International Journal of Radiology and Diagnostic Imaging

E-ISSN: 2664-4444
P-ISSN: 2664-4436
www.radiologypaper.com
IJRDI 2023; 6(3): 87-92
Received: 05-06-2023
Accepted: 08-07-2023

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Implementation of MRI (Magnetic resonance imaging) information system to improve service quality in radiology room Arifin Achmad general hospital

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DOI: https://doi.org/10.33545/26644436.2023.v6.i3b.346

Abstract
Background: Hospitals as health service providers have an obligation to always improve the quality of service at every service installation, including radiology room. Meanwhile, radiology services for checking MRI at Arifin Achmad General Hospital are still recording and registering manually and there is a lack of education for patients about MRI examinations so that examination failures occur. This affects the quality of radiology services, while the indicators of service quality are reliability, assurance, appearance, responsiveness, and empathy.
Objective: To produce an appropriate and effective MRI information system that can be applied in improving the quality of service at the radiology room of Arifin Achmad General Hospital.
Research Methods: This study used a pre-experimental research design with a one group pre-post test design. The population is all patients and staff in the radiology room. The sample was divided into three subjects, namely the first subject for data and information collection, the second subject for expert validation, the third subject for product users, namely MRI examination patients. The independent variable in this study is the MRI information system, the dependent variable is the quality of the information system and service quality. Data were tested using normality test and Wilcoxon test.
Results: The application of the MRI information system in an effort to improve service quality at the radiology room at Arifin Achmad General Hospital is feasible, it is proven that the average measures value is 0.416 (moderate agreement) and its application is effective in improving service quality, as evidenced by the p-value of 0.000.
Conclusion: The application of the MRI information system in the radiology installation of Arifin Achmad Hospital is feasible and effective in improving the quality of radiology service.

Keywords: MRI, radiology, quality of service

Introduction

Hospital is an institution that provides health services such as outpatient, inpatient, and emergency services including medical services, non-medical and supporting services [1]. One of the medical support services is radiology which is organized by the radiology installation service unit [2]. Radiology services are medical services that play an important role in the field of medicine to diagnose a disease by using ionizing and non-ionizing radiation sources. Radiology installation has two parts, namely radiotherapy and radiodiagnostics [3]. Radiotherapy is a radiology service for cancer treatment using external radiation therapy external radiation therapy and brachytherapy [4].

Radiodiagnostics is a service to diagnose disease using sophisticated and cutting-edge modalities in the field of medicine [5]. modalities in the field of medicine [5], including conventional radiography (x-ray), computed tomography (CT), ultrasound (USG), interventional radiology, nuclear medicine, and magnetic resonance imaging (MRI). And magnetic resonance imaging (MRI) [3, 6]. Magnetic resonance imaging (MRI) is a method or technique of medical imaging technique that is known to use radiofrequency and magnetic fields to examine and visualize the to examine and visualize body tissues, blood circulation, and metabolic activity. The strength of the applied magnetic field is between 0.3 - 7 Tesla [7]. MRI examinations have several advantages, such as the ability to produce multi-slice (multiplane) images, including axial, coronal and sagittal images as well as images with good spatial resolution and tissue contrast. Resolution and tissue-to-tissue contrast without ionizing radiation [8].

According to the Indonesia Minister of Health Decree No. 1014/Menkes/SK/XI/2008 concerning Diagnostic Radiology Service Standards in Health Care Facilities related to the diagnostic radiology service administration system policy states that diagnostic radiology service activities can be carried out according to a certain schedule up to 24 hours depending on the conditions, human resources and equipment used [6]. MRI is a sophisticated modality in diagnostic radiology and has procedures that are different from other modalities. Before conducting an MRI examination, education is given that patients with metal in the body cannot perform the examination, plus the duration of the MRI examination requires a long time so that scheduling is needed in advance. Standard operating procedures (SOP) regarding MRI examinations in hospitals, one of which is to get a good MRI image image, MRI examination requires contrast media and mandatory fasting for at least 6-8 hours [9].

Based on a preliminary study at the radiology room of Arifin Achmad General Hospotal, it was found that patients who wanted to check MRI had to wait up to ≥ 14 days, which was caused by scheduling that was not orderly and organized and recording was done manually. There were ±278 patients registered for MRI examination, ±223 patients came for examination, 45 patients came but were not examined because they had not fasted before. This was due to a lack of education so that patients did not understand the importance of fasting before MRI with contrast media.

If the problem is not addressed immediately, it will affect the quality of radiology services at Arifin Achmad General Hospital, which will result in a decrease in the number of patients. The quality of health services is an important thing that has five aspects in the quality of service indicators, namely reliability (reliability), which is providing satisfactory services on time according to a predetermined schedule. Assurance, namely services provided by officers who are competent, polite and trustworthy. Appearance (tangibles), namely in the form of complete facilities, facilities and infrastructure. Infrastructure pleasant appearance of officers. Responsiveness (responsiveness), namely providing services that are responsive quickly with responsibility. Full of responsibility. Attention (empathy), namely giving attention, communicate well and understand the needs of patients [1, 10].

To overcome this problem, the researcher wants to create an MRI information system that aims to organize scheduling, education, information and communication for patients who will conduct MRI examinations that can be accessed via smartphone. The advantage of this MRI information system information system is that patients can easily get MRI examination services digitally digital.

Materials and Methods

This research uses the research and development (R&D) method. The purpose of this method is to produce a product and test the effectiveness of the product. In this R&D research combines qualitative and quantitative approaches after which the effectiveness of the product is tested using the analytical method. Then to produce a product, researchers collect data using descriptive methods, therefore this research is called mixed method research (MMR)52. The application research and design procedure includes 5 main steps, which are as follows: 1) data and information collection, 2) product design, 3) expert validation, 4) product trials (trials using a pre-experiment research design with a one group pre-post test design) and 5). one group pre-post test design) and 5) product results. The population is all patients and staff in the radiology room. The sample was divided into three subjects, namely the first subject for data and information collection, the second subject for expert validation, the third subject for product users, namely MRI examination patients. The independent variable in this study is the MRI information system, the dependent variable is the quality of the information system and service quality. Data were tested using normality test and Wilcoxon test.

Results

A. Information Collection

The results of information collection conducted by interviews with the head of the radiology room, radiographer and radiology administration officer. Radiology administration officers obtained the following results:

1. The results of the respondent's interview can be concluded that the patient scheduling process is in accordance with standard operating procedures (SOP) but still done manually.
2. The waiting time for MRI examination at Arifin Achmad General Hospital is relatively long due to the large number of patients who want to do MRI examinations.
3. The occurrence of canceled MRI examinations can reach 2-3 patients in one day. The number of cancellations of MRI examinations like this is considered quite a lot, because the queue for MRI examinations is quite large.
4. Lack of education and information on MRI examination is one of the reasons for the cancellation.
5. Patients always get education and information about this MRI examination, if the patient has an action using contrast media the patient is informed to fast 6-10 hours.
6. Manual registration has the disadvantages of being ineffective, inaccessible, and ineffective.
7. There has been no good response and solution provided by the hospital to resolve this issue provided by the hospital to resolve this issue.

B. Product Design of MRI (Magnetic Resonance Imaging) Information System

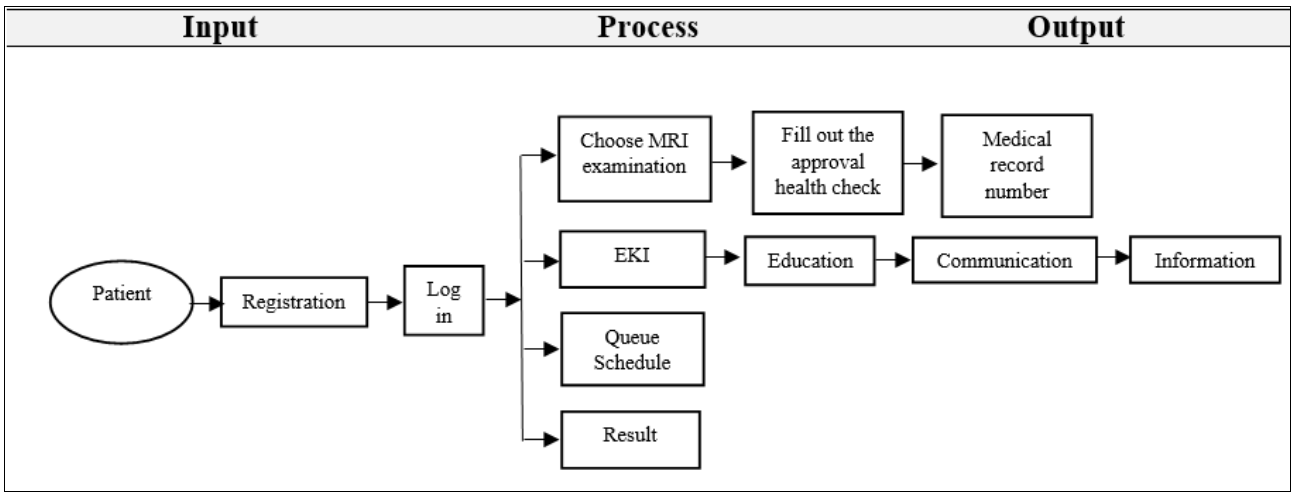

Fig 1: Use case diagram on the product of the application of the MRI information system to improve the quality of service in the radiology installation

Table 1: MRI Information System Framework

Input	Proses	Output
Register in system.	Enter name, data place birth, gender and address	User data is filled in completely
Select examination.	User selects the MRI examination to be performed.	Can find out the type of MRI examination that will be performed
Fill in examination consent, medical record number.	Approve the examination to be performed. After the data is filled in completely, you will get a medical record number.	Approve all MRI examinations. To be able to enter the website.
Log in.	Enter the medical record number in the log in menu.	To proceed to the next stage.
Education.	Click on the education menu on the dashboard page.	User can understand with education before doing MRI examination
Information	Clicking the information menu on the dashboard page.	Users can understand the information before conducting an MRI examination and consent to all medical actions.
Communication.	Clicking the communication menu on the dashboard page.	User can contact the administration.
Queue schedule	Clicking the scheduling section on the dashboard.	User confirms arrival tomorrow to be able to perform an MRI examination.
Results	After all examinations are completed, the user can report to the admin to confirm the examination.	User knows the result of MRI examination

C. Expert Validation

Table 2: Expert Validation

No.	Expert	Job Position	Score	Mean	Category	Average measures*
1	Expert 1	Head of EDP Room Arifin Achmad General Hospital	85%	84%	feasible	0,416
2	Expert 2	Software Developmpment Section Staff Arifin Achmad General Hospital	84%			
3	Expert 3	Medical Physicist Quality of Radiology Services at Arifin Ahmad General Hospital	83%			
4	Expert 4	Head of Human Resources and Administrative Management of Arifin Ahmad General Hospital	84%			

*Interclass Corelation Coeffient (ICC)

Based on the assessment results from expert validators, the average feasibility score is 84.00% with a feasible category. The results of expert validity show that the average measures value is 0.416 (moderate agreement), which means that the four validators provide a good assessment so that the MRI information system in an effort to improve the quality of services in the website-based Radiology Room of Arifin Achmad General Hospital is good, relevant and feasible to use.

D. Product Trials

The trial application of MRI (Magnetic Resonance Imaging) information system products in an effort to improve the quality of services at the Radiology Installation of Arifin Achmad Hospital uses a pre-experiment design method with a one group pre-post test design. This research was conducted at Arifin Achmad General Hospital, Pekanbaru, Indonesia. This model is used to analyze the effectiveness of the MRI (Magnetic Resonance Imaging) information system in an effort to improve the quality of service at the Radiology Room of Arifin Achmad General Hospital, with the independent variable in this study is the MRI information system. The dependent variables are information system quality and radiology service quality.

Researchers collected information from respondents to determine service needs and product design.

Before collecting data using a questionnaire, first the validity and reliability of the questionnaire was tested on 30 respondents. The validity test is a test used to determine the validity or invalidity of an instrument used as a measuring tool in research. Valid means that the instrument can be used in measuring what the researcher wants to measure. The test technique used is a correlation test technique through the product moment coefficient with valid and reliable results which are then distributed to trial respondents. After testing the product on 50 respondents, a data normality test was carried out using the Shapiro Wilk method because the number of samples in this study was less than 50 samples.

Table 3: Normality Test

Variable	*p-value
Reliability pretest	0,021
Reliability posttest	0,000
Assurance pretest	0,011
Assurance posttest	0,000
Tangible pretest	0,019
Tangible posttest	0,000
Responsiveness Pretest	0,009
Responsiveness Posttest	0,000
Empathy pretest	0,000
Empathy posttest	0,000

*shapiro-wilk

Based on the results of the data normality test, it is known that the p-value <0.05 so that the data is not normally distributed, so the test to be carried out is a non-parametric test using the Wilcoxon test.

Table 4: Effectiveness Test of Service Quality Aspects

Variable	Mean + SD		Delta ± SD (Δ)	*p-value
	Pre-test	Post-test		
Reliability	6,27±1,507	13,37±0,556	7,10±1,49	0,000
Assurance	4,67±1,155	8,77±0,568	4,10±1,18	0,000
Tangible	12,97±34,09	22,60±1,037	9,63±3,32	0,000
Responsiveness	5,63±1,732	13,00±0,643	7,37±1,92	0,000
Empathy	3,50±0,861	8,03±0,928	4,53±1,04	0,000

*Wilcoxon Test

Based on the results of the effectiveness test, it is known that the p-value before and after the application of the information system on the reliability aspect is 0.000. This shows that there is an increase in the aspects of reliability, assurance, tangibility, responsiveness, and empathy after the provision of a web-based information system.

E. Product Result

Researchers are innovating an MRI information system in an effort to improve the quality of service at the radiology installation of the Arifin Achmad Hospital based on the web which is expected to be able to provides benefits to overcome the problem of the length of waiting time / queue, education and information about MRI examinations that still use manual systems so as to improve the quality of service in radiology installations. The information system developed by researchers can be accessed on the website page http://si-mri.com/

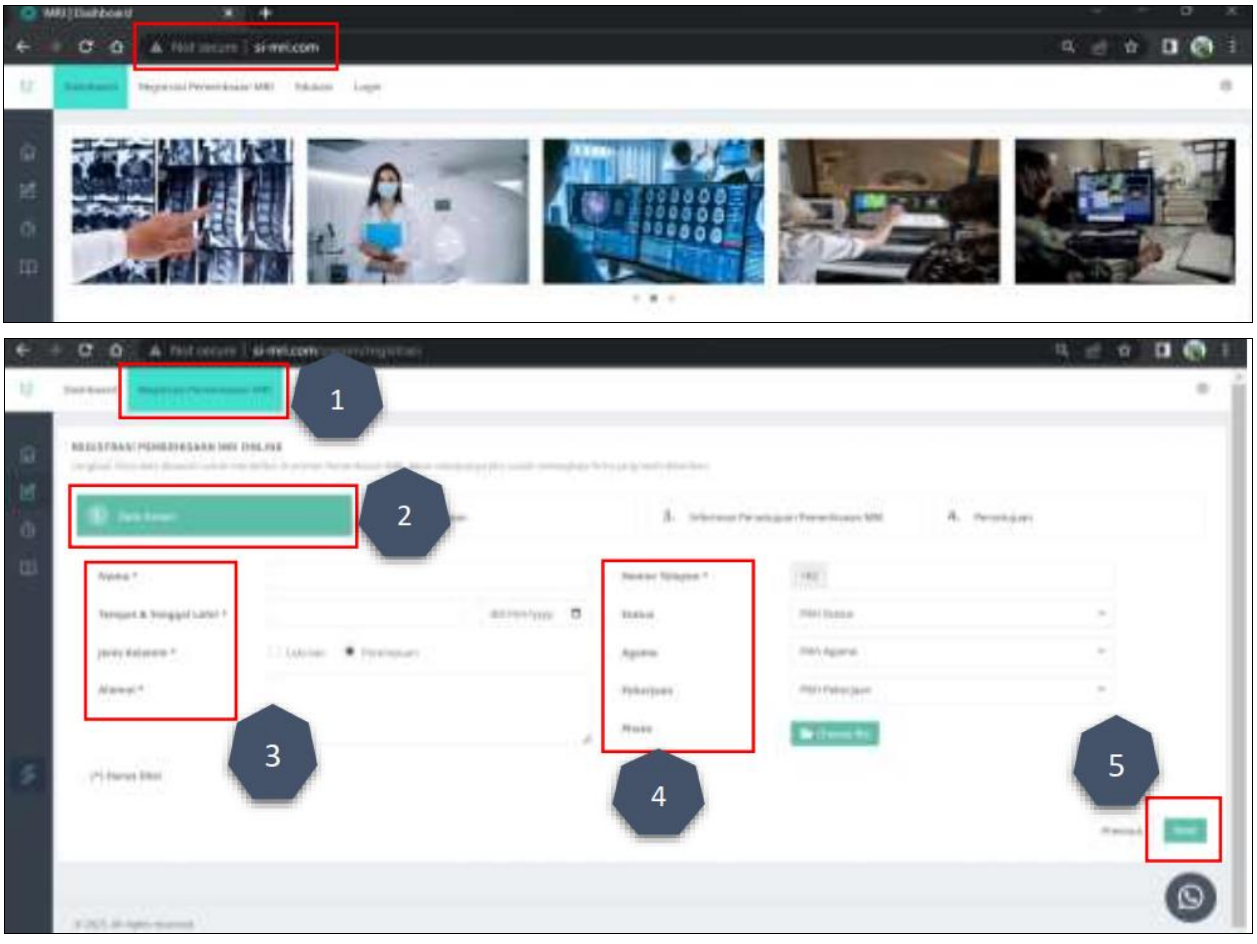

Fig 1: MRI website usage interface

Discussion

The registration process that is still recorded manually is one of the problems in hospital services. The obstacles encountered such as the long queue time in MRI examinations, the delivery of education and information about radiology examinations to patients still causes failure in examinations and lack of patient understanding of radiology examination preparation. So that this causes the quality of radiology services to decrease with patient complaints to officers. Efforts to overcome these problems are by utilizing technological advances that are able to carry out activities quickly, precisely, and accurately to ultimately become better productivity. The good impact of advances in information technology is the community rely on information generated by the developed system in order to use the information more effectively and efficiently. So that an MRI information system website development product is designed.

Based on the results of expert validation with an average product feasibility analysis score of 84% with a feasible category with an average measures value of 0.416 (moderate agreement). This indicates that the web-based MRI information system product is relevant and feasible to use in an effort to improve the quality of service in the radiology installation at Arifin Achmad Hospital.

The implementation of the MRI information system in the radiology installation of Arifin Achmad Hospital, there is a quality of service consisting of aspects of reliability, assurance, appearance, responsiveness and attention. In the aspect of reliability or reliability in providing services in the form of timeliness of services in accordance with a predetermined schedule and a good service process for patients. Good health services that can be relied upon should be carried out professionally according to what has been determined. Based on the results of the p-value before and after the application of the information system on the responsiveness aspect, the value is 0.000, which is a p-value of less than 0.05. This shows that there is an increase in the reliability aspect in an effort to improve the quality of service in the radiology installation at Arifin Achmad Hospital after the implementation of a web-based MRI information system.

After the implementation of the MRI information system, the waiting time for MRI services becomes shorter, this is because the application of the MRI information system allows confirmation of patient attendance for the next day's examination, so that patients who are unable to attend can be informed. Information about patient attendance also allows for rescheduling so that vacancies can be filled by patients in the next queue order. The efficiency of service waiting time shows an improvement in terms of service reliability, the results of this study can answer the problems of Arifin Achmad Hospital, namely the long waiting time for MRI examination. The results of this study are in accordance with Rahmania (2018) who revealed that the reliability aspect is an important thing to consider in service quality in order to increase patient satisfaction [11].

In improving the assurance aspect, it can be seen from the application of the MRI information system which makes changes to patient trust in officers, with this MRI information system patients can find out more about the time the MRI examination will be carried out so that patients no longer ask for certainty that the examination will be carried out, thus patients can feel satisfied getting good services like this. This is in accordance with Fatrida's research (2019) which reveals that the guarantee aspect of service quality is needed to gain patient trust in getting good health services [12].

In addition, there is an increase in the quality of service in the appearance aspect because the application of the MRI information system can be impressed that it refers to high technological values, this is because all MRI examination services are carried out using a website-based information system starting from registration, providing education, and information. So that all the things needed by patients are already available on the information system and make good convenience for patients. This is in accordance with Kasni's research (2020) which reveals that changing the appearance of what was originally a manual record and becoming digital will make health services effective and efficient [13].

Responsiveness in the aspect of service quality is needed in serving patients and the ability of officers to be fast, precise and responsive in completing a job. As well as the clarity of the officer in providing information about the examination needs to be considered so that the patient understands each examination that will be carried out. This is certainly the expectation of every patient and is the responsibility of the service provider in this case radiology officers, officers respond well to every complaint and desire of patients quickly and according to established standards. The p-value before and after the application of the information system on the responsiveness aspect is 0.000, which is a p-value of less than 0.05. This shows that there is an increase in the responsiveness aspect in an effort to improve the quality of service in the radiology installation after the application of a web-based information system.

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Basically, patients want to be treated individually or specifically, thus the sense of empathy of officers can meet patient expectations for good treatment. Based on the p-value before and after the application of the information system on the attention aspect of 0.000, the p-value is less than 0.05. This shows that there is an increase in the attention aspect in an effort to improve the quality of service in the radiology installation at Arifin Achmad Hospital after the provision of a web-based information system. The implementation of this web-based MRI information system can meet the needs and desires of patients when conducting MRI examinations and provide moral and psychological support to patients. Because the MRI information system is equipped with menus to support patients in MRI examinations to be easier. So that patients feel cared for, this is in accordance with Siyen's research (2020) which

reveals that a sense of caring or empathy has a direct relationship to the quality of health services [14].

Conclusion

Based on the results of the study it can be concluded that the application of the MRI (Magnetic Resonance Imaging) information system in the radiology installation is feasible and its application is effective in efforts to improve the quality of service and the quality of the information system, this is evidenced by the results of the expert validation test of the application of the MRI (Magnetic Resonance Imaging) information system is feasible as an effort to improve the quality of service in the radiology installation as evidenced by the feasibility value of 84% and the average measures value is 0.416 (moderate agreement). As for its implementation, the application of the MRI (Magnetic Resonance Imaging) information system in web-based radiology installations is effective in improving service quality in aspects of reliability, assurance, tangibility, responsiveness, and empathy as evidenced by the results of the Wilcoxon test obtaining a p-value of 0.000. This is a suggestion for hospitals that web-based information systems need to be implemented in every unit and service installation in the hospital, not only in radiology installations but in every other unit or installation in order to make it easier for officers to work more effectively and efficiently. And provide excellent service for patients so that it is expected to provide excellent service for patients. As well as providing excellent service for patients so that it is expected to improve service quality and provide better patient satisfaction. The application of a web-based MRI information system can be an illustration that utilizing current technological advances can facilitate work so that what is done can be more effective, accurate and efficient.

Acknowledgments

The authors would like to thank the hospital and all radiographers who participated in the product development and research.

Conflict of Interest

Not available

Financial Support

Not available

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How to Cite This Article
Hulmansyah D, Santoso B, Budiarti TA. Implementation of MRI (Magnetic resonance imaging) information system to improve service quality in radiology room Arifin Achmad general hospital. International Journal of Radiology and Diagnostic Imaging. 2023;6(3):87-92.