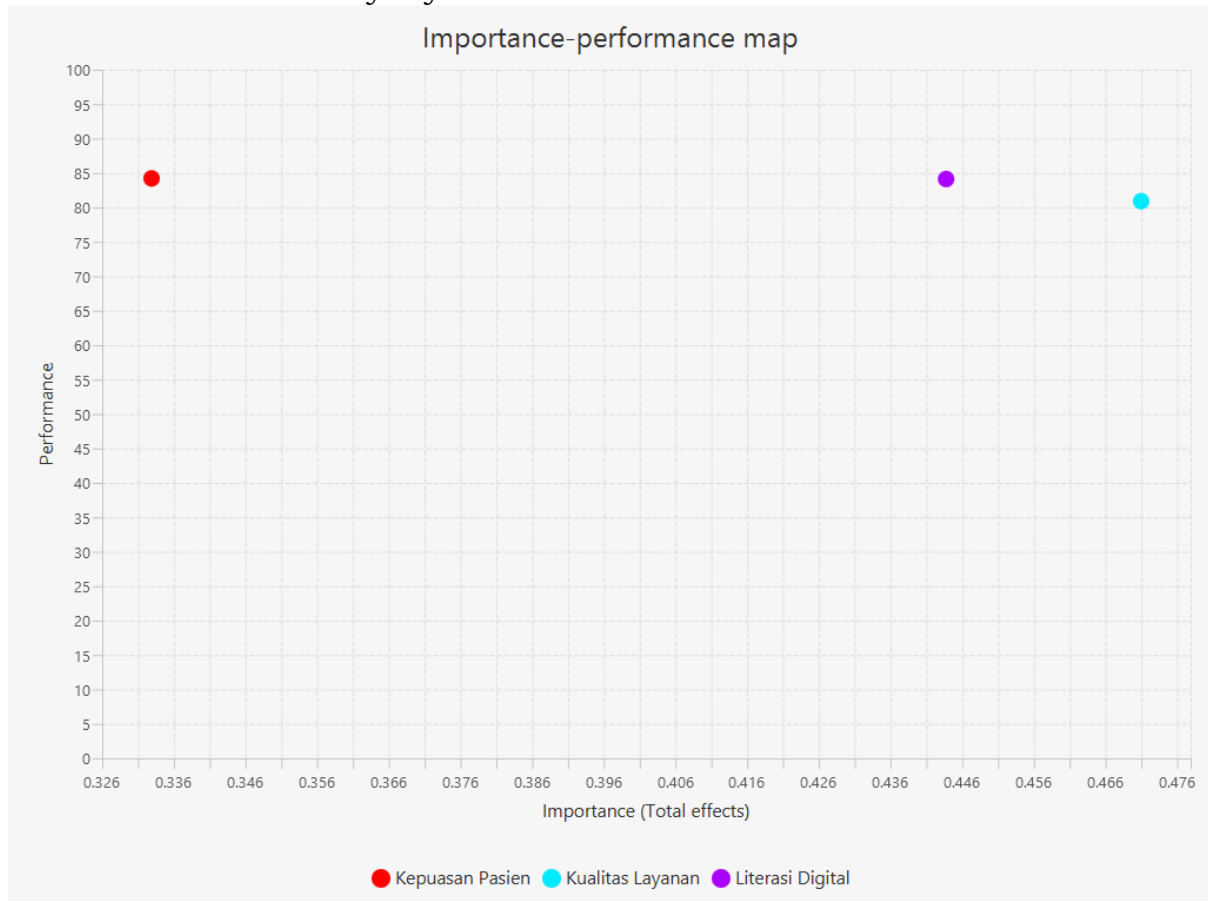


Figure 3. IPMA

The results of the Importance–Performance Map Analysis (IPMA) at the construct level show differences in the strategic role of each variable in influencing Patient Loyalty. Digital Service Quality has the highest importance value (0.471) but is accompanied by a relatively lower performance level (80.916) compared to other constructs. This finding indicates that Digital Service Quality is the most crucial factor in driving Patient Loyalty, but its performance is not yet fully optimal. Thus, improving Digital Service Quality, especially in the aspects of digital service reliability, responsiveness, and service consistency, is a strategic priority because it has the potential to have the greatest impact on increasing Patient Loyalty.

Meanwhile, Digital Literacy showed a high level of importance (0.444) with a relatively high performance (84.130). This indicates that patients' ability to understand and utilize digital services is already at a good level and contributes significantly to Patient Loyalty. However,

because of its high level of importance, efforts to strengthen Digital Literacy are still needed, particularly through education on the use of healthcare applications and improved user guidance, so that the benefits of digital services can be maximally felt by all patient groups.

Patient Satisfaction has an importance value of 0.333 with the highest performance among other constructs (84.218). This condition indicates that although Patient Satisfaction is not the most dominant factor directly influencing loyalty compared to other constructs, its performance level is already very good and needs to be maintained. Patient Satisfaction plays an important role in maintaining loyalty stability, especially as a mediating mechanism for Digital Service Quality. Overall, the IPMA results suggest that strategies to increase Patient Loyalty should be focused on improving Digital Service Quality as a top priority, followed by strengthening Digital Literacy, while maintaining the already high level of Patient Satisfaction.

DISCUSSION

The results of hypothesis testing and Importance–Performance Map Analysis (IPMA) analysis in this study consistently confirm that Digital Service Quality, Patient Satisfaction, and Digital Literacy are key elements in building Patient Loyalty in the context of modern, increasingly digitalized healthcare services. Empirically, Digital Service Quality has been shown to have a positive and significant effect on Patient Satisfaction with a coefficient of 0.378 ($p = 0.015$) and on Patient Loyalty with a coefficient of 0.371 ($p = 0.000$). These findings indicate that digital transformation in healthcare services not only functions as an operational support tool, but also as a service experience that shapes patient perception, satisfaction, and engagement. This is in line with Aljafari et al. (2023) who emphasized that Digital Service Quality in healthcare services is strongly influenced by the local environmental context and user experience, which ultimately determines the level of engagement and Patient Loyalty.

The discussion on the influence of Digital Service Quality on Patient Satisfaction and Patient Loyalty shows that good digital service quality can create a positive and sustainable service experience. A coefficient value of 0.378 in the Digital Service Quality–Patient Satisfaction relationship indicates that increasing ease of access, system reliability, and responsiveness of digital services directly increase patient satisfaction. Furthermore, the relatively strong direct effect of Digital Service Quality on Patient Loyalty ($\beta = 0.371$) indicates that patients are more likely to intend to reuse services and recommend healthcare facilities when digital service quality is perceived as optimal. These findings reinforce the results of previous studies that stated that digital system reliability and ease of use are the main determinants of Patient Satisfaction (Kitsios et al., 2023; Kanwel et al., 2024) and important factors in building patient trust and loyalty (Nguyen et al., 2021; Shie et al., 2022).

Furthermore, the results of this study confirm the central role of Patient Satisfaction in shaping Patient Loyalty, both as a direct influence and as a mediating variable. Directly, Patient Satisfaction was shown to have a positive and significant effect on Patient Loyalty with a coefficient of 0.333 ($p = 0.000$), indicating that satisfied patients have a higher tendency to demonstrate commitment and loyalty to healthcare providers. Furthermore, the results of the indirect effect test showed that Patient Satisfaction significantly mediated the effect of Digital Service Quality on Patient Loyalty with a mediation coefficient value of 0.126 ($p = 0.038$). These findings indicate that increased patient loyalty occurs not only through the direct influence of digital service quality but also through increased satisfaction as a psychological mechanism that strengthens the relationship. These results are consistent with AlOmari and Hamid (2022) and Rahman et al. (2021) who emphasized that Patient Satisfaction is an important mediator in the relationship between Digital Service Quality and loyalty, especially in the context of healthcare with limited resources. In this perspective, Patient Satisfaction reflects not only a rational evaluation of services, but also an emotional experience that builds patient trust and commitment (Dayan et al., 2021).

The discussion of Digital Literacy as a moderating variable provides a more contextual understanding of the research results. Empirically, Digital Literacy was not proven to moderate the effect of Digital Service Quality on Patient Satisfaction, as indicated by an interaction coefficient of -0.031 with a p-value of 0.242. This indicates that the level of patient satisfaction is more directly influenced by the quality of the digital service itself, regardless of the patient's level of digital literacy. This finding is in line with Gül et al. (2023) who stated that Patient Satisfaction in digital healthcare services tends to be universal and does not depend too much on variations in user digital capabilities. However, Digital Literacy was shown to significantly moderate the effect of Digital Service Quality on Patient Loyalty with a coefficient of 0.289 ($p = 0.004$). These results indicate that patients with higher levels of Digital Literacy are able to utilize digital services more optimally, thereby strengthening the influence of digital service quality on loyalty formation. This finding is consistent with Campanozzi et al. (2023) and Fitzpatrick (2023) who emphasized that loyalty in digital services requires more complex capabilities, including understanding, trust, and consistency in using the system.

The results of the Importance–Performance Map Analysis (IPMA) further strengthen the hypothesis testing findings by providing strategic managerial implications. Digital Service Quality emerged as the construct with the highest level of importance, yet its performance was relatively suboptimal, indicating a gap that needs to be addressed immediately by healthcare managers. This condition aligns with Phonthanukitithaworn et al. (2020) and Dayan et al. (2021), who emphasized that improving Digital Service Quality is the most effective strategy for driving Patient Loyalty. Meanwhile, Patient Satisfaction and Digital Literacy showed relatively high levels of performance, indicating that healthcare

institutions are on the right track, although they still need to maintain the sustainability and inclusiveness of digital services to prevent the emergence of a digital health divide (Campanozzi et al., 2023).

Overall, this discussion confirms that Patient Loyalty in the digital era is the result of a complex interaction between Digital Service Quality, Patient Satisfaction, and Digital Literacy. With the support of empirical evidence in the form of direct influence coefficients, mediation effects, and significant moderation, this study not only enriches the literature on marketing and healthcare management, but also provides a strategic basis for healthcare facility managers to prioritize improving Digital Service Quality, strengthening Patient Satisfaction, and developing inclusive and sustainable Digital Literacy programs.

CONCLUSION

This study provides a novel empirical contribution to the digital healthcare literature by uncovering the differential mechanisms between Digital Service Quality, Patient Satisfaction, Patient Loyalty, and Digital Literacy in the context of a regional hospital. Unlike previous studies that generally position Digital Literacy as a direct determinant of satisfaction, the findings of this study indicate that Digital Literacy does not moderate the formation of Patient Satisfaction, but significantly strengthens the influence of Digital Service Quality on Patient Loyalty. These results indicate that patient satisfaction is more universal and is primarily determined by the quality of the digital service itself, while loyalty requires patients' ability to utilize digital services consistently and optimally.

Furthermore, this study confirms the partial mediation role of Patient Satisfaction as a key mechanism that translates digital service experiences into patient loyalty, thus enriching the understanding of the indirect pathway in digital healthcare loyalty models. By combining the PLS-SEM and Importance Performance Map Analysis (IPMA) approaches, this study also provides a methodological contribution by identifying Digital Service Quality as a construct with the highest strategic importance but relatively suboptimal performance, a finding rarely explored in the context of regional and island hospitals.

Overall, this study extends the literature by emphasizing that patient loyalty in digital healthcare services is not only a function of system quality but also of user readiness, particularly digital literacy. These findings have theoretical implications for the development of digital-based loyalty models and practical implications for regional hospital managers to prioritize improving digital service quality along with strategies to continuously strengthen patient digital literacy.

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