Analysis of Thoracic Radiograph Quality at Dr. M. Haulussy Ambon Regional General Hospital

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A R T I C L E   I N F O

A B S T R A C T

Introduction: Chest radiography is a fundamental imaging modality used to detect abnormalities of the lungs and heart. The quality of the produced images is critical to ensuring diagnostic accuracy. However, several challenges—such as variations in examination techniques, patient positioning, exposure parameters, and equipment condition—can compromise radiographic quality. This study aimed to analyze the factors influencing chest radiography quality and to evaluate the imaging standards applied at the Radiology Department of Dr. M. Haulussy Ambon Regional General Hospital.A mixed-methods approach, combining quantitative and qualitative analyses, was employed. Quantitative data were obtained from 100 chest radiograph samples, while qualitative insights were gathered through in-depth interviews with radiographers and radiologists. The quantitative analysis revealed that 65% of the radiographs were of good quality, 25% were adequate, and 10% required repetition. Qualitative findings indicated that limited routine training, aging equipment, and inconsistencies in radiographic techniques among practitioners were key factors contributing to reduced image quality.Based on these findings, practical recommendations were proposed to enhance operational standards and strengthen human resource competencies. The study provides a valuable basis for continuous quality improvement in radiology services, particularly in hospitals within Eastern Indonesia.

INTRODUCTION

Chest radiography is one of the most frequently used medical imaging modalities for diagnosing various pulmonary and cardiovascular diseases (1-3). This examination plays a crucial role in detecting abnormalities such as pneumonia, tuberculosis, pleural effusion, and heart disease (4-6).The quality of chest radiographic results greatly determines the accuracy of diagnosis and the effectiveness of patient treatment (7,8). In practice, the quality of chest radiography can be influenced by several factors, including examination technique (9), patient positioning (10), X-ray exposure (11), and the condition of the equipment used (12). Suboptimal imaging results may lead to misinterpretation and delayed diagnosis (13,14).At Dr. M. Haulussy Ambon Regional General Hospital, chest radiography serves as one of the primary diagnostic services for respiratory diseases. However, ensuring consistently high-quality imaging results remains a significant challenge (15,16,17). Therefore, an analysis of chest radiography quality is essential to enhance diagnostic accuracy and improve the effectiveness of patient treatment (18,19).The main research question in this study is: How is the quality of chest radiographic results at Dr. M. Haulussy Ambon Regional General Hospital? This study carries high urgency, as the quality of chest radiography strongly influences diagnostic accuracy and the effectiveness of patient care (20,21).Evaluating the factors that affect imaging quality at Dr. M. Haulussy Ambon Regional General Hospital can contribute to improving the operational standards of radiographic examinations (22,23). Furthermore, this study can serve as a basis for improving the quality of radiology services through equipment optimization, enhancement of medical personnel competence, and implementation of more effective standard operating procedures (24,25).

METHODS

This study employed a mixed-method approach with a descriptive–evaluative design. The quantitative approach was used to analyze data from the audit of chest radiography image quality, while the qualitative approach was applied to explore in-depth information through interviews. The research received ethical approval from Dr. M. Haulussy Ambon Regional General Hospital (Approval No.: 57/BDPA/PEN/VII/2025).The study population

consisted of all chest radiography examinations conducted at the Radiology Department of Dr. M. Haulussy Ambon Regional General Hospital. A total of 100 chest radiographic images were selected as samples and assessed by qualified auditors. In addition, interviews were conducted with five radiographers and two radiologists working at the hospital.The research instruments included an image quality audit observation checklist and a structured questionnaire for radiographers and radiologists. The questionnaire comprised ten items assessing technical aspects of examination procedures, understanding of standard operating procedures (SOPs), and implementation of chest radiography quality audits. The questionnaire was developed based on the guidelines of the Radiological Society of North America (RSNA, 2021) and the framework by Bontrager & Lampignano (2018). Content validity was reviewed by two radiologists and one lecturer specializing in radiodiagnostic sciences.Quantitative data were analyzed descriptively to determine the frequency distribution and percentage of image quality categories (Good, Fair, and Repeat Required). Qualitative data were analyzed using thematic analysis to identify key themes emerging from participants' responses.

RESULT AND DISCUSSION

RESULTS
Respondent Characteristics

Table 1. Respondent Characteristics at RSUD Dr. M. Haulussy Ambon

No	Code	Position	Gender	Age	Education	Experience (years)	Employee Status	Unit
1	R1	Radiographer	Female	41	D3 Teknik Radiologi	5	Civil Servant	Radiology Department
2	R2	Radiographer	Male	26	D3 Teknik Radiologi	2	Contract Employee	Radiology Department
3	R3	Radiographer	Male	48	D4 Teknik Radiologi	22	Civil Servant	Radiology Department
4	R4	Radiographer	Male	40	D4 Teknik Radiologi	16	Civil Servant	Radiology Department
5	R5	Radiographer	Male	39	D4 Teknik Radiologi	15	Civil Servant	Radiology Department
6	D1	Radiographer	Male	37	Spesialis Radiologi	6	Civil Servant	Radiology Department
7	D2	Radiographer	Male	45	Spesialis Radiologi	10	Civil Servant	Radiology Department

Based on the table above, the majority of respondents were radiographers (71%), while the remaining were radiologists (29%). Most respondents were male (57%) with an age range of 26–48 years. Among the radiographers, two held an Associate Degree (D3) in Radiography Technology and three held a Bachelor's Degree (D4) in Radiologic Technology, whereas both radiologists possessed a Specialist Qualification in Radiology. The majority of respondents were civil servants (ASN) with more than five years of work experience. These findings indicate that the respondents possessed adequate professional competence and experience to support the validity of the study results.

Quantitative Analysis
Table 2. Questionnaire Assessment Results of Radiographers and Radiologists

Code	Position	Total score	category	Aspects Assessed (Technique, SOP, Audit)
R1	Radiographer	36	Good	Proficient in exposure technique and patient positioning
R2	Radiografer	40	Good	Lacking in the implementation of collimation SOPs
R3	Radiographer	32	Good	Independently conducts quality audits
R4	Radiographer	45	Very good	Regularly participates in training programs

R5	Radiographer	30	Adequate	High variability in techniques among shifts
D1	Radiographer	36	Good	Supervises quality audit activities
D2	Radiographer	42	Very good	Routine image quality evaluation is conducted

Based on the questionnaire results, the average scores of the radiographers ranged from fair to good and very good, while the radiologists were categorized as good and very good. This indicates that the radiology personnel at Dr. M. Haulussy Regional General Hospital possess adequate professional competence, although improvements are still needed to ensure consistency in the implementation of standard operating procedures and regular quality audits.

Table 3. Summary of Chest Radiography Image Quality at Dr. M. Haulussy Regional General Hospital, Ambon

No	Category	Total (n)	Presentage (%)	Description
1	Good quality	65	65%	The image meets all technical and anatomical criteria
2	Fair Quality (Needs Improvement)	25	25%	The image shows slight asymmetry, with suboptimal scapular positioning
3	Repeat Required	10	10%	The image demonstrates rotation and uneven density distribution
	Total	100	100%	

The table above shows that the majority (65%) of chest radiography images at Dr. M. Haulussy Regional General Hospital, Ambon, demonstrated good quality. However, 25% of the images required improvement, and 10% needed to be repeated. The 10% repetition rate warrants attention, as it may increase patient radiation exposure and reduce service efficiency.
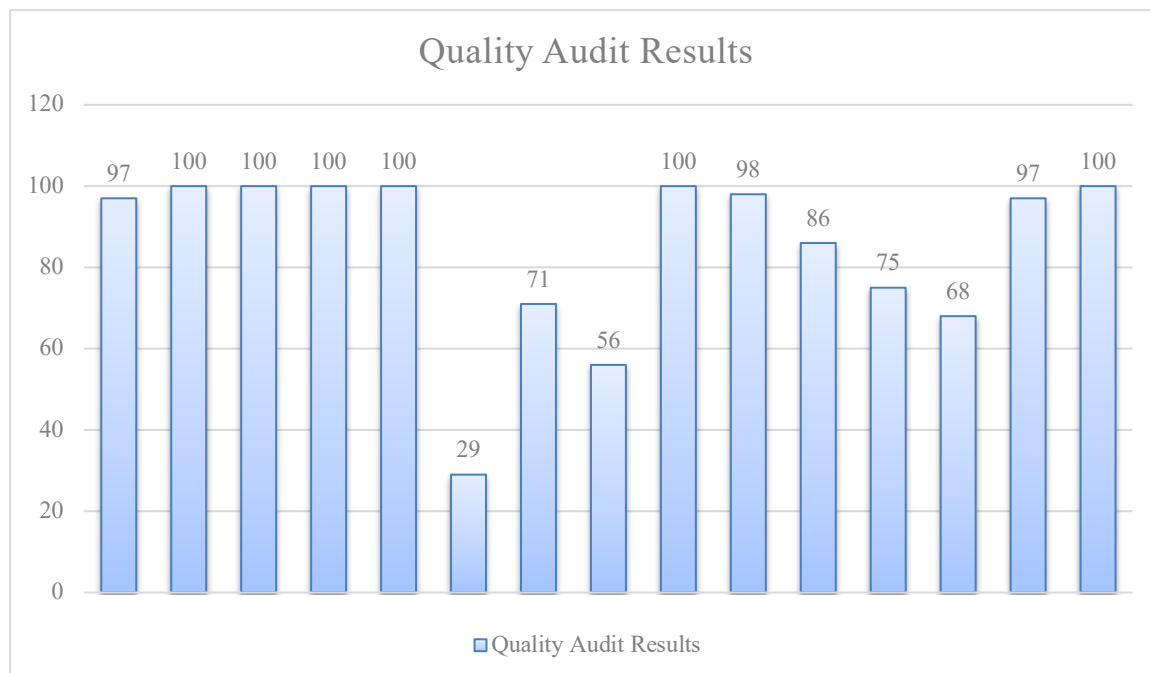

Figure 1 . Percentage of Quality Audit Results Based on Chest Radiographic Image Quality Assessment Parameters

Based on the graph above, analysis of 100 chest radiographic images using 15 quality assessment criteria revealed the following results. For technical parameters, 97% of the images showed clearly visible lateral markers, 100% were free from artifacts, 100% had no cropping or collimation errors, 100% demonstrated optimal exposure, and 100% included the entire thoracic area.In terms of patient positioning criteria, 29% of the images showed proper erect or sitting positions, 71% demonstrated symmetrical scapulae, 56% had symmetrical clavicular alignment, and 100% showed no evidence of rotation.For anatomical and visual parameters, 98% of the images clearly demonstrated the trachea and main bronchi, 86% had well-defined cardiac borders, 75% showed normal diaphragmatic contours, 68% displayed clearly visible costophrenic angles, 97% showed homogeneous lung fields, and 100% had appropriately faint spinal visualization.These results indicate that the majority of chest radiographic images met most of the established quality standards.

Qualitative analysis

Table 4. Results of Interviews with Radiographers and Radiologists

No	Quotes from Respondents	Subtema	Theme
1	*"The radiographic equipment has been in use for a long time and is seldom maintained; however, it continues to be operated due to the absence of replacement units.." (Radiografer R3)*	Aging Equipment Condition	Technical Factors Affecting Image Quality
2	*"At times, the radiographic density appears excessively opaque or overly lucent, which complicates image interpretation."." (Radiolog R2)*	Variation in Exposure Quality	Human Resource Competence and Training
3	*"Not all radiographers have received regular training, so the techniques still vary among them." (Radiolog D1)*	Lack of Continuous Training	Implementation of Standard Operating Procedures (SOPs)
4	*"The SOPs actually exist, but not all staff apply them consistently. (Radiografer R5)*	Inconsistency in SOP Implementation	Execution of Image Quality Audits
5	*"If an image is not diagnostically acceptable, it is usually reviewed and repeated immediately." (Radiolog D2)*	Internal Quality Audit	Strengthening the Radiology Service Quality System
6	*"There should be joint training sessions with radiologists so that image evaluation can be more standardized." (Radiografer R2)*	Radiographer–Radiologist Collaboration	Consistency of Technical Procedures
7	*"There are still differences in exposure techniques among staff, depending on individual habits." (Radiografer R4)*	Variability in Examination Techniques	Enhancement of Quality Audit and Monitoring Systems
8	*"Quality audits need to be scheduled regularly to identify which images still fall below the expected standard." (Radiolog D1)*	Importance of Periodic Evaluation	Technical Factors Influencing Examination Accuracy
9	*"We often find suboptimal images due to incorrect patient positioning; sometimes the scapula still overlaps the lung fields." (Radiolog D1)*	Inaccurate Patient Positioning	Optimization of Diagnostic Quality
10	*"Images that are underexposed or overexposed are challenging to interpret, particularly when subtle pulmonary infiltrates are present. Greater attention is required from radiographers in selecting appropriate exposure parameters." (Radiolog D2)*	Determination of Exposure Factors	Interprofessional Collaboration in Image Quality Improvement
11	*"The involvement of radiologists in quality audits is very important, as it allows them to provide direct feedback to radiographers." (Radiolog D2)*	Radiologist Supervision and Evaluation	Quality Management in Radiology Services
12	*"Ideally, quality audits should be conducted at least twice a year, but so far they have not been carried out regularly." (Radiolog D1)*	Frequency of Quality Audits	Strengthening Technology-Based Quality Systems
13	*"A digital image quality reporting system is needed so that data can be continuously monitored." (Radiolog D2)*	Digital Management of Quality Data	Strengthening Technology-Based Quality Systems

DISCUSSION

Quantitative Results Interpretation

The audit of 100 chest radiography images showed that 65% were of good quality, 25% were fair, and 10% required repetition. These findings indicate that the majority of radiographs met the required quality standards, although some inconsistencies were still observed.Technical aspects such as lateral marker visibility, collimation, and exposure were optimal, with compliance scores ranging from 97% to 100%. However, the most common issues were related to patient positioning, with only 29% showing proper erect or sitting positions, 71% demonstrating symmetrical scapulae, and 56% showing symmetrical clavicular alignment. This suggests that patient positioning remains the main factor contributing to suboptimal chest image quality. This finding aligns with Sutaryo , who reported that patient positioning errors are the predominant cause of inaccuracy in thoracic radiographic results at type B hospitals (7).Furthermore, the 10% repetition rate indicates inefficiency in time and resource use, as well as increased patient radiation exposure. This rate is still higher than the international standard recommended by the Radiological Society of North America (RSNA, 2021), which suggests maintaining repetition rates below 5% (9,8). Therefore, strengthening operational procedures and implementing regular image quality evaluations should be prioritized.

Qualitative Results Analysis

In-depth interviews with five radiographers and two radiologists yielded four main themes: Technical factors and equipment condition, Human resource competence and training,SOP implementation and quality audits, andCollaboration among radiographers, radiologists, and the quality management system.Radiographers mentioned that aging radiography equipment and infrequent maintenance contribute to image quality variations. Radiologists added that differences in exposure factors and patient positioning often lead to density inconsistencies, reducing image interpretability. These findings are consistent with Kim, who found that equipment condition and operator accuracy significantly influence radiographic quality (6).In addition to technical factors, the interviews revealed that the lack of regular training causes variability in techniques among radiographers. Radiologists suggested joint training sessions to harmonize understanding of image quality criteria. This aligns with Gillard, who emphasized that continuous professional development and systematic evaluation are key to improving imaging consistency (4,5).Regarding SOP implementation and quality audits, several radiographers stated that while SOPs exist, their application remains inconsistent. Radiologists also noted that quality audits are not conducted regularly, despite being a key indicator in radiology quality assurance systems (10). The absence of a digital reporting system further limits documentation and evaluation of image quality outcomes.importance of their involvement in quality audits to provide direct feedback to radiographers. Such collaboration has been shown to reduce image repetition rates and improve image uniformity (15). Hence, strengthening interprofessional communication is a strategic factor in enhancing thoracic radiography quality in regional hospitals.

Integration of Quantitative and Qualitative Findings

The integration of both quantitative and qualitative results demonstrates a strong convergence between the two data sets. Numerically, imperfections in patient positioning and variations in exposure parameters explain why some radiographic images were categorized as "fair" or "repeat required." Meanwhile, the qualitative interviews revealed underlying causes, including aging equipment, inconsistencies in technique among radiographers, and the absence of regular training programs.The combination of these approaches confirms that image quality issues do not solely arise from technical aspects but are also influenced by operator competence and radiology quality management systems. This finding aligns with the *Quality Assurance in Radiography* framework proposed by Bontrager and Lampignano, which emphasizes that radiographic quality is the result of interaction among human factors, equipment performance, and procedural consistency (10).

CONCLUSION

This study revealed that the overall quality of chest radiographic images at Dr. M. Haulussy Regional General Hospital, Ambon, generally meets radiographic quality standards, although several aspects still require improvement.Based on the quantitative results from 100 audited chest radiography samples, 65% of images were classified as good, 25% as fair, and 10%

required repetition due to patient positioning errors and exposure variation. These findings indicate that most radiographic procedures were performed according to established standards; however, inconsistencies in positioning and exposure techniques continue to affect image outcomes.Meanwhile, qualitative findings from in-depth interviews with radiographers and radiologists identified four major themes:Aging equipment and limited maintenance;Variation in competence and lack of technical training among radiographers;Irregular implementation of SOPs and image quality audits; andInsufficient systematic collaboration between radiographers and radiologists in image quality evaluation.

The integration of these two approaches highlights that the variation in image quality is not solely technical in nature but also influenced by managerial factors and human resource competencies. Therefore, improving the quality of chest radiography at Dr. M. Haulussy Regional General Hospital requires a comprehensive strategy that includes:Regular equipment maintenance and calibration;Continuous professional training for radiographers and radiologists;Implementation of a structured and routine image quality audit system; and Strengthening interprofessional collaboration in quality supervision and image evaluation.Implementing these measures is expected to significantly enhance the quality of radiology services at Dr. M. Haulussy Regional General Hospital, thereby supporting more accurate, efficient, and patient-safety-oriented diagnoses.

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