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Implementation of a quality control system for radiation waiting time services in radiotherapy based on web applications using notification reminder WhatsApp gateway

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Abstract

Background: Radiation therapy services are services that use ionizing and/or non-ionizing radiation as primary and secondary radiation therapy services for cancer or non-cancer patients. The use of ionizing radiation in cancer therapy is an effective and efficient treatment. The Quality of Service Committee at the Hospital determines that the longest waiting time for radiation is 30 working days from the CT Simulator stage until the first radiation is carried out. The process of delineation and planning to determine which organs will be irradiated and minimized from excessive radiation doses also takes time. Then countlatency and control efforts using the application can maintain service quality according to the goals set by the Quality Committee team by providing reminders in the form of messages WhatsApp to the related medical team to increase attention and it is expected to maintain the quality of service for radiation waiting time.

Objective: Producing an effective information system in implementing web application based waiting time service quality control with WhatsApp gateway reminder notifications to improve and maintain the quality of radiotherapy installation services.

Method: This study uses a research and development design or Research and Development (RnD). Integrating qualitative and quantitative approaches, in testing the feasibility of products using analytical methods, and producing products researchers collect data using descriptive methods, called mix method research (MMR). The research sample consisted of secondary data (without using a web application / comparison) and primary data (using a web application) taken from February to October 2022. Univariate data analysis used Sapphire-Wilk or Kosmogorv-Smirnof. Bivariate analysis was performed Independent sample t-test or Mann-Whitney test to measure the difference between before and after web application usage.

Results: From the results of the data normality test, it was found that the Sig on the waiting time data before using the application was 0.001 and after using the application it was 0.000. Both data have a Sig < 0.05, which means that the data is not normally distributed. Then a non-parametric test statistical analysis was carried out using Mann Whitney with the result Asymp. Sig. (2-tailed) 0.000 < 0.05 which means H0 is rejected and H1 is accepted. It is statistically proven that there is a difference in waiting time before using the application and after using the application.

Keywords: Quality control system, radiation wait time, reminder notification WhatsApp

Introduction

Quality health services are health services that satisfy all service users. One of the activities to create quality that meets the standards is to implement an appropriate quality management system with clear goals and expectations to prevent and solve problems faced by the hospital according to the order of the Indonesian Minister of Health Number 129 / Menkes / SK / II / 2008 concerning hospital Minimum Service Standards to provide innovation ^[1]. Services are formed based on five principles of service quality, namely direct evidence, reliability, responsiveness, safety, and empathy. The ultimate goal of healthcare is to achieve outcomes that benefit patients, healthcare providers, and society. Achieving the desired outcomes is highly dependent on the quality of healthcare services ^[2]. There are several types of hospital services, one of which includes radiotherapy services owned by several hospitals according to the Directorate General of Medical Services (RI) of the Ministry of Health.

According to the regulation of the Minister of Health of the Republic of Indonesia Number 780 / MENKES / PER / VIII / 2008, radiation therapy services are services that use ionizing and/or non-ionizing radiation and are considered as primary radiation therapy services, secondary radiation therapy services, for cancer or non-cancer patients who need treatment consisting of tertiary radiation therapy services. The use of ionizing radiation in cancer therapy is an effective and efficient treatment^[3]. The main principle of radiation therapy is to use ionizing radiation to damage the genetic material (DNA) of cancer cells, causing them to die or lose the ability to grow. Radiation exposure to normal tissues must be considered when radiation therapy is used as a treatment. All forms of genotoxic therapy affect normal tissues with varying degrees of damage and these side effects can limit cancer therapy^[4].

Currently, the South Jakarta Regional General Hospital is the only hospital that has radiotherapy facilities owned by the Jakarta Government. Based on observations made, there are still many patients with cancer who have not been treated properly. Due to the limitations of Radiotherapy services that have not been able to meet service needs. Cancer patients from small areas that do not have radiotherapy service facilities must go to big cities for radiation treatment. Therefore, several hospitals owned by the local government and the Ministry face the same problem in facing the fulfillment of the need for Radiotherapy services.

Due to the lack of radiotherapy services, there is a long queue for cancer patients to get Radiotherapy services. Therefore, there is a need for vigilance and also reminders to personnel working in radiation therapy facilities so that patients can be treated immediately according to the promised time.

Research using the design of a system for disseminating immunization information to mothers of toddlers based on sms gateway at the West Pontianak District Community Health Center using PHP programming language and MySQL as a database has been carried out by Siti Fajarwati Harahap.^[5] The reminder system that is connected to the sms gateway provider system will automatically reminder the immunization schedule according to the existing data, so that sms messages containing immunization reminder schedules can be sent to the destination number^[6].

The application that the author developed has similarities with the research above, which can be used as a reminder for the Delineation process, Planning, and providing information to patients for the first day of radiation schedule, and can also calculate how many days it takes from completion of CT Simulation to the first day of radiation schedule. For the reminder system, the author uses the WhatsApp gateway system. So that the information needed by officers and patients can be directly received through the whatsapp number that has been registered. This application uses Several programming languages, namely PHP, MySQL, Java Script, CSS and HTML. These languages are combined using the codeigniter framework and the Bootstrap CSS framework. The codeigniter framework functions as the main framework for the Backend. While CSS Bootstrap functions as the Frontend display in the application.

Materials and Methods

This type of research is research and development (RnD). The research and development method is aimed at producing products and testing their effectiveness and efficacy in their application^[7]. In this study, it combines qualitative and quantitative approaches, in testing the feasibility of products using analytical methods, while in producing products researchers collect data using descriptive methods, therefore it is called mixed method research (MMR). This method has the following main steps: 1) System Planning, 2) System Analysis and Design, 3) Implementation/Testing, 4) System Maintenance, 5) User Training, 6) Data Collection, 7) Data Analysis and 8) Results

Results

A. Information Collection

The results of discussions with health workers in radiotherapy, namely Radiation Oncology doctors, Medical Physicists, Radiotherapists, and Nurses were carried out by exchanging ideas with each other. From the discussion, the following results were obtained:

1. According to the radiation oncologist, it is necessary to record every date of action taken so that the waiting time can be monitored.
2. Medical physicist, said that creating a table on Google Sheets containing columns of action columns and the date the action was completed and summing up the dates from the initial process to the final process in order to obtain the amount of radiation waiting time.
3. A radiotherapist informant suggested giving a reminder in the form of a short message or whatsapp for every action that has been taken, so that the radiation planning relay can be continued. In other words, it is necessary to add an enthusiast system to keep the flow of radiation planning running.
4. The nurse stated that it is still necessary to coordinate with health workers or personnel involved in radiation planning.
5. Previously, recording waiting time was done manually. That is by looking at the CT Simulator scheduling book, and the radiation scheduling book. Then the results were used as radiotherapy service quality reporting. In this way, the staff of the service quality committee in radiotherapy faced difficulties in not knowing the details of radiation waiting time.

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

The process from the CT Simulator stage until the first day of radiation can be done is difficult to know the details of the process because you have to search and see the patient's examination documents. The quality control system for radiation waiting time services in radiotherapy based on *web* applications using WhatsApp reminder notifications was created as a tool in making it easier to calculate and record every radiation planning process. So that the authorized officer can easily monitor the waiting time of radiation in radiotherapy.

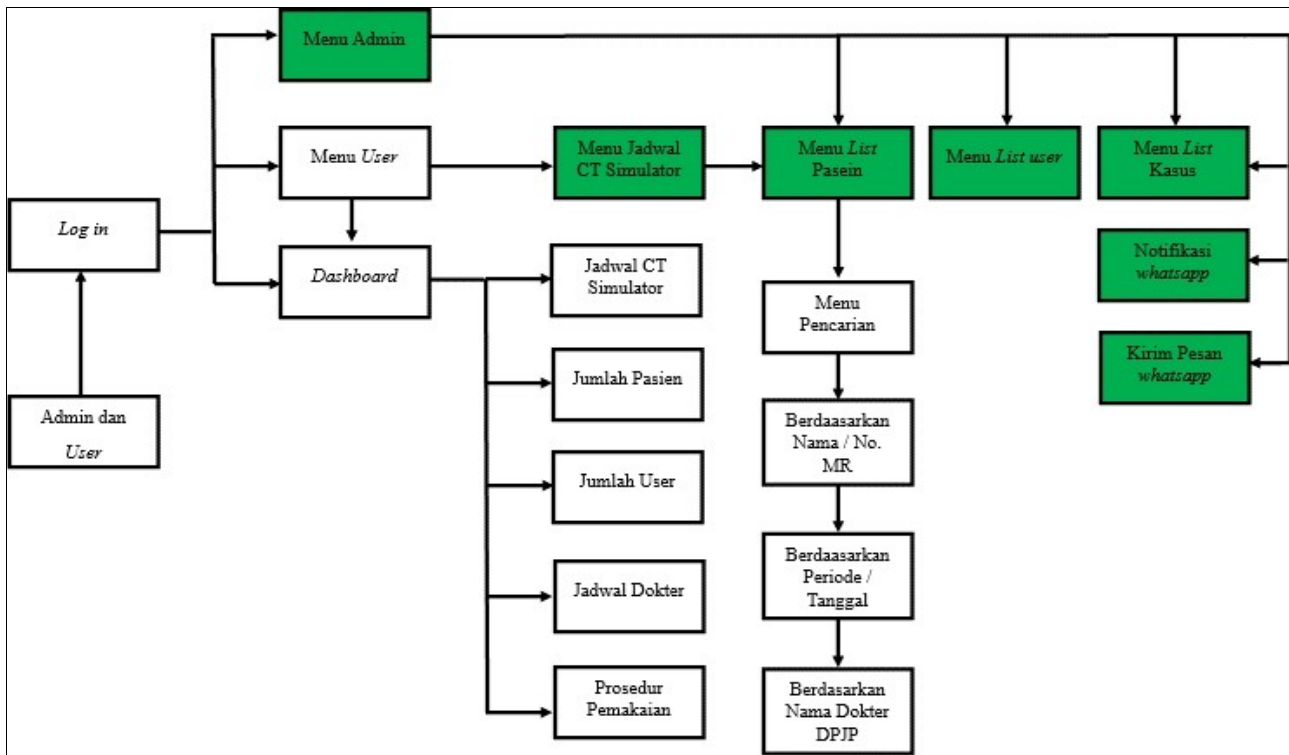


Fig 1: Design of quality control system for radiation waiting time services in web-based radiotherapy using WhatsApp gateway reminder notification

The page on the quality control system for radiation waiting time services in WEB-based Radiotherapy using whatsapp gateway reminder notifications consists of:

1. Log in system
2. User menu
3. CT Schedule Menu
4. Patient list menu
5. Dashboard
6. Administrator Menu
7. System Implementation This system implementation includes:
 - a) Training of users, namely nurses, doctors, radiotherapists, and medical physicists in radiotherapy.
 - b) Training to Hospital quality assurance team representatives in radiotherapy

c) The methods used are simulation, independent practice, then evaluation.

C. Expert Validation

The trial and validation were carried out by health workers in the radiotherapy installation totaling 5 people, namely representatives of Radiation Oncology Doctors, representatives of Medical Physicists, representatives of Nurses, members of hospital quality assurance in radiotherapy installations, and Radiotherapists. On the validation sheet there are four aspects that are assessed, including Usability, Functionality, Reliability, and Data security^[8]. From five validators, the validation results were obtained as follows:

Table 1: Expert Validation

No.	Validator	Profession	Aspects				Value	%	Aver age %
			Usability	Functionality	Reliability	Data Security			
1	Bagus Cahyadi	Nurse	26	21	8	12	67	83.75	93.25
2	Try Wulan Kurnia	Radiotherapist (PJ Quality Radiotherapy)	29	25	9	15	78	97.5	
3	Dea Ryangga	Physicist Medical	26	25	9	15	75	93.75	
4	Hari Murti W	Doctor Radiation Oncology	29	24	10	15	78	97.5	
5	Imam Muhamad Fathoni	Radiotherapist	27	24	9	15	75	93.75	
Total			137	119	45	72	373		

Based on the assessment results from expert validators, the average feasibility score is 93.25% with a feasible category that is very feasible.

D. Product Trials

The trial application of radiation waiting time service quality control system in radiotherapy based on web application using notification reminder whatsapp gateway at the Radiology Installation of Hospital uses a pre-experiment

design method with a one group pre-post test design. This research was conducted at a hospital in Jakarta, Indonesia. This model is used to analyze the effectiveness of the system with independent variables, namely services using web applications with whatsapp gateway reminder notifications, and without using reminders. While the dependent variables in this study are Service Quality (effectiveness, efficiency, convenience, technical competence) and Waiting Time.

Table 2: Data Value of waiting time before and after using the application

Intervention	Number of Patients	Median value Waiting time	Min-Max Value
Before	131	48	14-119
After	157	14	1-54

Table 2 shows the median and minimum maximal (min-max) waiting time before and after using the app without separating the data by month.

Table 3: Normality test of data before and after using the application

Month	Kolmogorov-Smirnova			Shapiro-Wilk			
	Statistic	df	Sig.	Statistic	df	Sig.	
Waiting Time	Before	.104	131	.001	.952	131	.000
	After	.110	157	.000	.889	157	.000

After conducting a normality test using Kolmogorov-Smirnov on the data obtained before and after using the application, the results obtained as in table 3. It is said that the data is not normally distributed. So that the bivariate analysis will use mann whitney analysis.

Table 4: Data analysis using Mann Withney

	Waiting Time
Mann-Whitney U	1156.000
Asymp. Sig. (2-tailed)	.000

Based on table 4, it is known that the Asymp. Sig. (2tailed) of 0.000 <0.05. it can be said that there is a difference between the length of waiting time before using the application and the length of waiting time after using the application. Apart from being seen from the value of the

difference in the waiting time interval for patients at the radiography installation, an analysis of the effectiveness of using the application on waiting time was carried out. Product effectiveness is measured from the difference in the median value of waiting time before and after using the application in the data table 4.6 using the formula:

$$\alpha WT = WT \text{ Before} - WT \text{ After}$$

Formula Description

WT Before = median value of waiting time before using the app. WT After = the median value of waiting time after using the app.

The median value of waiting time before using the application is 48 working days while the median value of waiting time after using the application is 14 working days. The difference between the time before and after using the application is 34 working days.

E. Product Result

Researchers create a web application-based radiation waiting time service quality control system using *whatsapp gateway reminder* notifications that are expected to help and provide benefits to overcome the problems faced by officers in radiotherapy installations and members of the hospital quality committee team who have been reporting and recording manually. The appearance of the system made by researchers is as follows:

1. Log in page

Before entering the application system, users must *log in* by entering a username and password on the radioterapy.my.id web page using the *username* that has been registered by the admin, then click log in. The login menu is used to limit access rights to operate the system.

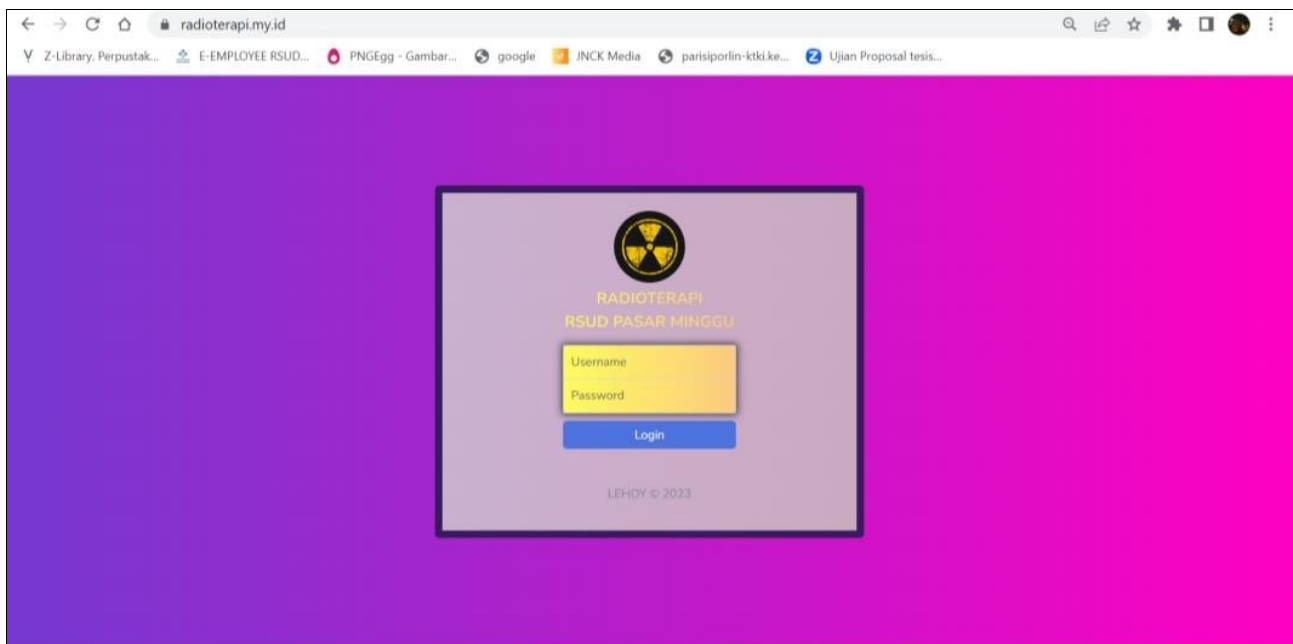


Fig 2: Login page

2. CT Schedule Menu

This menu shows the patient's CT Simulator schedule that has been scheduled every month. In this menu the officer or

user can see the scheduled CT Simulator, which was previously seen through the CT Simulator scheduling notebook manually.

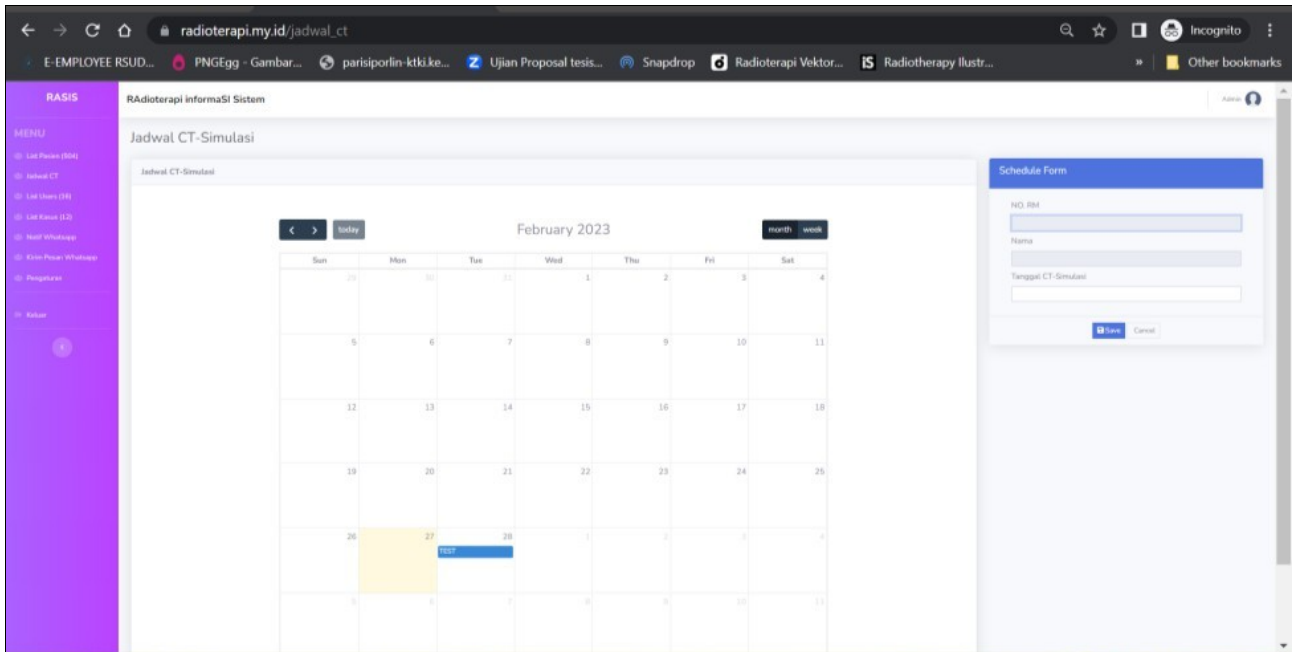


Fig 3: CT Simulation Schedule Page

3. Patient List Menu (Nurse user login)

In this menu, nurses can enter new patient data by clicking Add Patient, and filling in the required patient data, then click Add. When the nurse finishes adding new patient data, a notification message will be sent via whatsapp to each

radiographer (RTT). The message aims to notify that the patient with the MR number and Name as follows has been completed in the input, and has been scheduled to perform CT Simulator.

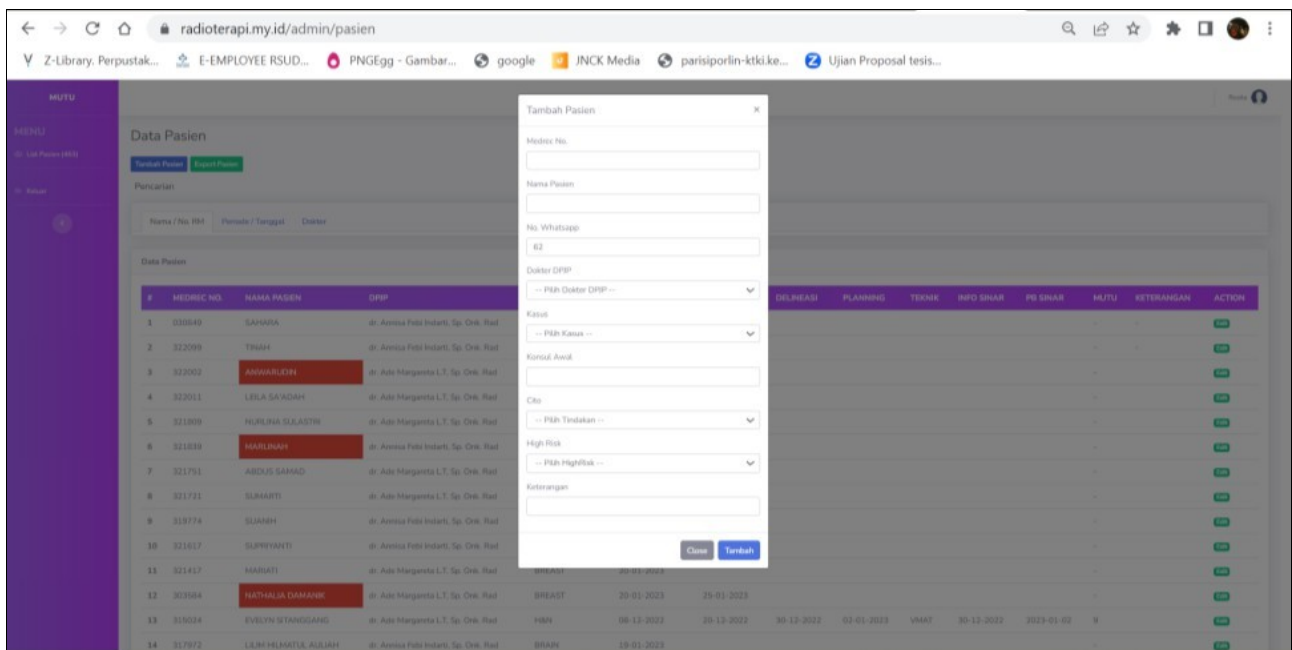


Fig 4: Add Patient Menu on Nurse account

4. Patient list menu (RTT user login)

After the patient is carried out CT Simulator Action on the scheduled day, then the RTT will input data on the date of the CT Simulator in the application by logging in using the RTT username. After logging in, click the Patient List menu, then search for the patient's name using the name or

MR No. then click edit at the end of the right column and enter the CT Simulator date in the column provided, then click edit. After that a whatsapp reminder message will enter the number of the doctor in charge of the patient which aims to remind that it is possible to delineate or draw the area to be radiated.

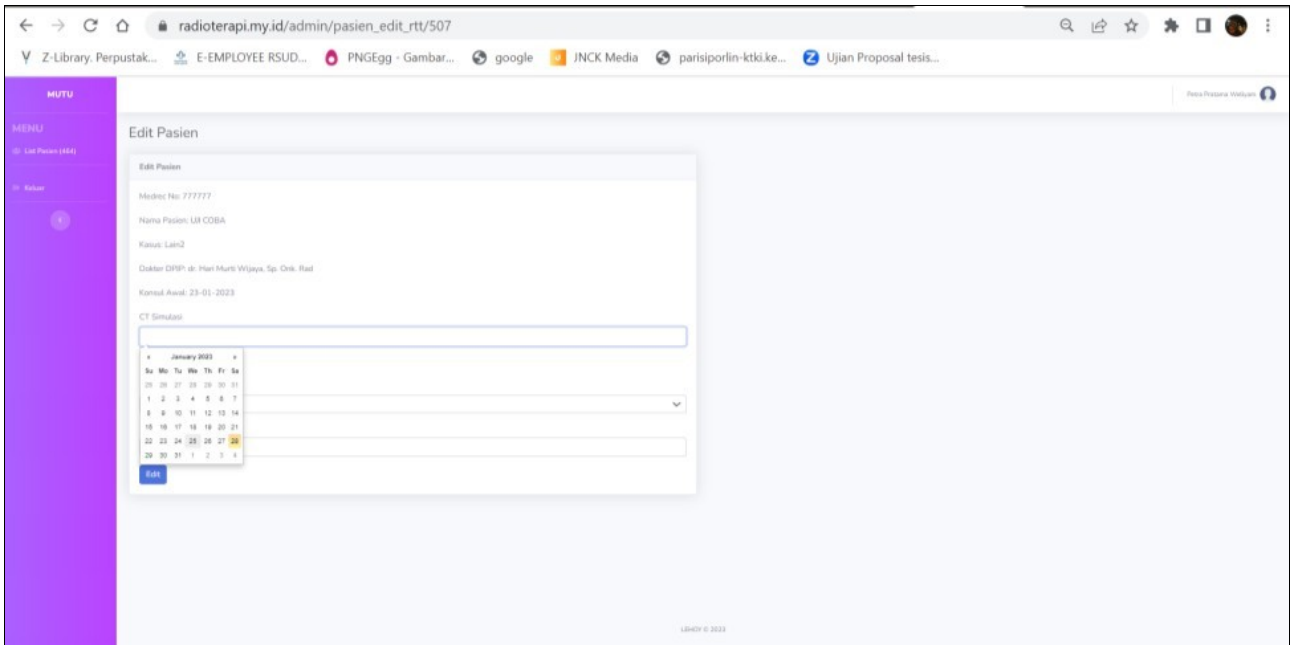


Fig 5: Display for entering the CT Simulation date

5. Patient list menu (Oncology doctor user login)

Then fill in the Delineation date carried out by the radiation oncologist or the doctor in charge of the patient. First the doctor logs in using the account that has been registered, then clicks on the patient List menu, then searches using the name or MR number of the patient who will be updated to fill in the delineation date that has been completed, then click edit. A display will appear that contains the

Delineation column which is Fill in the date the delineation was completed by the doctor, the doctor selects the date and then clicks edit at the bottom of the page. After the data is saved, a whatsapp will be sent to the medical physicist as a reminder that it is possible to plan and determine the direction of the beam and the dose to be given according to the delineation data from the oncologist and determine the irradiation technique to be used.

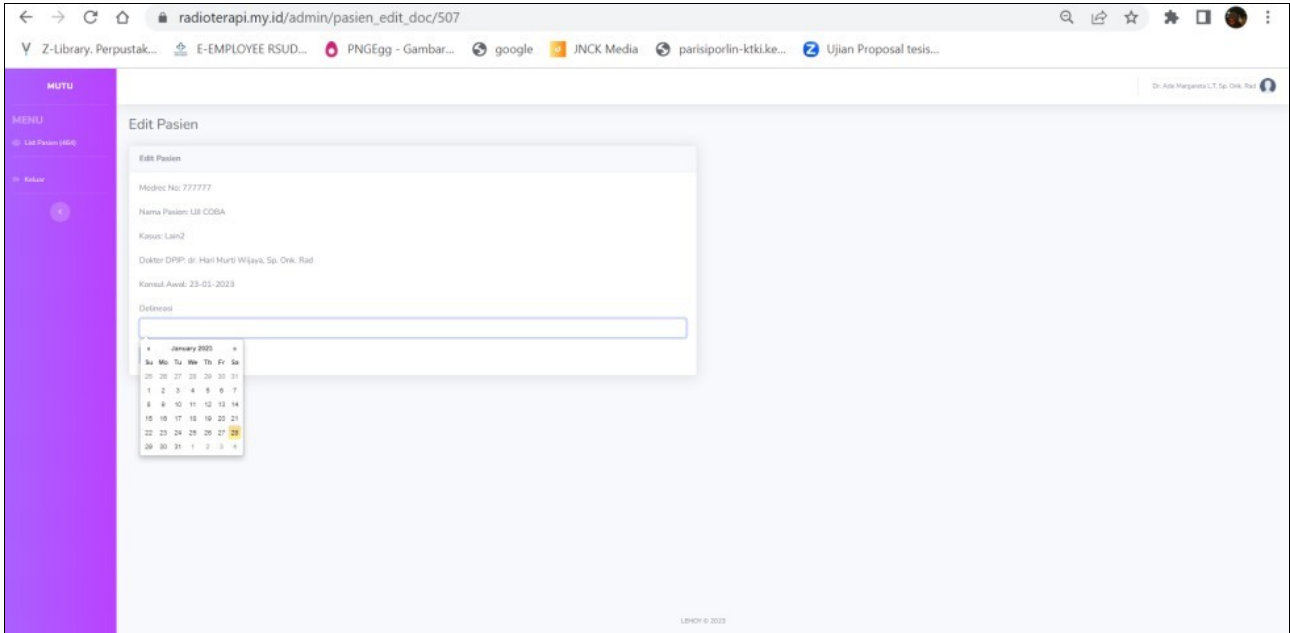


Fig 6: Display for entering the Delineation date

6. Patient list menu (Medical Physicist user login)

Medical physicists perform radiation planning including determining the dose used in accordance with the results of delineation by radiation oncologists, determining the direction of irradiation and irradiation techniques used. After completion, the planning results are discussed again with the radiation oncologist to make sure whether they are in accordance with the delineation results. If so, then the medical physicist enters the planning completion date data

in the application by logging in using the medical physicist username, clicking the patient list menu, then searching for patient data by name or MR number then clicking edit on the far left on the patient's name. After that, enter the date of completion of planning and the radiation technique used, then click edit to end. After that, a notification message via whatsapp will be sent automatically to the nurse so that she can contact the patient to schedule the first day of radiation.

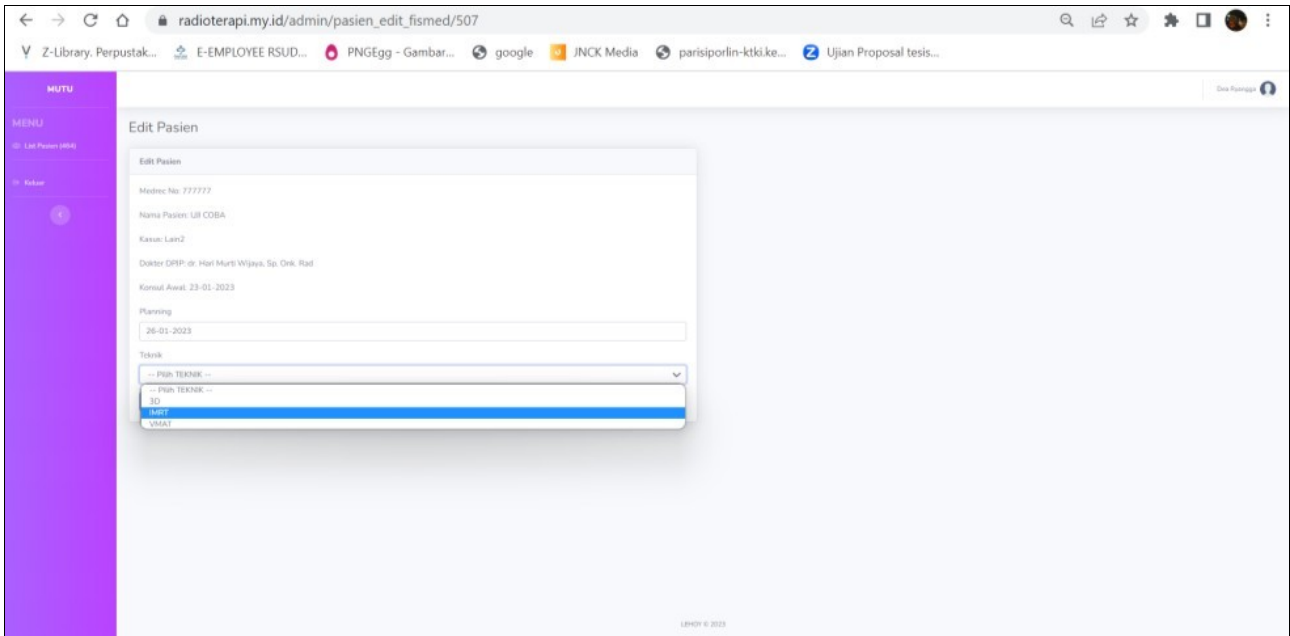


Fig 7: Display for entering the Planing date

7. Patient List Menu (Nurse user login)

After receiving the notification via whatsapp, the nurse will call the patient and schedule the first day of radiation for the patient. After being given a schedule, the nurse then enters the date of the day when making a call to the patient in the

application. Using the same steps, by logging in using the nurse's account, then clicking the Patient List menu, and searching for the patient's name using the Name or MR No. then click edit and a page will appear to fill in the date the beam info was given to the patient.

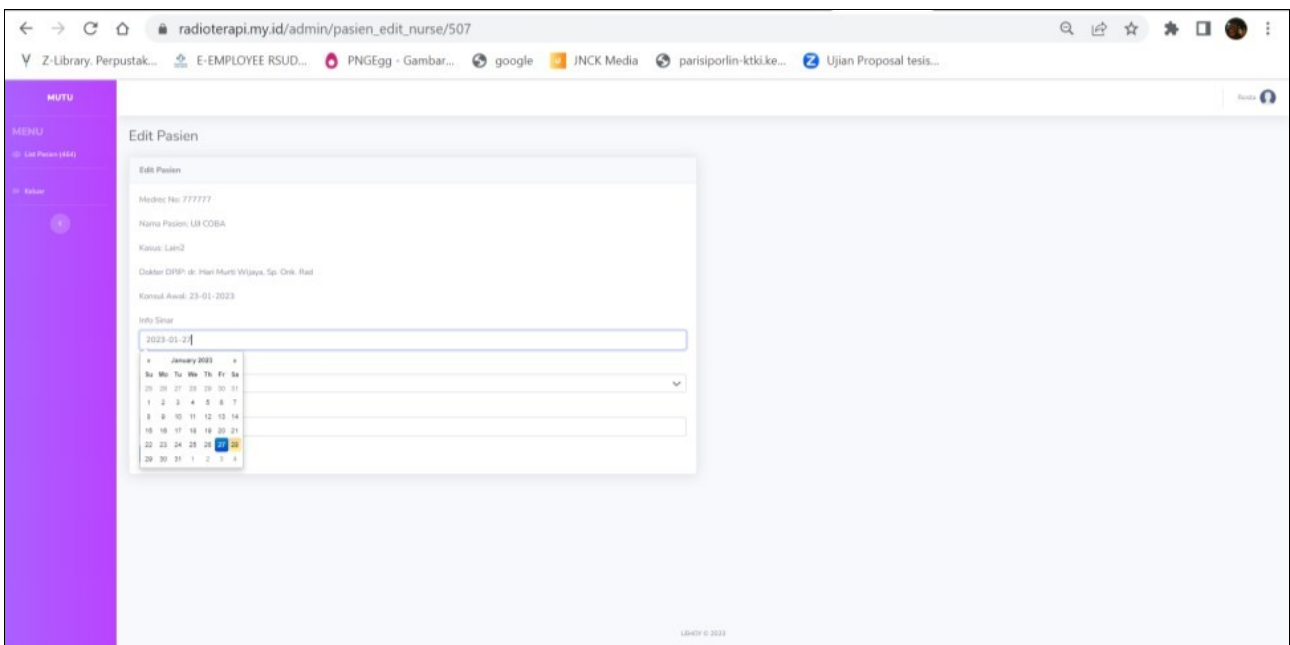


Fig 8: Display for entering the date radiation info was given

After the nurse enters the ray info date, the Quality of waiting time service will be seen in the Quality column which contains the number of days as the days the patient needs to wait for the radiation planning process to be carried out. This account is given access to download the required

data on the patient List menu page. There is a patient *export* option to download detailed waiting time data entered. This data is used for the purpose of analyzing and reporting the quality of radiation waiting time quality to the Hospital Quality Committee team.

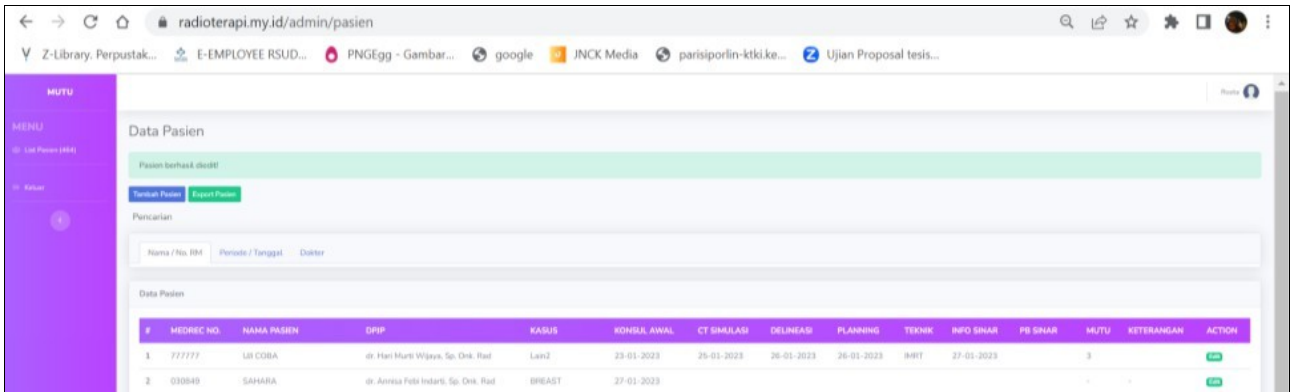


Fig 9: A view showing if all radiation planning processes have been completed

8. Patient list menu (RTT user login)

the first day of radiation in the PB Sinar column by RTT.

The last step is to fill in the date when the patient was given

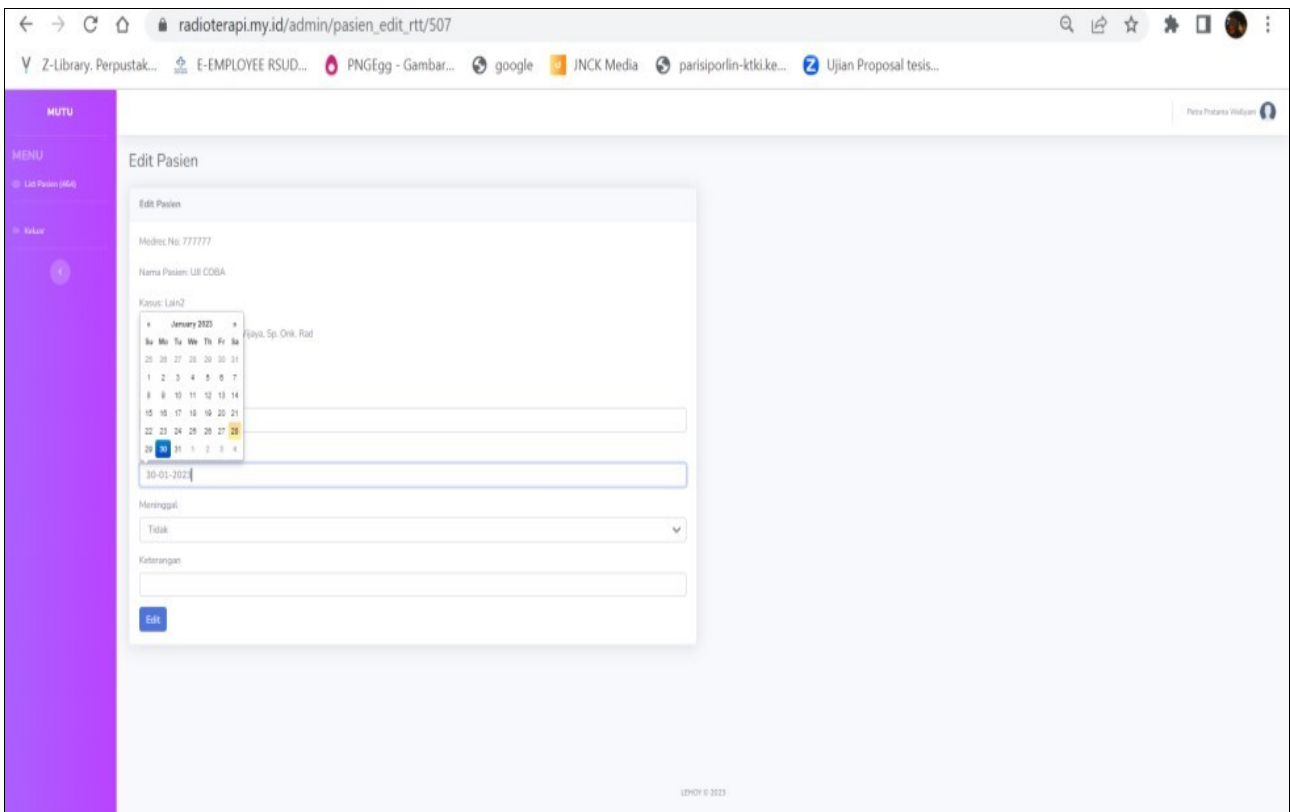


Fig 10: Page view when inputting the date of the first day of radiation

9. Administrator Account

In the admin account there are several additional menus. This account is created as application maintenance. Admins can add new users on the *List User* menu then click add user, besides that they can also delete users, add a *list of*

disease lists, set the contents of whatsapp notification messages and reminders that will be sent to application users, namely Nurses, Radiotherapists, Doctors and Medical Physicists.

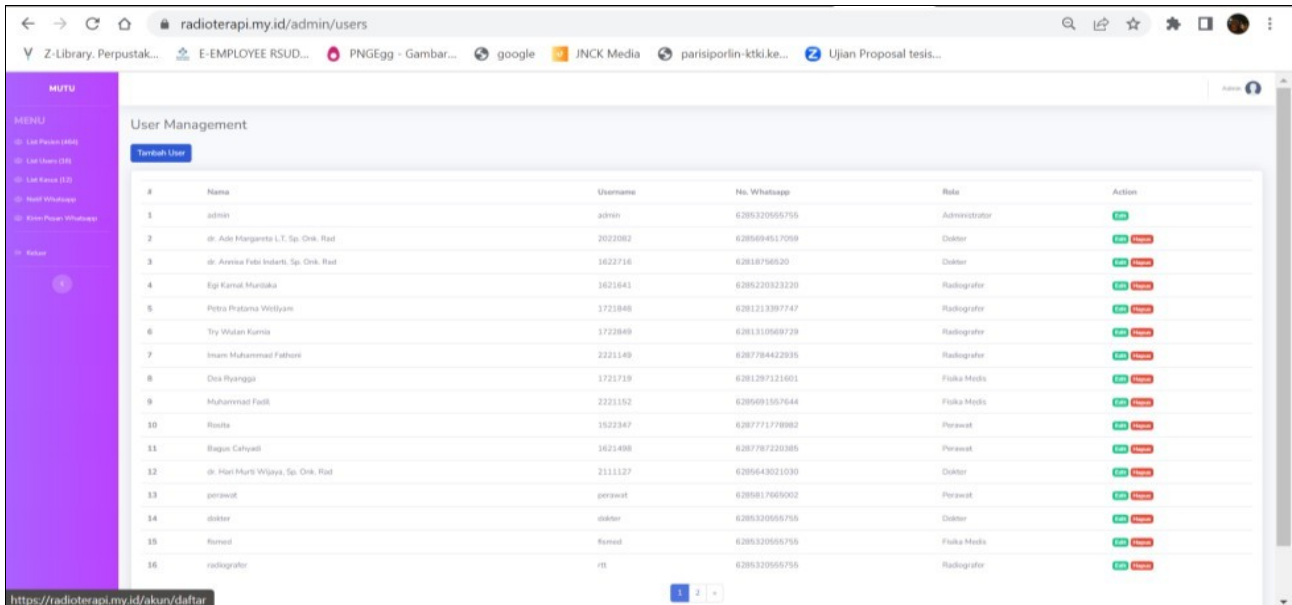


Fig 11: Display for adding users

Everything needed for data maintenance, additions and changes in case of data input errors, or repeated input, is available and can be fixed easily through the admin account.

Discussion

The importance of service quality standards in medical installations, especially in the field of radiotherapy for cancer or tumor patients, cannot be ignored. Radiation waiting time is a service benchmark that has a direct impact on the recurrence rate. In line with the times, the use of information systems and automatic reminders through web applications, with WhatsApp gateway notifications, is the right solution to maintain and improve the quality of hospital services [9]. Web-based application development using PHP brings ease of access without requiring local storage on a PC. MySQL database was chosen for its security and good storage capacity [10]. The importance of integration with the goowa.id application, through bridging connections (API), offers automatic message processing via WhatsApp. In addition, the advantages of PHP as a simple and multiplatform programming language add value to the creation of this application. Thus, this application not only meets the quality standards of installation and hospital services, but also provides an efficient solution in controlling and tracking radiation waiting time, according to the needs of patients who require radiation therapy.

In developing a web application-based radiotherapy waiting time service quality control system with WhatsApp gateway reminder notifications, a series of menus have been designed to ensure organized and accurate data. First of all, there is a user menu with different accesses, providing detailed information on radiation planning processing time and quality indicators for each patient. Next, the add patient menu allows nurses or administrative staff to enter patient data, such as MR number, patient name, WhatsApp number, DPJP doctor, and other information. Once the patient data is entered, the system automatically sends a WhatsApp notification to the Radiographer Therapist (RTT) who will perform the CT Simulator.

After the patient undergoes CT Simulation, the RTT must confirm in the system by editing the patient's data and selecting the date of the CT Simulator. Next, the oncologist

performs delineation, and confirmation is done in the system by editing the patient's data and specifying the date of completion of delineation. A WhatsApp notification is then sent to the medical physicist to perform planning based on the oncologist's delineation results.

The medical physicist confirmed the planning completion date and the radiation technique used. After that, a WhatsApp notification is sent to the nurse and admin to contact the patient for radiation scheduling, while the patient is also notified that they can schedule the first radiation. The nurse or admin confirms in the system by recording the date of contact with the patient, so that the system can display the amount of waiting time in days for each completed radiation planning process. Each staff member, according to their role, confirms in the system using their respective accounts. Through this series of steps, the system ensures efficient tracking and delivery of quality radiotherapy services [11].

The feasibility assessment of the application system for quality control of radiation waiting time services in radiotherapy based on web applications using WhatsApp gateway reminder notifications was carried out through various steps. First of all, the Black Box Testing validation method was used, focusing on evaluating the input and output of the application, involving validators from various related professions. The results of this validation were recorded in a validation sheet, and the score was obtained by dividing the score given by the validator by the ideal score, then multiplied by 100% to get a percentage.

The first aspect evaluated was Usability [12]. The total usability score was 137, which, when compared to the ideal score (150), resulted in a usability percentage of 91.4%. The interpretation is "Very Good," as the percentage exceeds 90. Functionality was the second aspect assessed [8]. The total functionality score was 119, with a functionality percentage of 95.2%. The interpretation of the score also reached the level of "Very Good," exceeding the 90% threshold. The Reliability aspect was the third focus. With a total score of 45 and a percentage of 90%, the interpretation was "Good," in accordance with the established eligibility criteria. Data Security was the last aspect assessed [13]. The total score of data security was 72, and the percentage of data security

was 96%. The interpretation reached the level of "Very Good," as it exceeded the 90% threshold. The final results showed that the average eligibility score of the four aspects was 93.25%, with an overall interpretation of "Very Good" [14].

Thus, Thee implementation of a quality control system for radiation waiting time services in radiotherapy based on web applications using WhatsApp gateway reminder notifications is considered relevant and feasible. Statistical analysis was conducted to determine the difference in waiting time before and after using the application. The unpaired two means t-test was used after the normality test results showed that the waiting time data was not normally distributed ($\text{Sig} < 0.05$). Mann-Whitney analysis showed a significant difference ($\text{Asymp. Sig. } 0.000 < 0.05$), proving a difference in waiting time. Univariate analysis was conducted on waiting time data before and after using the application. The normality test showed that the data was not normally distributed. Therefore, univariate analysis was performed by looking at the median value and minimum maximum value (min-max). The results of the univariate analysis showed significant differences between waiting times before and after using the app. Before using the app, the median was 48 days, min 15 days, max 119 days, with 131 patients; after using the app, the median was 14 days, min 1 day, max 54 days, with 157 patients. The difference in median waiting time between the two conditions was 34 days. A waiting time service quality control system using a web application and WhatsApp Gateway notifications proved effective, shortening radiation waiting times. The use of WhatsApp reminders as part of the web application-based radiation waiting time service quality control system helps ensure the quality of waiting time does not exceed the longest time limit set by the hospital service quality committee team. The positive impact of using this system involves the patient, namely the risk of recurrence and malignancy of cancer cells can be minimized with faster radiation waiting times. Then the positive impact on the hospital, namely increasing the effectiveness of human resource performance and the number of patient visits [15]. However, there is a long time span between the Delineation and Planing processes, caused by the oncologist's approval requirement in the Planing process. Double Checks on the delineation and planning process also caused a considerable time gap [1].

Conclusion

Based on the results of the study, it can be concluded that the implementation of a quality control system for radiation waiting time services in web application-based radiotherapy using WhatsApp gateway reminder notifications is considered feasible and effective in improving and maintaining the quality of radiation waiting time. The implementation successfully met the radiation waiting time quality reporting target. This system is designed as a web-based application using PHP programming language with MySQL database, and bridging connection with goowa.id application to get the notification process. Health workers in radiotherapy, including Nurses, RTT (radiation therapy technician), Radiation Oncology Doctors, and Medical Physicists, use this application system in the radiation planning stage. The validation test by representative users of the application system showed an average validation result score of 96%, with a very good category. In addition, the

effectiveness of this system is proven in maintaining the quality of radiotherapy service quality, seen from the results of the difference in waiting time data before and after the use of the application system which reached 34 days.

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Conflict of Interest

Not available

Financial Support

Not available

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