



THE RELATIONSHIP BETWEEN THE DIGITALIZATION OF THE RADIOLOGY SERVICE SYSTEM AND THE PATIENT SATISFACTION LEVELS AT PKU MUHAMMADIYAH YOGYAKARTA HOSPITAL

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Abstract

Digitalization in radiology services aims to enhance efficiency and facilitate easier access for patients. However, its implementation can elicit various responses from users. This study examines the relationship between the digitalization of radiology services and patient satisfaction levels. A quantitative analytic cross-sectional design was employed, involving 100 respondents selected incidentally from a population of 1,055 regular radiology patients. Data were analyzed using univariate and bivariate methods with the chi-square test at a 5% significance level. The results demonstrated a significant relationship between digitalization in terms of accessibility and patient satisfaction concerning product quality ($p = 0.000$) and service quality ($p = 0.004$). Meanwhile, digitalization related to efficiency showed no significant effect on satisfaction regarding product quality ($p = 0.100$), but was significantly associated with service quality ($p = 0.040$). These findings indicate that digitalization of radiology services has a significant impact on patient satisfaction, particularly through improved accessibility influencing both product and service quality, as well as efficiency affecting service quality. This underscores the importance of optimizing digital systems to improve the overall quality of healthcare services.

Keywords: Digitalization, Radiology Service, Patient Stisfaction

Introduction

The COVID-19 pandemic has had a significant impact on the healthcare delivery system in Indonesia. Hospitals faced an increase in the number of patients exceeding capacity, while at the same time dealing with management systems that were not yet optimal. Limitations in patient medical history recording, room management, drug stock, and healthcare workers' workload highlight the need for fundamental improvements in healthcare service governance (Kemenkes, 2023). In response, the Ministry of Health has prioritized digital transformation of healthcare services for 2021–2024. Digital transformation is not merely about providing information through online platforms but aims to record and integrate all healthcare service processes into electronic data that can support faster service delivery, patient safety, and managerial efficiency.

Radiology is one of the hospital service units most affected by digitalization. This unit is closely related to technology utilization, ranging from high-capacity digital imaging to data system integration. Radiology digitalization through the use of Picture Archiving and Communication System (PACS) allows physicians to interpret examination results flexibly, anytime and anywhere, while providing access to attending physicians and related medical staff via Electronic Medical Records (EMR). This system not only improves the speed and convenience of services but also supports the implementation of paperless and filmless concepts that reduce operational costs and are more

environmentally friendly (Mas'uul & Marwati, 2020). However, despite the mature implementation of radiology digitalization, various technical challenges remain, especially regarding system integration, equipment maintenance, and service continuity (Setyawan & Supriatna, 2016)

In the context of service quality, patient satisfaction is an important indicator and also a hospital accreditation standard (Premenkes No 24, 2022). Previous studies have shown that dimensions such as service speed, healthcare workers' attitudes, environmental comfort, and system reliability have significant correlations with patient satisfaction (Elvina, 2018) (Rahmania & Admin, 2021). These findings confirm that service digitalization has the potential to positively impact patient experience, but at the same time introduces new challenges, such as patients' preference for printed results, which are still perceived as more trustworthy than digital results. Preliminary data from the Radiology Installation at PKU Muhammadiyah Yogyakarta Hospital also show a quality gap: 75% of regular patients still experience waiting times for radiology results exceeding six hours, which does not meet the maximum waiting time standard of ≤ 6 hours, even though the average waiting time from registration to examination is relatively short, at 3.2 minutes.

This phenomenon indicates differences in patients' perceptions and experiences regarding the benefits of digitalizing the radiology service system. On one hand, digitalization has proven to accelerate service flow, improve accessibility, and simplify administrative procedures. On the other hand, some service quality aspects, especially waiting time for examination results and the mode of delivering radiology results, still cause dissatisfaction. This situation shows the need to evaluate the extent to which the digitalization of the radiology service system truly correlates with patient satisfaction.

Based on these issues, this study focuses on analyzing the relationship between digitalization of the radiology service system and patient satisfaction at PKU Muhammadiyah Yogyakarta Hospital. The analysis reviews the accessibility and efficiency aspects of the digital service system and their relationship to patient satisfaction from the dimensions of product quality and service quality. The research results are expected to provide theoretical contributions in the development of knowledge related to healthcare service digital transformation in Indonesia, as well as practical contributions as managerial evaluation material for hospitals to optimize digital radiology services to be more accessible, efficient, and patient satisfaction oriented.

Method

This study employed an analytic quantitative design with a cross sectional approach conducted at the Radiology Department of PKU Muhammadiyah Hospital Yogyakarta during April to June 2025. The study population comprised all regular radiology patients who underwent standard X-ray examinations in December 2024, totaling 1,055 patients. Inclusion criteria were non emergency patients and exclusion of those who underwent CT-Scan, ultrasound, or special procedures. The sample size was calculated using Slovin's formula with a 10% margin of error, resulting in a minimum of 91 respondents, however 100 respondents were selected to anticipate potential dropouts. The sampling technique used was incidental sampling. Data collection instruments consisted of a validated and reliable questionnaire measuring variables including accessibility, efficiency, product quality, and service quality on an ordinal scale. Data were collected through self administered questionnaires and analyzed univariately to describe respondent characteristics, and bivariately using the Chi-Square test at a 95% confidence level ($p < 0.05$). This study obtained ethical approval from the Ethics Committee of PKU Muhammadiyah Yogyakarta Hospital, with letter number 00117/KT.7.4/IV/2025 dated April 14, 2025, valid until April 13, 2026.

Results

A total of 100 radiology patients at PKU Muhammadiyah Hospital Yogyakarta participated as respondents in this study. The respondents' characteristics are presented in Table 1. The majority of respondents were female (60%), aged between 20 and 30 years (21%), had completed secondary education (high school, 47%), and most were unemployed (47%).

Table 1. Respondent Characteristics

Variable	Category	Number	%
Gender	Male	40	40
	Female	60	60
Age	<20 years	20	20
	20-30 years	21	21
	31-40 years	9	9
	41-50 years	8	8
	51-60 years	15	15
Education	Elementary School	3	3
	Junior High School	13	13
	Senior High School	47	47
	Higher School	37	37
Occupation	Civil Servant/Military/Police	5	5
	Entrepreneur	18	18
	Private Employee	30	30
	Unemployed	47	47

The distribution of respondents based on the study variables is presented in Table 2. The majority of respondents rated the accessibility of digital radiology services as easy (89%), while 11% indicated difficulties. These difficulties were mainly related to re-accessing digital radiology results (8% reported difficult and 2% very difficult) and accessing digital radiology services (4% difficult and 5% very difficult). This suggests that although most respondents found the digital system helpful, a small portion still faced technical challenges or limitations in digital literacy.

Regarding the efficiency variable, nearly all respondents (99%) stated that the digital system was efficient, with only 1% perceiving it as inefficient. Minor concerns generally involved the speed of radiology examinations and reduction of administrative errors; however, overall, the digital system has accelerated service workflows and shortened waiting times.

For the product quality aspect, 90% of respondents expressed satisfaction, whereas 10% were dissatisfied. Dissatisfaction was mainly related to the format of radiology results in soft file form, with 6% reporting dissatisfaction and 2% expressing strong dissatisfaction. This indicates that while the technical quality of digital radiology results is perceived as good, improvements are needed in the format and ease of accessing examination results.

Finally, in terms of service quality, 96% of respondents reported satisfaction and 4% dissatisfaction. Those dissatisfied primarily cited staff responsiveness (3% dissatisfied and 3% very dissatisfied), along with minor concerns regarding clarity of information and facility comfort. Nevertheless, overall service quality was perceived positively, particularly with respect to staff friendliness and the comfort of services provided.

Table 2. Distribution of Respondents' Responses Based on Study Variables (n = 100)

Variable	Category	Frequency	%
Accessibility	Easy	89	89
	Not Easy	11	11
Efficiency	Efficient	99	99
	Inefficient	1	1
Product Quality	Satisfied	90	90
	Dissatisfied	10	10
Service Quality	Satisfied	96	96
	Dissatisfied	4	4

Bivariate analysis was conducted to examine the relationships between variables using the Chi-Square test (Table 3). The results indicated a significant association between the digitalization of the radiology service system in terms of accessibility and patient satisfaction levels for both product quality ($p = 0.000$) and service quality ($p = 0.004$). A significant relationship was also found between the digitalization of the radiology service system in terms of efficiency and patient satisfaction with service quality ($p = 0.040$). However, no significant association was observed between efficiency and patient satisfaction regarding product quality ($p = 0.100$).

Table 3. Cross Tabulation of Digitalization of Radiology Service System and Patient Satisfaction

Digital Radiology Service System	Patient Satisfaction	Category	Not Satisfied n (%)	Satisfied n (%)	Total n (%)	p-value
Accessibility	Product Quality	Not Easy	10 (90.9)	1 (9.1)	11 (100)	0.000
		Easy	0 (0)	89 (100)	89 (100)	
	Service Quality	Not Easy	3 (27.3)	8 (72.7)	11 (100)	
		Easy	1 (1.1)	88 (98.9)	89 (100)	
Efficiency	Product Quality	Not Efficient	1 (100)	0 (0)	1 (100)	0.100
		Efficient	9 (9.1)	90 (90.9)	99 (100)	
	Service Quality	Not Efficient	1 (100)	0 (0)	1 (100)	
		Efficient	3 (3.0)	96 (97.0)	99 (100)	

Table 3 presents the cross-tabulation between the digitalization of the radiology service system from the accessibility aspect and patient satisfaction in terms of product quality. It shows that all 89 respondents (100%) who perceived the accessibility of the digital radiology service system as easy expressed satisfaction with the product quality, while none (0%) were dissatisfied. Conversely, among those who found accessibility not easy, 1 respondent (9.1%) was satisfied, and 10 respondents (90.9%) were not satisfied with the product quality. Based on the chi-square test, the significance level for the variable accessibility regarding product quality is $p = 0.000$, which is less than 0.05. This indicates a significant relationship between the accessibility of the radiology service system's digitalization and patient satisfaction in terms of product quality.

Table 3 presents a cross-tabulation between the digitalization of the radiology service system from the aspects of accessibility and efficiency with patient satisfaction, viewed from product quality and service quality. The cross-tabulation between accessibility and patient satisfaction based on product quality shows that all 89 respondents (100%) who perceived the accessibility of the digital radiology service system as easy reported satisfaction with the product quality, while none (0%) were

dissatisfied. Meanwhile, among those who found accessibility not easy, only 1 respondent (9.1%) reported satisfaction, and 10 respondents (90.9%) reported dissatisfaction with the product quality. The chi-square test results indicated a significant p-value of 0.000 (< 0.05) for the accessibility variable with respect to product quality, proving that there is a significant relationship between accessibility in the digital radiology service system and patient satisfaction based on product quality.

The cross-tabulation between accessibility and patient satisfaction based on service quality indicates that 88 respondents (98.9%) who perceived accessibility as easy were satisfied with the service quality, while 1 respondent (1.1%) was dissatisfied. Conversely, among respondents who perceived accessibility as not easy, 8 (72.7%) were satisfied, and 3 (27.3%) were dissatisfied with the service quality. The chi-square test yielded a significant p-value of 0.004 (< 0.05), confirming a significant relationship between accessibility of the digital radiology service system and patient satisfaction in terms of service quality.

The cross-tabulation between efficiency and patient satisfaction assessed from product quality revealed that 90 respondents (90.9%) who considered the digital radiology system efficient were satisfied with the product quality, whereas 9 respondents (9.1%) were dissatisfied. Among respondents who perceived the system as inefficient, none (0%) were satisfied and 1 respondent (100%) was dissatisfied with the product quality. The chi-square test showed a non-significant p-value of 0.100 (> 0.05), indicating no statistically significant relationship between efficiency in the digital radiology service system and patient satisfaction based on product quality.

Finally, the cross-tabulation between efficiency and patient satisfaction based on service quality indicated that 96 respondents (97%) who perceived the system as efficient were satisfied with the service quality, while 3 respondents (3%) were dissatisfied. Among those who considered the system inefficient, none (0%) were satisfied and 1 respondent (100%) was dissatisfied. The chi-square test resulted in a significant p-value of 0.040 (< 0.05), demonstrating a significant relationship between efficiency in the digital radiology service system and patient satisfaction in terms of service quality.

Discussion

This study's findings demonstrate that the digitalization of the radiology service system at PKU Muhammadiyah Hospital Yogyakarta received relatively high scores across all four measured variables. Accessibility was rated as facilitating the registration process, information acquisition, and access to examination results. Efficiency was reflected in faster service processes, reduced waiting times, and minimal administrative errors. Product quality received high satisfaction levels from respondents, particularly regarding clarity, image sharpness, and accuracy of examination results. Service quality was appreciated through staff friendliness and politeness, clarity of information, and facility comfort. Nonetheless, some minor shortcomings were identified, indicating the need for a more in-depth analysis of these four variables. The following section discusses the relationships between variables in this study:

Relationship Between Accessibility and Patient Satisfaction Based on Product Quality

The results indicate a significant relationship between the digitalization of the radiology service system in terms of accessibility and patient satisfaction regarding product quality. This finding demonstrates that improved accessibility within the digitalized radiology system positively influences patients' satisfaction with product quality. This is consistent with a study in Ethiopia by (Nigatu et al., 2025), which confirmed that radiology digitalization enhances patient access, reduces waiting times, and indirectly increases patient satisfaction in hospitals. Similarly, a systematic review by (Rockall et al., 2025) reported that patient experience factors, including accessibility and product quality, positively correlate with patient satisfaction.

In radiology services, product quality encompasses accurate imaging results, high image sharpness, and the provision of radiology outcomes in digital (soft file) format (Indrayani, 2023). Digitalization allows these results to be stored and accessed electronically via PACS or hospital information systems, enabling both patients and physicians to retrieve radiology reports quickly without waiting for physical film printing (Purwanto, 2022). This capability directly enhances patients' perception of product quality. These findings emphasize that service quality is not solely evaluated by technical radiology outputs but also by how comfortably and conveniently patients can access medical information. This aligns with Donabedian's quality framework, which highlights the importance of process and outcome dimensions oriented toward patient needs (Donabedian, 1988).

The researchers conclude that improvements in accessibility through digitalization not only facilitate smoother service delivery but also directly influence patients' perceptions of radiology service product quality. Therefore, accessibility is a critical determinant of overall patient satisfaction. However, a small proportion of respondents still considered accessibility to be difficult, suggesting that despite the optimization brought by digitalization, especially regarding access to digital radiology results and file formats, continuous attention is required to ensure equitable product quality experiences for all patients.

Relationship Between Accessibility and Patient Satisfaction Based on Service Quality

This study found a significant relationship between the digitalization of the radiology service system in terms of accessibility and patient satisfaction regarding service quality. The ease of access afforded by digitalization was shown to positively affect patient satisfaction with the quality of services received. This aligns with (Abuzaid et al., 2023), who emphasized that ease of access plays a crucial role in shaping patient satisfaction with radiology service quality. Similar results were reported by (Fatiah & Saragih, 2024), who found that accessibility positively influences patient satisfaction. Furthermore, research by (Nigatu et al., 2025) in Ethiopia demonstrated that digitalization significantly reduced waiting times and improved overall patient satisfaction with radiology services, reinforcing the view that easy access via digital systems is essential in fostering patient trust and comfort.

According to the researchers, digitalization of accessibility not only streamlines administrative and technical processes but also expands the service dimension, positively impacting perceived service quality. Speedy service delivery, easy retrieval of examination results, and seamless communication of medical information create a more efficient, structured, and comfortable patient experience. With faster and integrated access, patients feel valued as their time and needs are optimally met. This underscores accessibility as a foundational pillar in strategies to improve service quality in the digital era.

Nevertheless, some respondents still rated digital accessibility as less than fully easy. Dissatisfaction within the service quality variable was linked to staff responsiveness and speed, as well as, to a lesser extent, clarity of information and facility comfort. These findings highlight the need for continuous evaluation and improvement in both accessibility and service quality. Focused efforts to optimize examination speed, report distribution, reliability of information systems, and facility comfort are necessary to ensure equitable service quality perceived by all patients, thereby maintaining and enhancing the positive association between radiology digitalization and service quality satisfaction.

Relationship Between Efficiency and Patient Satisfaction Based on Product Quality

This study found no significant relationship between the digitalization of the radiology service system in terms of efficiency and patient satisfaction regarding product quality. Despite high reported efficiency in the digitalized radiology system, this did not translate into increased satisfaction with

product quality. This result aligns with (Chen et al., 2024), who stated that enhancements in administrative efficiency through digital systems do not necessarily lead to higher patient satisfaction, as the humanistic aspects and service quality remain crucial to patient experience in healthcare facilities. Similarly, (Tabche et al., 2023) reported no significant change in patient satisfaction after digital system implementation. While data management and service recording efficiency improved, patient satisfaction remained constant. (Abbasi et al., 2020) also found that although healthcare professionals experienced efficiency gains from digital service implementation, no significant correlation existed between system efficiency and patient satisfaction with product quality.

These findings suggest that digitalization's efficiency dimension, for example, faster service workflows, shorter waiting times, reduced administrative errors, and integrated information technology, does not significantly impact patient satisfaction from the perspective of product quality. Although both efficiency and patient satisfaction for product quality were rated highly, statistical analysis did not reveal a significant relationship between them. The researchers attribute this to limited variability in the data distribution, which may have obscured a detectable association. In other words, both efficiency and patient satisfaction showed positive outcomes, yet the similarity of responses limited the strength of correlation. Descriptively, digitalization still provides tangible benefits in accelerating service and minimizing administrative errors, and continued optimization could further enhance patient satisfaction regarding the quality of digital radiology products.

Relationship Between Efficiency and Patient Satisfaction Based on Service Quality

The analysis revealed a significant association between the digitalization of the radiology service system in terms of efficiency and patient satisfaction with service quality. Efficiency improvements were found to positively influence patient satisfaction concerning service quality. This agrees with (Komalasari, 2024), who reported that efficiency directly impacts sustainable strategies and service quality, indicating that higher efficiency correlates with better service delivery to customers. Similarly, (Sugondo et al., 2021) found a strong, positive correlation between efficiency and patient satisfaction.

Efficiency also relates to patients' emotional experience. Patients who do not have to wait long or repeat processes feel valued, as their time is respected, positively affecting quality perception. (Komalasari, 2024) noted that efficient service is a key factor in enhancing perceived service quality and supporting hospital service sustainability strategies. When combined with effective communication and clear medical information, patient satisfaction hinges not only on outcomes but also on the service process itself.

The researchers emphasize that efficiency plays a crucial role in shaping perceived service quality. Efficient service delivery not only reduces waiting times but also reflects a well-organized system that prevents confusion, delays, and unnecessary procedures. In modern healthcare, patients are also consumers whose perceptions of quality depend heavily on how hospitals manage overall efficiency. Therefore, consistent and patient centered implementation of digital radiology service efficiency directly enhances satisfaction, particularly in service quality aspects.

However, this study also identified areas needing improvement in efficiency and service quality. Despite tangible benefits from digitalization, optimization is necessary, especially regarding examination speed, staff responsiveness, and the appropriateness of radiology report file formats. Targeted improvements are essential to ensure all patients experience consistent service quality.

Conclusion

This study confirms that the digitalization of the radiology service system at PKU Muhammadiyah Hospital Yogyakarta plays a significant role in enhancing patient satisfaction, although certain limitations still require attention. Accessibility was found to have a significant association with patient satisfaction across both product quality and service quality dimensions. This indicates that ease of registration, examination, and access to digital radiology results strengthens patients' perceptions of service quality. Such ease not only increases confidence in the accuracy of radiology products but also fosters a more efficient and comfortable service experience. However, a subset of patients reported difficulties in re-accessing digital examination results and understanding the file formats provided, highlighting the need for continued system optimization, enhanced digital literacy initiatives, and patient support mechanisms.

Furthermore, the study confirms that service efficiency significantly correlates with patient satisfaction when assessed from the perspective of service quality. Reduced waiting times, streamlined examination workflows, and more organized systems contributed to a positive patient experience. Patients who avoided long waits or repetitive administrative procedures tended to rate service quality higher, emphasizing efficiency as a critical factor in building satisfaction. Nevertheless, efficiency showed no significant relationship with patient satisfaction concerning product quality. This suggests that while faster service and decreased administrative barriers improve the service experience, they do not directly influence evaluations of radiology results, which are more strongly judged on diagnostic accuracy and technical image quality. Another possible explanation is the relatively homogeneous data distribution, which limited the statistical strength of the association despite practical benefits perceived by patients.

Overall, the findings underscore that digitalization positively impacts patient satisfaction through improved accessibility and perceived efficiency in service delivery. Yet, key areas require further improvements especially regarding easy re-access to examination results, clarity of digital file formats, and the responsiveness of staff in meeting patient needs. These findings highlight that digitalization extends beyond technology deployment; it involves readiness across systems, human resources, and service management to adapt to evolving patient demands.

From a practical standpoint, these insights advocate for continuous enhancements both in hospital information system infrastructure and in the quality of staff-patient interactions. Strengthening staff competencies through technical and communication training, implementing standardized service workflows, and integrating digital systems with mobile applications or patient portals are strategic approaches to elevate overall service quality. Such efforts will transform digitalization from being merely an efficiency tool into a strategic instrument for building patient satisfaction and trust in hospital radiology services.

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