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Original Article

การวิเคราะห์การถ่ายฟิล์มซ้ำและผลกระทบต่อการประกันคุณภาพในงานรังสีวินิจฉัย: กรณีศึกษาในสถาบัน

Repeat film analysis and its implications for quality assurance in diagnostic radiology: an institutional case study

บุญชัย นิตยสุภาภรณ์[1] • จตุพงษ์ พฤกษ์เกิด[2] • มนัสวี เพิ่มวงษ์[2] • ฐิติทิพย์ ทิพยมนตรี[2*]

[1]ฝ่ายรังสีวิทยา โรงพยาบาลจุฬาลงกรณ์ สภากาชาดไทย กรุงเทพมหานคร 10330 ประเทศไทย

[2]ภาควิชารังสีเทคนิคและฟิสิกส์ทางการแพทย์ คณะสหเวชศาสตร์ จุฬาลงกรณ์มหาวิทยาลัย กรุงเทพมหานคร 10330 ประเทศไทย

Bunchai Nittayasupaporn[1] • Jatupong Proukkerd[2] • Manassawee Permwong[2] • Thititip Tippayamontri[2*]

[1]Department of Radiology, King Chulalongkorn Memorial Hospital, Bangkok, 10330, Thailand

[2]Department of Radiological Technology and Medical Physics, Faculty of Allied Health Sciences, Chulalongkorn University, Bangkok, 10330, Thailand

ผู้รับผิดชอบบทความ: | Corresponding author: Thititip Tippayamontri (Thititip.T@chula.ac.th)

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บทคัดย่อ

งานวิจัยนี้มีวัตถุประสงค์เพื่อวิเคราะห์อัตราการตรวจทรวงอกซ้ำโดยใช้โปรแกรมเครื่องมือวิเคราะห์การปฏิเสธและการใช้งาน (Reject and Usage Analysis) ของเครื่องเอกซเรย์ Samsung XGEO-GC80 การศึกษาวิจัยเป็นแบบย้อนหลัง (Retrospective study) ดำเนินการที่แผนกรังสีวินิจฉัย โรงพยาบาลจุฬาลงกรณ์ สภากาชาดไทย การศึกษานี้เกี่ยวข้องกับการรวบรวมสถิติและตรวจสอบสาเหตุที่อยู่เบื้องหลังรูปภาพที่ถูกปฏิเสธภายในระบบเครื่องเอกซเรย์อย่างละเอียด ผลการวิจัยที่สำคัญ ได้แก่ การถ่ายภาพเอกซเรย์ทรวงอกมีจำนวนภาพมากที่สุด คิดเป็น 39.32% ของภาพทั้งหมด 40,400 ภาพ ภาพที่มีการถ่ายซ้ำที่พบได้บ่อยที่สุดในการถ่ายภาพเอกซเรย์ทรวงอกคิดเป็น 32.21% จาก 7,550 ภาพที่ถูกปฏิเสธ และ 6.02% ของภาพทั้งหมด สาเหตุหลักในการปฏิเสธภาพ คือการวางตำแหน่งจัดท่าที่ไม่เหมาะสม คิดเป็น 75.47% ของภาพที่ถูกปฏิเสธทั้งหมด สาเหตุที่พบบ่อยที่สุดสำหรับการปฏิเสธภาพคือการหายใจที่ไม่เหมาะสม ซึ่งคิดเป็น 54.3% ของภาพที่ถูกปฏิเสธทั้งหมด 1,321 ภาพ และ 14.0% ของภาพที่ถูกปฏิเสธทั้งหมดในการศึกษานี้ นอกจากนี้ การศึกษาแสดงให้เห็นอย่างชัดเจนว่าสาเหตุสำคัญของการปฏิเสธภาพเอกซเรย์เป็นผลมาจากข้อผิดพลาดของมนุษย์ โดยส่วนใหญ่มาจากนักรังสีเทคนิค ดังนั้นจากผลการทดลองของงานวิจัยนี้มีข้อเสนอแนะเพื่อลดอัตราของการถ่ายภาพซ้ำ ดังนี้ i) การประเมินสภาพของผู้ป่วยอย่างรอบคอบก่อนการตรวจเอกซเรย์ ii) การดูแลการจัดท่าผู้ป่วยให้อยู่ในตำแหน่งที่เหมาะสม iii) การดำเนินการภายในหน่วยการดูแลสุขภาพ ที่ส่งเสริมให้นักรังสีเทคนิคเข้ารับการฝึกอบรมอย่างสม่ำเสมอและต่อเนื่อง และ iv) การกำหนดเกณฑ์การยอมรับภาพเอกซเรย์ของนักรังสีเทคนิคในแผนกวินิจฉัย โดยสรุป การวิเคราะห์อัตราการตรวจทรวงอกซ้ำเหล่านี้มีประโยชน์อย่างยิ่งในการปรับปรุงคุณภาพของบริการงานรังสีวินิจฉัยของโรงพยาบาลจุฬาลงกรณ์ สภากาชาดไทย เพื่อลดอัตราของการปฏิเสธภาพ และเพื่อพัฒนาการดูแลผู้ป่วยและความปลอดภัยทางรังสีให้ดียิ่งขึ้น

คำสำคัญ: การวิเคราะห์อัตราการถ่ายเอกซเรย์ซ้ำ, การวิเคราะห์การปฏิเสธและการใช้งาน, ภาพถ่ายเอกซเรย์ทรวงอก, การประกันคุณภาพในงานรังสีวินิจฉัย

Abstract

The primary objective of this research was to analyze the rate of repeated chest examinations using the Reject and Usage Analysis tool program of the Samsung XGEO-GC80 X-ray machine. A retrospective study was conducted at King Chulalongkorn Memorial Hospital (KCMH) in the Department of Radiological Diagnostic. The study involved collecting statistics and closely examining the causes behind rejected images within the machine system. Among the key findings were Chest examinations accounted for the highest number of images, comprising 39.32% of the total 40,400 images. Repeated images were most prevalent in chest examinations, making up 32.21% of the 7,550 rejected images and 6.02% of all images. The primary reason for rejecting images was improper positioning, constituting 75.47% of all rejected images. In chest examinations, the most common reason for image rejection was improper breathing, contributing to 54.3% of all 1,321 rejected images and 14.0% of all rejected images in the study. Furthermore, the study highlighted that a significant portion of X-ray image rejections resulted from human errors, primarily from radiological technologists. To reduce the rate of repeated imaging, the following recommendations were proposed for i) comprehensive evaluation of the patient's condition before the X-ray examination, ii) Ensuring proper patient positioning, iii) Implementation of various initiatives within the healthcare unit, including regular training for radiologists, and iv) Establishment of criteria for accepting radiographic images across all radiological technologists within the diagnostic department. In conclusion, these analyses are essential to enhance the quality of radiological services at KCMH, minimize image rejections, and ultimately improve patient care and radiation safety.

Keywords: Repeat film analysis, Reject and usage analysis, Chest x-ray, Quality assurance in diagnostic radiology

Introduction

The process of radiological imaging for diagnosis utilizes radiation to pass through an object, creating images that reveal the characteristics inside that object, with varying intensities of radiation being absorbed by different materials. These resulting images provide clear and valuable information for medical diagnosis and treatment.

Radiological image retakes are prompted by the inadequate quality of the images taken for medical diagnosis. These retake images (or repeat images) can result from a range of factors, including technical issues, patient movement, positioning errors, or other factors that affect the clarity and accuracy of the image[1, 2, 3]. A retake is typically initiated when the initial X-ray images are deemed suboptimal or of insufficient quality for accurate diagnostic interpretation. This image will be rejected once it is deemed unacceptable for diagnostic purposes and is not considered for interpretation. Nevertheless, a high rate of repeat radiological imaging can entail adverse repercussions for organizations or healthcare facilities. This includes elevated operational costs, such as increased electricity expenses and the need for equipment maintenance[4, 5].

Regarding the preliminary survey of the repeat rate conducted in the Department of Radiology at King Chulalongkorn Memorial Hospital (KCMH), Thailand in 2021, it revealed a concerning finding. The repeat rate was remarkably high, amounting to 13% of the total number of images captured. This percentage surpasses the recommended limit set forth by the American Association of Physicists in Medicine (AAPM), as outlined in Task Group-151's 2015 report. According to AAPM guidelines, the repeat rate in radiology departments should not exceed 8% per year[6]. Moreover, the report suggests that if the repeat rate surpasses the 10% mark annually, the organization or healthcare facility should take proactive measures to mitigate this issue[6]. Therefore, there is a notable need for a comprehensive analysis of the statistical data pertaining to the repeat radiography rate. It is equally crucial to delve into the underlying causes that lead to these repeat instances. Simultaneously, strategies should be developed and implemented to prevent the contributing factors that result in repeat radiography.

Radiological imaging utilizing X-ray machines employs ionizing radiation, which possesses the capability to ionize atoms as it traverses various materials. This ionization process can have two significant consequences: it can directly inflict damage to DNA or generate free radicals that subsequently harm DNA[7]. Consequently, the same radiation that proves advantageous for medical diagnostic purposes can also be detrimental, contingent on its application, dosage, and the value it contributes to medical examinations[8]. Elevated repeat rates in radiological imaging have the potential to expose both patients and radiological technicians to unnecessary additional radiation doses, thereby amplifying the risk of adverse biological effects stemming from radiation exposure. This scenario, in any case, runs contrary to the fundamental principle of Radiation Protection known as ALARA (As Low As Reasonably Achievable). ALARA stipulates that patients should receive the minimum radiation dose essential for precise diagnosis and effective treatment[9]. For standard general X-ray examinations conducted at KCMH, patients are subjected to a radiation dose of approximately 50 microsieverts per examination, a level considered low when compared to the public exposure dose limit, which should not exceed 1 millisievert per year[10]. Nevertheless, the unwarranted escalation in radiation dose due to repeat images still poses a risk of stochastic effects, which can manifest even with low radiation exposure[11]. Hence, the reduction of the repeat rate is imperative, serving the dual purpose of ensuring patient satisfaction and upholding the credibility of the organization or healthcare facility. Additionally, since the repeat rate functions as a crucial indicator of radiological technologists' performance, its analysis is deemed an essential quality assurance measure.

The primary objective of this study is to delve into the statistics surrounding chest X-ray image rejection, specifically employing the Samsung XGEO-GC80 X-ray machine within the Department of Radiology at King Chulalongkorn Memorial Hospital, Thailand. This investigation aims to comprehensively analyze the reasons behind the rejection of these X-ray images. The specific objectives of this study are as follows:

i) Determine Overall Repeat Rate: The study seeks to calculate and understand the overall repeat rate of radiographs conducted using this particular X-ray machine. This statistic serves as a fundamental benchmark for assessing the efficiency of the radiological procedures.

ii) Assess Error Prevalence: The research aims to identify and assess the prevalence of different types of errors that contribute to the need for image repeats. This analysis is essential in pinpointing areas where improvements can be made to reduce the repeat rate.

iii) Generate a Database: A critical aspect of this study involves creating a comprehensive database detailing the reasons behind chest X-ray image rejection. This database will not only serve the current investigation but also provide valuable data for future research endeavors in the field of radiology.

By pursuing these objectives, this study endeavors to enhance the quality of radiological services, minimize image retakes, and contribute to the overall improvement of patient care in the Department of Radiology at King Chulalongkorn Memorial Hospital.

Materials and Methods

The data collection was conducted during the study period, spanning from June to December 2022. The scope of this study followed the conceptual research framework, as illustrated in Figure 1.

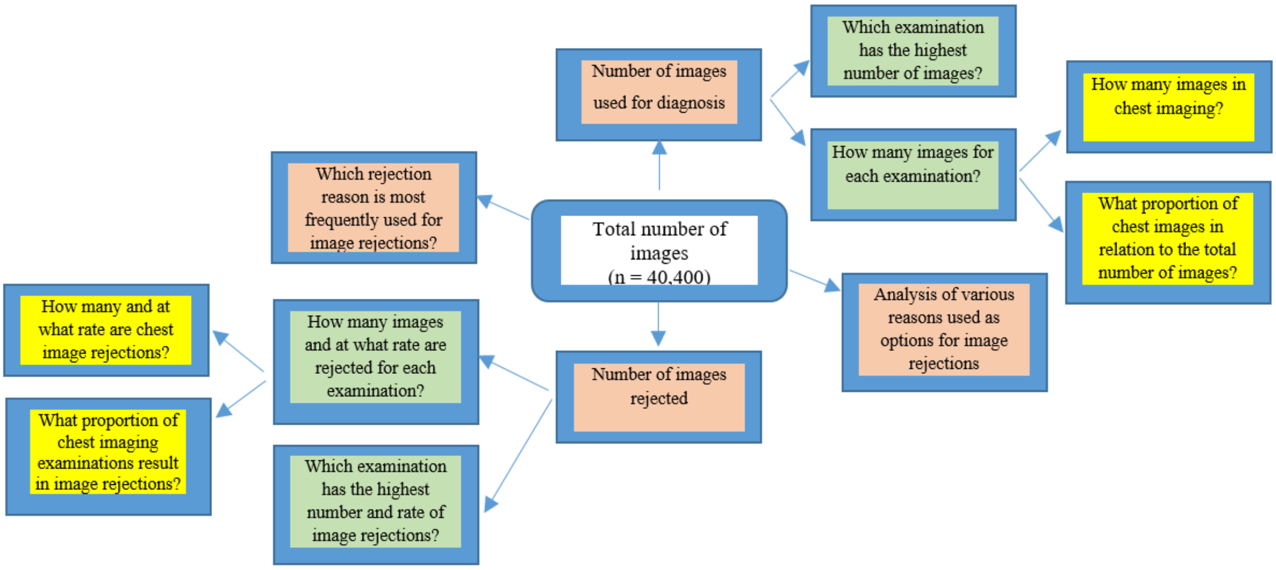

Figure 1. Research conceptual framework for this study

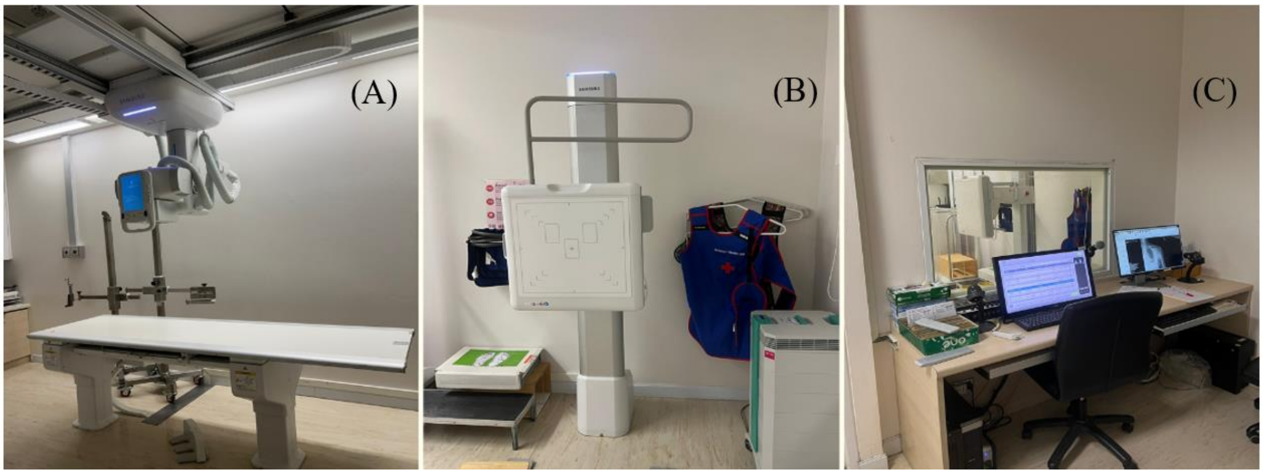

Figure 2. X-ray machine (including X-ray tube and bed) (A), standing detector (B), and work station (C), which are located at KCMH.

Ethical approval

This study was approved by the ethics and research committee at King Chulalongkorn Memorial Hospital, Thailand. The ethical approval number: 133/2566.

Digital X-ray system

Figures 2A-C depict the X-ray machine (including the X-ray tube and bed) alongside the radiological technologist's workstation at KCMH. The survey and collection of statistical data were carried out using the Samsung XGEO-GC80 X-ray machine, employed for patient diagnostic examinations.

Reject and usage analysis tool (RUA)

The X-ray machine is equipped with an image storage and reject system. Whenever the radiological technologist identified inadequate image quality, a repeat X-ray examination was initiated. The system then prompted the technologist to select a reason for image rejection. Subsequently, both the number of rejected images and the specific reasons for rejection in all types of X-ray examinations were recorded within the system. The reasons for image rejection encompassed various factors, including positioning, not full inspiration, patient motion, artifacts, underexposure, system/equipment failure, and testing.

The process for accessing data from the Reject and Usage Analysis Tool software is elucidated in Figure 3A-G. This software facilitated the analysis of rejected images, allowing for the determination of the repeat rate, which was defined as the proportion of rejected images relative to the total number of images exposed.

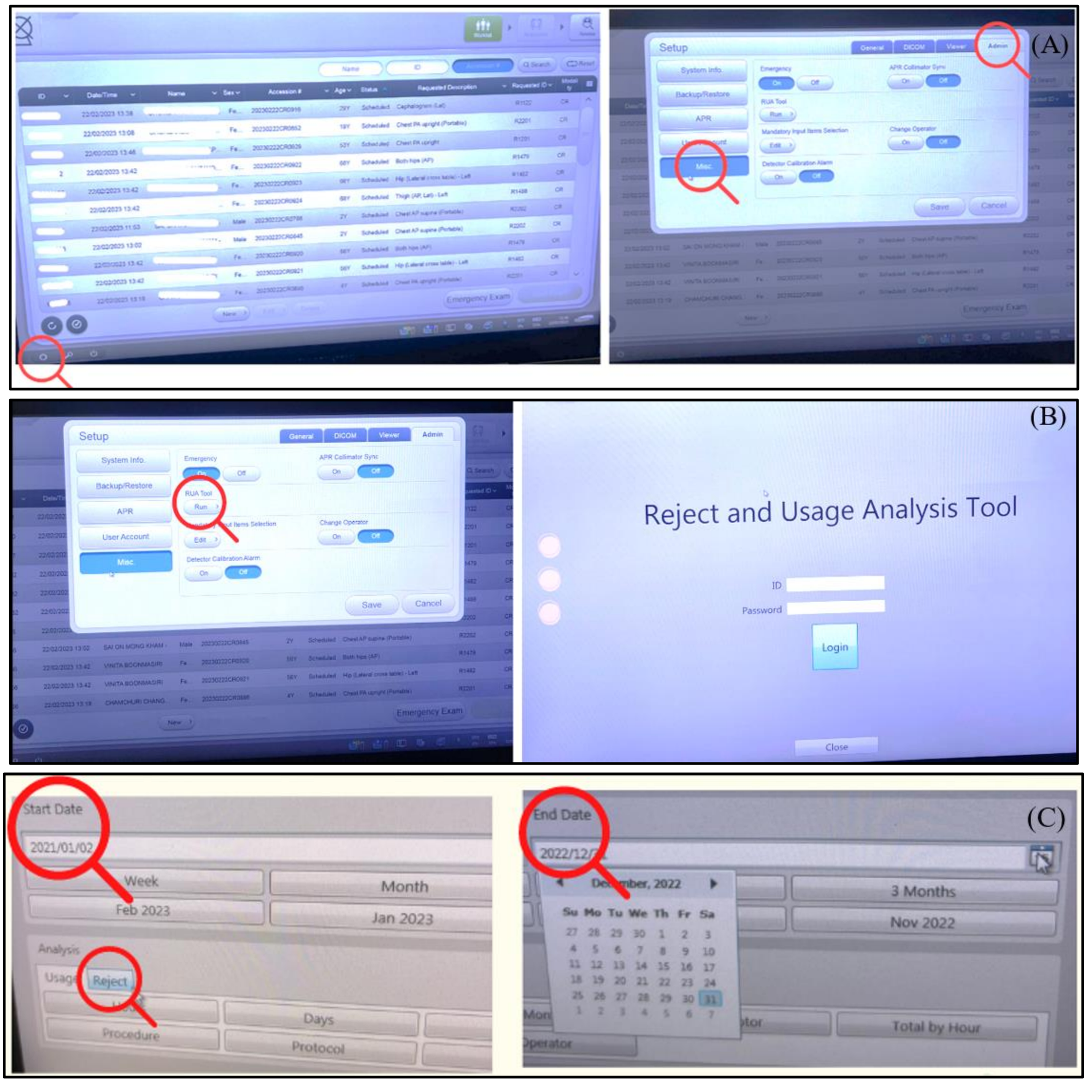

Figure 3. The process for accessing data from the Reject and Usage Analysis Tool software (A-C)

Data collection

The X-ray machine is equipped with a rejection system that offers selectable reasons for image rejections. This functionality allows researchers to gather both numerical data and detailed information regarding the causes behind image rejections, enabling subsequent in-depth analysis. Throughout the study period, data recorded in the system were organized into distinct categories, including image components (Protocol), imaging angles (Procedure), instances of image rejection (Reject), and the specific reasons for these rejections (Reject reason). To facilitate this research, the researchers conducted a survey and collected data on image rejections in radiography, while also documenting the associated reasons for these rejections. This data collection process was accomplished using the Reject and Usage Analysis

Tool, which is integrated within the Samsung XGEO-GC80 X-ray machine.

Data analysis

In this study, both quantitative and qualitative analyses were conducted. The collected data underwent comprehensive statistical analysis, which included a range of mathematical calculations, such as percentages, maximum values, and frequencies. This statistical analysis was carried out on a monthly basis, encompassed several key aspects including i) Total Number of Radiological Examinations: The researchers scrutinized the overall number of radiological examinations performed. ii) Rejected Images: A thorough examination of the total count of rejected images. The rejection rate was determined by dividing the number of rejected radiographs by the total number of acquired radiographs. iii) Reasons for Image Rejection: The study also involved a detailed breakdown of the specific reasons for image rejection.

Results

The statistical findings regarding radiographic imaging conducted using the Samsung XGEO-GC80 X-ray machine for diagnostic purposes at KCMH during the period from June to December 2022 have been illustrated in Figure 4. A total of 40,400 radiographic images were performed, out of these 7,550 images were rejected. The percentage of rejected images relative to the total number of images is 18.69%. Furthermore, it's noteworthy that chest examinations constituted the largest portion of radiographic images, accounting for 15,887 images. This comprises 39.3% of the entire set of radiographic images, which amounted to 40,400 images.

Figure 5 illustrates the distribution of rejected images based on various reasons across all types of examinations. Chest examinations had the highest number of rejected images, totaling 2,432 images. This represents 32.21% of all rejected images, which numbered 7,550 images in total.

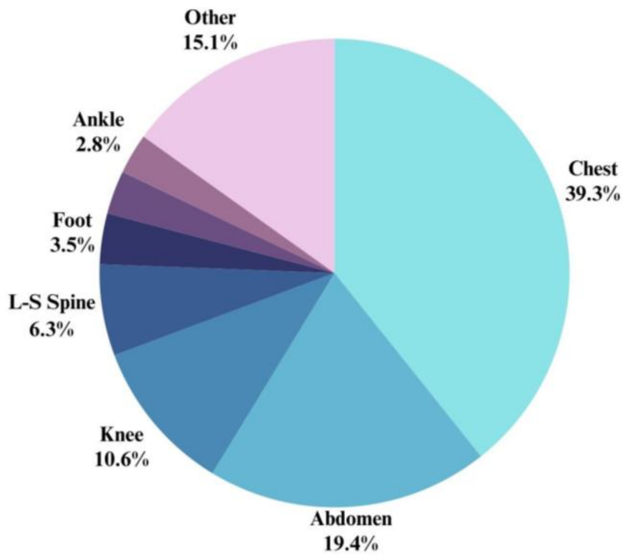

Figure 4. The proportion of the number of radiographic images for each type of examination.

The rate of repeated imaging for chest examinations was calculated to be 15.31% of all chest examinations conducted, which amounted to 15,887 images. Among all types of examinations, the most frequently used reason for image rejection was positioning, accounting for a total of 5,698 images. This reason constituted a substantial 75.5% of all rejected images, which totaled 7,550 images.

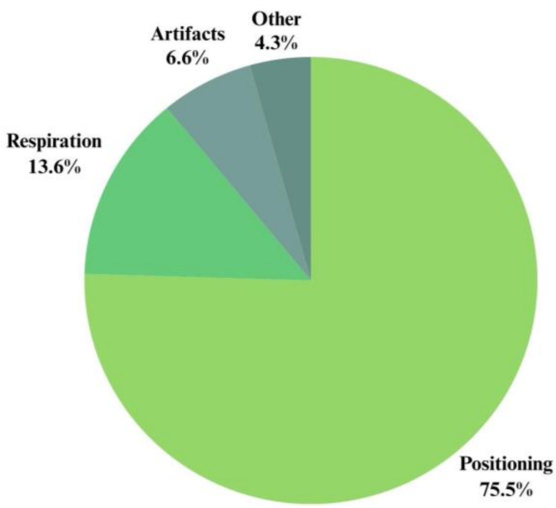

Figure 5. The proportion of the total number of rejected images based on various reasons for all types of examinations.

The analysis examines into the breakdown of image rejection causes, which are categorized into two primary groups: human errors and mechanical errors. Human errors can be traced back to both radiographers and patients, while mechanical errors are associated with equipment and devices utilized in the imaging process. Figure 6 provides a visual representation of the proportions of these image rejection reasons. Human errors constitute the predominant cause of image rejection in radiographic imaging, accounting for 99.6% of all rejected images. This category can be further subdivided into errors attributable to radiographers (84.3%) and errors stemming from patients (15.7%). For mechanical- related errors contributed to only 43 rejected images, comprising a mere 0.4% of all rejected images.

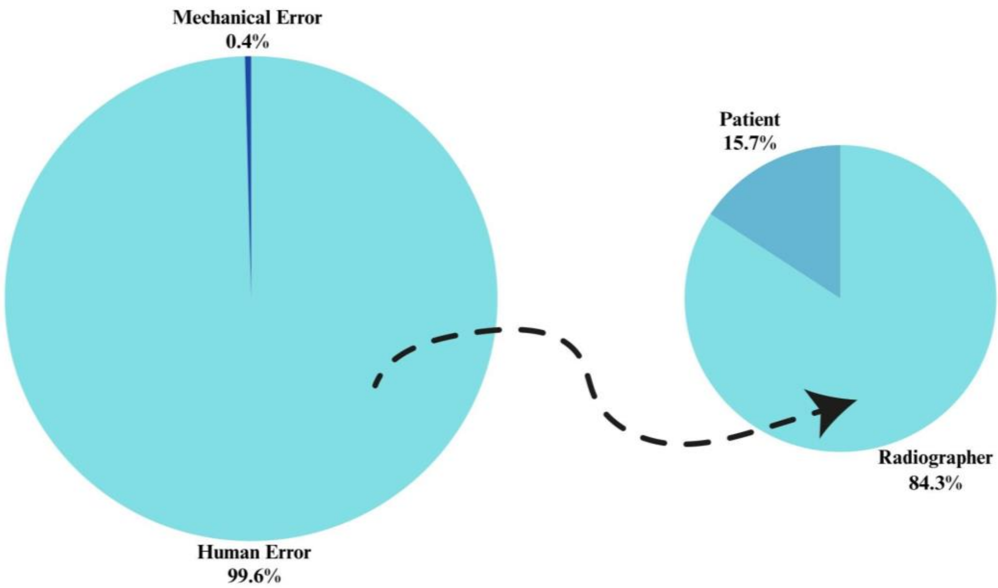

Figure 6. The proportion of reasons for all image rejection.

Table 1. Number of rejected chest x-ray images by various causes from June to December 2022.

Month	Not Full Inspiration	Positioning	Artifacts	Under-exposure	Equipment Failure	Other (etc.)	Total images
June	106	74	10	6	1	6	203
July	98	51	16	0	0	11	176
August	85	51	12	1	0	3	151
September	313	127	82	2	1	6	531
October	234	129	48	2	0	6	418
November	106	93	18	2	0	1	220
December	116	84	20	1	0	2	223

From Table 1, a statistical analysis comparing the number of radiological examinations to the total number of images captured each month, spanning from June to December 2022. Notably, the top three most frequently used reasons for rejecting chest radiography images all pointed in the same direction. The distribution of reasons for rejection in chest radiography images is depicted in Figure 7. The most commonly used reason for image rejection in chest radiography was "Not Full Inspiration," with a total of 1,395 images rejected. This reason accounted for a significant 54.3% of all rejected chest radiography images. Following thoroughly, positioning issues constituted 32.2% of all rejected chest radiography images. Artifacts were responsible for 10.0% of the rejected chest radiography images. A smaller portion, approximately 3.5%, of the rejected chest radiography images was attributed to other reasons.

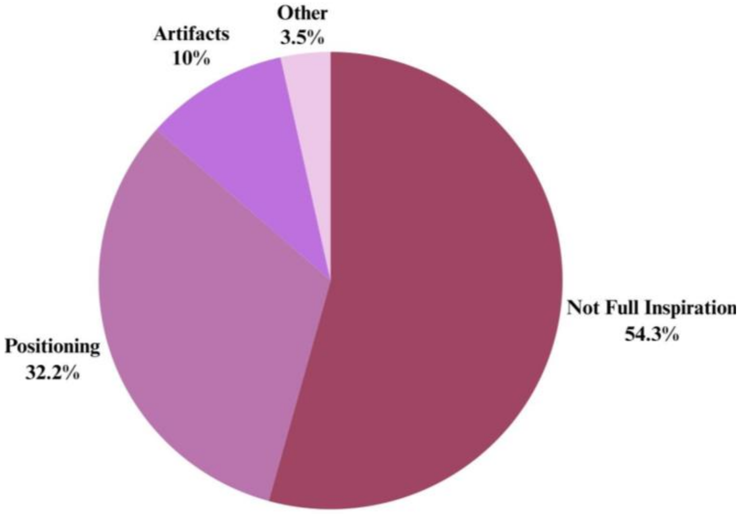

Figure 7. The proportion of reasons for rejection of chest radiography images.

Discussion

Based on statistical data collected from radiographic imaging within the Department of Radiology at KCMH, utilizing the Samsung XGEO-GC80 X-ray machine during the period spanning from June to December 2022, it was found that the chest X-ray examination emerged as the most frequently performed, yielding the highest number of radiographic images. A total of 15,887 images were rejected, constituting 15.31% of all images performed. The primary cause of rejection across all examinations was attributed to positioning. However, when specifically considering chest X-ray examinations, “not full inspiration” stood out as the leading cause of rejection.

Table 2 presents a comparison of the compiled data from this study with findings from previous reports. This research aligns with the results of Atkinson et al.[12], where out of 90,298 radiographic images, 8,578 were rejected, resulting in a 9.5% rejection rate. The most prevalent reasons for rejection were improper patient positioning and anatomy cut-off. A Assi's previous study[13] found an average rate of repeated images at 10% (500 images). The rate of repeated images for chest and abdominal X-rays was 42%, similar to this study's findings. Furthermore, this study's outcomes corroborate the research of Iempala et al.[14], where out of 12,905 chest radiographic images, 1,484 were rejected, resulting in an 11.2% rejection rate. Chest radiography exhibited the highest rate of rejected images at 29.7% among all examinations. Key factors contributing to image rejection included inadequate patient inspiration, improper patient positioning, artifacts, and improper exposure parameters.

Table 2. The comparison of collated data from this study with other previous reports.

Reason for image rejection	This study No. of image (%)	Atkinson et al. [12] No. of image (%)	Iempala et al. [14] No. of image (%)
Positioning	5,698 (75.47)	4,207 (49)	85 (19.8)
Not Full Inspiration	1,024 (13.56)	185 (2)	328 (76.3)
Artifacts	500 (6.62)	682 (8)	5 (1.2)
Patient Motion	159 (2.11)	416 (5)	N/A
Exposure	126 (1.67)	412 (5)	2 (0.5)
System failure	10 (0.13)	N/A	1 (0.2)
Equipment failure	10 (0.13)	N/A	N/A
Reposition	10 (0.13)	N/A	N/A
Test	2 (0.03)	N/A	N/A
Change shunt setting	2 (0.03)	N/A	N/A
Others	9 (0.12)	N/A	9 (2.1)

In this study, the primary cause of image rejection in radiographic imaging was found to be human errors, primarily attributed to radiation technologists. This observation closely aligns with the findings of Assi's report[13], which indicated that human errors were the predominant cause of rejected radiographic images, accounting for 53.4% of cases, with radiation technologists being responsible for the majority of these errors (48%). These findings highlight that despite the considerable experience and high-level healthcare professional skills possessed by radiological technologists at KCMH, the possibility of rejected images still exists. Therefore, there remains a need for ongoing improvement efforts, which could include:

- Improving the communication with patients to relieve their anxiety.
- Restructuring processes of chest X-ray examination, ensuring equipment readiness, and optimizing workflow.
- Assessing the condition of each patient before conducting examinations. This can help identify potential challenges and adapt imaging techniques accordingly.
- Ensuring correct patient positioning before each examination.
- Establishing standardized criteria for image quality to accept radiographic images.

The repeat rate in chest X-ray examinations refers to the frequency with which a radiological technologist needs to retake or repeat an X-ray image due to technical errors, positioning issues, or image quality concerns. A high repeat rate can have several implications, including increased patient radiation dose, prolonged examination times, and potential delays in patient care. It's crucial to understand the factors contributing to repeat rates and implement strategies to minimize them. A potential causal analysis for all the reasons utilized by radiological technologists to reject radiographic images across all examinations in this study has been presented in Table 3. Some common factors contributing to repeat rates in chest X-ray examinations found in this study as follows:

1. Patient Positioning: Incorrect placing patient positioning, incorrect alignment of patient's body parts, and wrong angle of projection can lead to anatomical distortions, inadequate image clarity, and the need for retakes. Ensuring proper patient positioning and communication is essential to reduce repeat rates.

2. Respiration: Patients with inadequate or irregular breathing patterns or those experiencing respiratory issues may induce breathing artifacts, resulting in image blur or distortion.

3. Artifact Management: Certain factors like jewelry and accessories, clothing contains zippers and buttons, metallic objects on or inside patient's body, or medical devices on the patient's body can cause artifacts. Technologists need to be vigilant in identifying and addressing these artifacts to prevent the need for repeats.

4. Motion Artifacts: Patient movement or an inability to remain still during exposure can lead to blurred images. This is particularly significant in chest X-rays, where patients may find it challenging to hold their breath. Adequate coaching and support can be instrumental in reducing motion artifacts.

5. Exposure Factors: Inaccurate selection of exposure parameters like inappropriate kVp settings can affect image contrast, and inappropriate mAs settings can affect image brightness and clarity. In addition, mistakes in X-ray equipment settings, cassette or detector positioning, or image processing can lead to suboptimal images.

6. Mechanical failure: Outdated or faulty system or poorly maintained equipment can produce suboptimal images, requiring a system update or upgrade.

7. Reposition: The doctor may modify the examination plan, adjusted the positioning, or implemented new examination techniques.

8. Chang shunt setting: Adjusting the shunt settings and introduced new equipment.

9. Test: Conducting tests to evaluate the performance of the system and equipment.

10. Other: Other unspecified changes, e.g. taking images of the wrong patient

It is strongly recommended to incorporate quality assurance (QA) procedures into X-ray examinations [15, 16, 17], in order to ensuring that imaging procedures consistently produce high-quality images with the least possible radiation dose, minimizing the need for repeat imaging. Key components of a QA program are shown in Table 4 including, Technologist Training and Education, Standardized Protocols, Equipment Maintenance and Calibration, Image Processing and Display, Radiation Dose Monitoring, Peer Review, Feedback Loop, Clinical Communication, Data Analysis, and Continuous Improvement. By implementing effective QA programs, healthcare facilities can enhance patient care, reduce patient and staff radiation exposure, and optimize resource utilization. Here's an overview of key components of a QA program aimed at reducing repeat imaging:

This study is subject to certain limitations, which encompass: i) Data Completeness: Data for certain months were either absent or not consistently representative of typical circumstances. Factors contributing to this included data loss following machine maintenance or lower-than-expected data volumes due to various factors such as accidents, the impact of COVID-19, or machine downtime. ii) Data Details: The data recorded within the machine lacks comprehensive information or additional contextual explanations. It primarily consists of numerical counts for examinations, rejections, and associated reasons.

Table 3 Summary of the available choices for reasons utilized to decline radiographic images across all types of examinations.

Reason for image rejection	Possible causes analysis
Positioning	Incorrect Positioning • Patient in the wrong position • Incorrect alignment of body parts • Wrong angle of projection
Respiration	Breathing Artifacts • Inadequate or irregular breathing • Patient has respiratory issues
Artifacts	Clothing Accessories and Artifacts • Zippers and buttons on clothing • Jewelry and accessories • Metallic objects on or inside the body
Patient motion	• Patient movement or inability to stay still • Patient moving during the examination • Patient unable to remain still
Exposure	Improper Parameter Settings • Inappropriate kVp settings affecting image contrast • Inappropriate mAs settings affecting image brightness and clarity
Mechanical failure	System Malfunction • Outdated or faulty system • Needs a system update or upgrade
Reposition	The doctor modified the examination plan, adjusted the positioning, and implemented new examination techniques.
Chang shunt setting	Adjusting the shunt settings and introduced new equipment.
Test	Conducting tests to evaluate the performance of the system and equipment.
Other	Other unspecified changes, e.g. taking images of the wrong patient.

Table 4. An overview of key components of a QA program aimed at reducing repeat imaging.

Key components	Possible action
Technologist Training and Education	Highly skilled and well-informed radiological technologists play a crucial role in reducing the need for repeat imaging. Continuous education and training programs should encompass a range of essential areas, including proper patient positioning, radiation safety, equipment operation, and image processing techniques.
Standardized Protocols	Developing and implementing standardized protocols for patient positioning, exposure settings, and image acquisition techniques is vital. These clear and consistent protocols serve to diminish errors and ensure uniformity in procedures across all technologists.
Equipment Maintenance and Calibration	Routine maintenance and calibration of X-ray equipment are indispensable for generating consistent and precise images. QA programs should incorporate scheduled inspections and calibrations of imaging systems to guarantee their optimal functionality.
Image Processing and Display	Establishing standardized image processing techniques and monitoring the performance of image display monitors is imperative. Inconsistencies or errors in image processing can result in suboptimal images, potentially necessitating repeat examinations.
Radiation Dose Monitoring	Implementing dose monitoring systems to monitor patient radiation exposure over time is highly beneficial. Such systems aid in identifying trends and potential areas for improvement in radiation safety practices and patient care.
Peer Review	Incorporating a peer review process, wherein experienced radiologists or technologists routinely review a sample of images, is a valuable practice. This process can pinpoint areas for enhancement and offer constructive feedback to technologists, contributing to continuous improvement in image quality and diagnostic accuracy.
Feedback Loop	Creating a mechanism for technologists to provide feedback about challenges encountered during imaging procedures or repeat imaging scenarios is pivotal. This feedback system can help in identifying common issues and facilitate the implementation of targeted training initiatives or process enhancements to address these challenges effectively.
Clinical Communication	Ensuring effective communication among technologists, radiologists, and referring physicians is of paramount importance. Clear and open communication can help alleviate any uncertainties regarding the imaging request, resulting in appropriate image acquisition and fewer instances of repeat examinations.
Data Analysis	Regularly analyzing data pertaining to repeat rates, reasons for repeat examinations, and types of errors is a crucial practice. Identifying recurring patterns in repeat cases serves as a valuable guide for the development of targeted interventions aimed at reducing the incidence of repeats and enhancing overall imaging quality.
Continuous Improvement	QA programs should be dynamic and adaptable. Regularly evaluating the effectiveness of the program, identifying areas that require improvement, and updating protocols and training materials as necessary is essential to ensuring ongoing enhancements in imaging practices and patient care.

However, it does not include the actual rejected radiographic images or crucial patient information, such as age, gender, weight, height, physical conditions, and detailed reasons for image rejection. The inclusion of such information would be valuable for more in-depth statistical analysis. iii) Rejection Explanation System: Some X-ray machines may lack a structured system for inputting rejection reasons, which limits the extent of data collection. It is advisable for developers of X-ray machines to consider implementing a more robust, secure, and detailed data storage system that allows for the comprehensive recording of rejection reasons. Addressing these limitations in future studies could enhance the depth and accuracy of the research findings and provide a more comprehensive understanding of the factors influencing radiographic image rejections

Conclusion

From the statistical data collection of radiographic imaging using the Samsung XGEO-GC80 X-ray machine in the Radiology Department at Chulalongkorn Hospital, Thailand, from January to December 2022, it was found that the highest number of examinations was in chest radiography, with a total of 15,887 images. Out of these, 2,432 images were rejected, accounting for 15.31%. The most common reason for rejection was positioning for all examinations and not full inspiration for chest radiography. Furthermore, it was observed that the majority of rejected images resulted from human errors, primarily attributed to radiological technologists. Therefore, to reduce the rate of repeated radiographic imaging, radiological technologists should assess the patient's condition before each examination, enhance precision in patient positioning, and improve communication with patients. Additionally, the hospital should provide basic and specialized training for radiologic technologists and establish standardized criteria for accepting radiographic images collaboratively.

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