Analysis of Factors Causing Repetition of Computed Radiography Images to Improve Radiology Service Quality

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Abstract:

Radiology is a vital component of healthcare services in hospitals, aimed at assisting diagnoses through radiographic imaging using X-rays. To ensure optimal image quality, a quality assurance program is implemented. One of the objectives of this program is to minimize the repetition of radiological examinations. Therefore, a reject analysis of radiographic images is conducted to identify the causes and reasons for repeated imaging. This research aims to analyze the factors contributing to repeated computed radiography (CR) images to improve the quality of radiology health services. It is a quantitative descriptive study conducted through observation to determine the percentage of image repetitions and identify the causes. The data was analyzed using the repeat rate formula to calculate the repetition percentage systematically. The study took place from February to April 2024, with a total of 8,197 CR images, of which 410 were repeated. Results: The quality of radiology services is categorized as good, based on a monthly image repetition rate of 1.75%, which is within the acceptable limit of ≤2% as per the Indonesian Ministry of Health Regulation No. 129/Menkes/SK/II/2008 on minimum hospital service standards.

Keywords: Reject Analysis, Computed Radiography, Repeat Rate, Quality Assurance

Introduction

Hospital is a health facility that organizes health services evenly by prioritizing efforts to cure diseases and restore health. (Rahmawati & Ramadhika, 2024). One of the supports in organizing health services is radiology which aims to help establish a diagnosis of the patient's illness by producing images (images) so as to provide a more informative diagnosis for a disease by utilizing X-ray aircraft, and the quality of radiology services can be carried out. To support an optimal radiographic image, a quality assurance (QA) program must be carried out (Painan, 2022) (Nurrohmah, 2021).

Quality assurance is a comprehensive management program used to ensure superior health services through systematic data collection and evaluation. The main objectives of quality assurance are to improve patient care, management techniques, radiology department policies and procedures, service effectiveness and efficiency, service education, and produce radiographic images on time (Delima, 2023). The application of time in radiology services is

also an important variable in determining effectiveness for patients. Delays in one examination procedure due to repetition of previous examinations will have an impact on the total patient service time in a day. The process of expertise, diagnosis, and treatment of repeated patient examinations is also delayed so that the effectiveness and efficiency of services are also disrupted. (Rochmayanti & Ardiyanto, 2018)

QA emphasizes human resources or human factors that can cause variations in service quality. One of the main objectives of radiology service quality is to minimize the amount of radiation exposure to patients, namely by eliminating repetition in taking radiographic images (Irsal et al., 2020). Repetition of radiographic images is the result of radiographic images that are not diagnostically acceptable and require additional exposure to patients. Evaluation of the repetition rate in radiographic images can be useful as a means to improve patient care, reduce radiation exposure, and reduce costs. Image repetition analysis is carried out regularly to ensure good results. (Anwar & Priscylo, 2019)

Quality assurance in Computed Radiography technology refers to a series of procedures and activities carried out systematically to ensure that Computed Radiography systems operate in accordance with established specifications and can produce high quality radiographic images. Comprehensive and sustainable implementation of quality assurance in Computed Radiography technology is essential to ensure optimal radiographic image quality and minimize patient radiation exposure pasien (Ike Ade Nurliscyaningsih1, 2022).

Repetition analysis is a systematic process for recording rejected or repeated images to determine the cause of repetition so that image repetition can be minimized and patient dose is low. Repetition of radiographic images occurs because radiographs cannot establish a diagnosis because the object does not fit and is not visible (Sayuti, 2020)

By applying the radiographic image repetition analysis program, it can determine the factors that cause repetition of radiographic images and the reasons for repetition, then evaluation and corrective actions will be taken. Some factors that cause repetition of radiographic images are repetition errors due to patient movement, equipment machine errors, artifacts, fog, over exposed, under exposed, errors in selecting programs (Mohammad & General, 2022). The repetition rate of unreadable radiographic images according to the Decree of the Minister of Health Number 129 / Menkes / SK / II / 2008 concerning hospital minimum service standards states a repetition rate of < 2% per month.

In this modernization era, technological advances are developing very rapidly, especially in the field of radiology, both from equipment and methods. One of them is the use of Computer Radiography (CR) by implementing an image digitization process using an imaging plate (IP). Inside the IP there is a photostimulable phosphor (PSP) that captures analog signals after x-rays penetrate the object to be displayed on the monitor screen in the form of digital signals. By using a digital system in radiography, it is possible to improve the image through a computer device so that it can make a diagnosis, and the operating principle of the CR system is supported by CR image processing software and can be equipped with

statistical data processing applications and repetition data integrated in the CR system (Marpaung et al., 2022) (Harun et al., 2022). The use of computed radiography (CR) equipment is expected to minimize the number of repetitions of radiographic images. Therefore, all computed radiography (CR) devices must function properly according to predetermined standards. Radiographic examination is a technique of examining human organs using X-ray aircraft to produce images of bones, soft tissues, and pathological abnormalities. Types of radiographic examinations include upper extremities, lower extremities, vertebre, thorax, abdomen.

Research Methodology
Approach and Design

Research Design This research is quantitative descriptive in nature by analyzing the factors that cause repetition of computed radiography images in an effort to improve the quality of health services in radiology. The sample in the study was 8197 non-contrast computed radiography images with 410 images that experienced repetition from February - April 2024 at the Radiology Installation of Hospitals in Jakarta. The collection technique, carried out by observation, was recorded in a table to find out the various factors causing image repetition, which then the factors would be grouped according to the type of examination and the factors causing repetition with the Computed Radiography (CR) modality, then the data was systematically calculated using the repeat rate formula so as to determine the percentage results and the number of image repetitions. Data analysis is carried out by analyzing the percentage value of image repetition and evaluated to ascertain whether it is in accordance with the Minimum Hospital Service Standards set by the Decree of the Minister of Health of the Republic of Indonesia No. 129 / Menkes / SK / II / 2008.

Results and Discussion

To identify and understand the factors that cause image repetition in computed radiography (CR) examinations in radiology units and improve the efficiency and accuracy of radiology services and ensure patient safety in improving the quality of health services in radiology health facilities, a comprehensive data analysis of all types of examinations is needed which will be evaluated in an effort to improve the quality of health services. The following is data on the type of examination and cit repetition.

Table 1. Types of radiographic image examinations in February-April 2024

Examination	Approved		Repetition/Reject		Total
	=	%	=	%	
Thorax	3529	94,59	196	5,25	3725
Abdomen	162	84,38	30	15,6	192

Examination	Approved		Repetition/Reject		Total
	=	%	=	%	
Cervical	238	91,19	23	8,8	261
Genu	300	93,75	20	6,3	320
Sinus Paranasal	316	98,44	18	5,61	334
Lumbal	420	96,33	16	3,7	436
Thoracal	126	95,45	16	12,1	142
BNO	40	68,97	14	24,1	54
Femur	310	96,57	11	3,4	321
Pelvis	107	93,04	10	8,7	117
Antebrachi	164	94,80	9	5,2	173
Manus	334	97,95	7	2,1	341
Kepala	36	85,71	6	14,29	42
humerus	136	96,45	5	3,5	141
Wrist Joint	152	97,44	4	2,6	156
Cruris	172	97,73	4	2,3	176
Pedis	334	98,82	4	1,2	338
Ankle	86	95,56	4	4,4	90
Shoulder	94	96,91	3	3,1	97
Scapula	54	96,43	2	3,6	56
Clavicula	72	97,30	2	2,7	74
Elbow	96	97,96	2	2,0	98
Calcaneus	68	97,14	2	2,9	70
Panoramic	343	99,71	1	0,3	344
Mandibula	4	80,00	1	20,00	5
Mastoid	10	100,0	0	0,0 0	10
Os Nasal	16	100,00	0	0,00	16
TMJ	24	100,00	0	0,0	24

Examination	Approved		Repetition/Reject		Total
	=	%	=	%	
Sacrum	44	100,00	0	0,0	44
Total	7787	95,17	410	5,0	8197

Based on Table 1. above in February to April 2024 there are types of examinations that experience repetition of radiographic images amounting to 8197 radiographic images obtained, with a total repetition of 410 times (5.0%). The frequency of accepted and rejected images in each type of examination is with the highest repetition rate of thorax images of 196 times (5.25%).

Referring to the Decree of the Minister of Health of the Republic of Indonesia No. 129 / Menkes / SK / II / 2008 concerning Minimum Hospital Service Standards that for the repetition rate of radiology images in 1 (one) month $\leq 2\%$. Based on the research data in table 1, which was conducted for 3 months, the percentage of repetition of images with computed radiography was 5.25%, which can be explained in detail if viewed per month for the repetition rate of 1.75%, which means that it is still in the range in accordance with the provisions of hospital service standards, so that the quality of service quality in radiology examinations is in the good category.
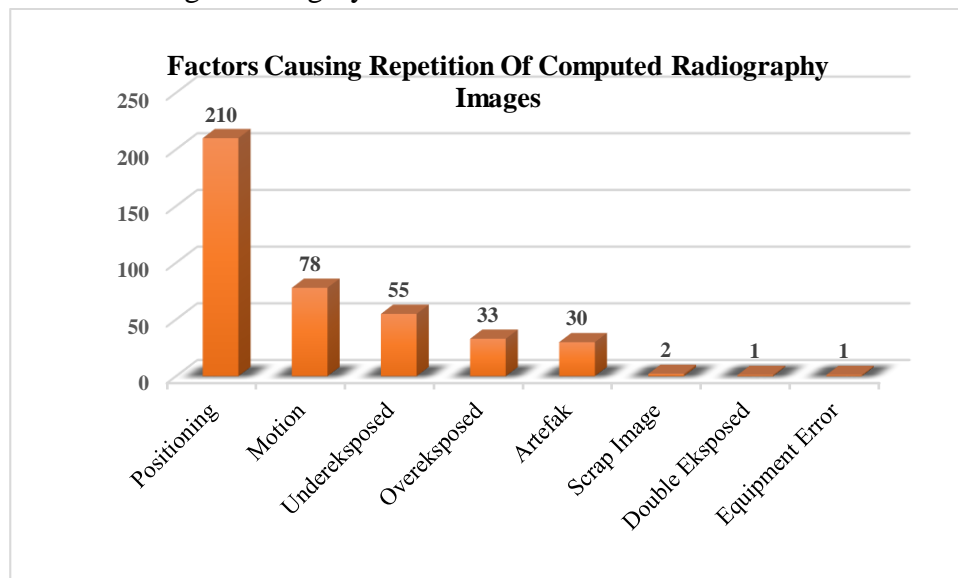

Figure 1. Factors causing image repetition in computed radiography

Based on the figure.1 above in February to April 2024 there are factors that cause repetition of radiographic images, positioning has the highest percentage of 210, Motion 78,

underexposed 55, overexposed 33, artifact 30, scrap image 2, double exposed 1, equipment 1.

In detail, when viewed based on each type of examination, there are several that produce a percentage of repetition of more than ≤2%, namely in the types of abdominal, cervical, genu, thoracal, BNO, pelvic, head and mandibular examinations. The factors causing repetition in the types of examinations above are mostly due to positioning, motion and underexposed, this is in accordance with research (Pratama, 2021), the positioning factor can be caused by the patient's uncooperative condition, this means that the patient cannot be communicated with effectively and the form of this factor causes movement or motion during exposure, this needs to be observed by radiographers and the ability to expose techniques quickly and precisely. Underexposed occurs due to the provision of an exposure factor that is less than the image receptor response, so that the resulting image is less than optimal in providing anatomical image information in establishing a diagnosis. So it can be interpreted that the quality of service in the type of examination above needs to be evaluated and improved service quality from the results of the analysis of factors causing repetition of radiographic images using computed radiography.

Conclusion

The quality of health services in radiology installations reviewed from radiographic image repetition data using computed radiography based on the Decree of the Minister of Health of the Republic of Indonesia No. 129 / Menkes / SK / II / 2008 concerning Minimum Hospital Service Standards that for the category of service quality in the good category refers to image repetition less than ≤2% per month. Repetition of photos is mostly caused by positioning, motion and under-exposed factors..

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