**Scholars Journal of Applied Medical Sciences**
Abbreviated Key Title: Sch J App Med Sci
ISSN 2347-954X (Print) | ISSN 2320-6691 (Online)
Journal homepage: https://saspublishers.com

OPEN ACCESS

**Radiological Sciences**

# Reject Analysis in Digital Radiography Prospective Study

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**DOI:** 10.36347/sjams.2022.v10i06.006 | **Received:** 21.04.2022 | **Accepted:** 29.05.2022 | **Published:** 10.06.2022

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**Abstract** **Original Research Article**

Rejecting, deleting and repeating of diagnostic radiographs are against the professional and ethical issues of the radiology departments. Repeated images of radiological examinations increase the risk of radiation exposure of the patients, wastes medical resource, and reduce the quality of services of radiology department. The aim of this study is to perform X-ray images reject analysis in radiology departments of different hospitals in Riyadh. Saudi Arabia. KSA. ***Materials and Methods*:** A prospective study was conducted in the radiology department of different hospitals in Riyadh, Saudi Arabi, KSA. A total of 100 radiographs were evaluated manually by examining all types of radiological images. The data were analyzed by using Microsoft Excel 2010 program. ***Results*:** Out of 100 random radiograph were analyzed, most frequent repeats were observed for chest (38%) chosen, it appears that chest was registered as the highest exams (37 %) while the lower extremities were (19 %), Abdomen (9%), Spine, pelvis and upper examination (8%) for each exam, Chest and abdomen (6%), Cranium and Paranasal sinuses registered as the lowest exams repeated as (4%). where the major factors contributing the causes of rejection were anatomical side marker, followed by collimation and positioning error. ***Conclusion*:** The study has shown that, the highest reject rate was for chest exams and the most frequent causes for reject are side marker and collimation and position error.

**Keywords**: X-ray Radiograph, Reject analysis, Radiology department.



## INTRODUCTION

Diagnostic imaging using X-rays represent the common examinations in medicine, account for the most remarkable artificial source of radiation exposure to the population in diagnostic imaging, one of the main goals of a quality assurance (QA) program is to produce consistent high-quality radiographs at a minimum exposure to the patient [1].

Digital radiography (DR) systems are in use throughout the medical imaging community and now represent the standard of care at many hospitals and imaging centers [2]. Reject analysis (RA) has been one of the key quality control tools in conventional medical imaging departments using film processing technology for as long as many of us can remember. The Quality Control in Diagnostic Imaging [3]. Reject/repeat radiographs are those radiographs which are not accepted clinically and asked to be retaken. Besides, the images which are irrelevant with the patient and being used for quality control purpose are also considered in the waste category [4]. The deletion, rejection and repetition of radiographs are considered as professional and ethical problems of the radiology departments [5]. This repeat imaging increases the patient's radiation dose and detracts from the principle of keeping the patient's exposure to ionizing radiation to 'As Low As Reasonably Achievable' (ALARA) [6]. Which will negatively affect the patient's satisfaction with the services provided by the radiology department. Reject analysis is an important component of quality assurance programs for medical imaging departments. It forms a basis for determining the causes of rejected images and helps guide radiographer training, department workflow and ultimately reduces patient dose [7].

Five guidelines for training less-experienced imaging technologists to rectify patient position and for displaying notes at suitable sites in the changing room to ask patients to take out artifacts or in the X-Ray imaging rooms notifying technologists to examine machine condition, to take out patients' artifacts, and to adjust patients' position prior to examinations [8]. Reject rate is described as the number of films rejected from a particular department and indicated as a percentage of the overall film utilized:

Reject rate=$Reject\ rate = \frac{\text{Number of rejected films}}{Number\ of\ examinations}$ X 100

The repeat rate; represent the percentage of clinical X-ray images that must be retaken because of fault leading to inappropriate quality of image:

$Repeat\ rate = \frac{\text{Number of repeated films}}{\text{Number of examination}}$ X 100

Thus if radiographic film repeats and rejects are completely avoided or are reduced to the minimum, it can be adjudged that the radiology department is performing optimally in quality assurance [8].

**Aim**

The aim of this study is to perform X-ray images reject analysis in radiology departments of different hospitals in Riyadh, Saudi Arabia KSA.

**Objectives:**

**General Objective:** To study the reject radiograph in digital radiography.

**Specific Objective**

- To study different examination and detect percentage of rejected exam.
- To study the causes of rejected exam.

## MATERIAL AND METHODS

A prospective study was conducted in the radiology department of different hospitals in Riyadh. Saudi Arabia. KSA.A 100 x-ray images were collected and reviewed from March 2022 to April 2022 and it shows different issues that become the reason for this image's rejection. After all the radiographies of the patient were completed, all the images taken were analyzed by Microsoft Excel Program. The distribution of repeat images with respect to rejection reasons were calculated. The anatomical regions studied were abdomen, vertebra/pelvis, upper extremity, lower extremity, cranium, and chest. Although we know that the positioning errors cover the centering errors too, a distinction was made between centering errors and positioning errors

## RESULTS

Out of 100 random radiograph were analyzed, Most frequent repeats were observed for chest (38%) chosen, it appears that chest was registered as the highest exams (38%) while the lower extremities were (19 %), Abdomen (9%), Spine, pelvis and upper examination (8%) for each exam, Chest and abdomen (6%), Cranium and Paranasal sinuses registered as the lowest exams repeated as (4%) Fig 1.

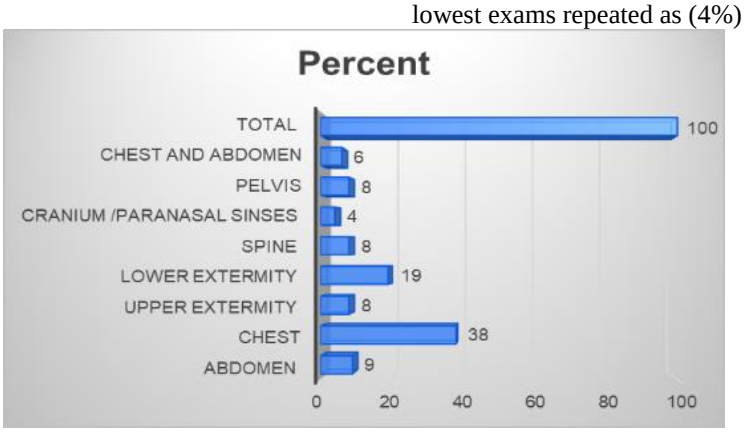


**Fig-1: Repeat rates of different anatomical regions**

In Fig 2 Show the major factors contributing the causes of rejection were anatomical side marker, followed by collimation and positioning error.

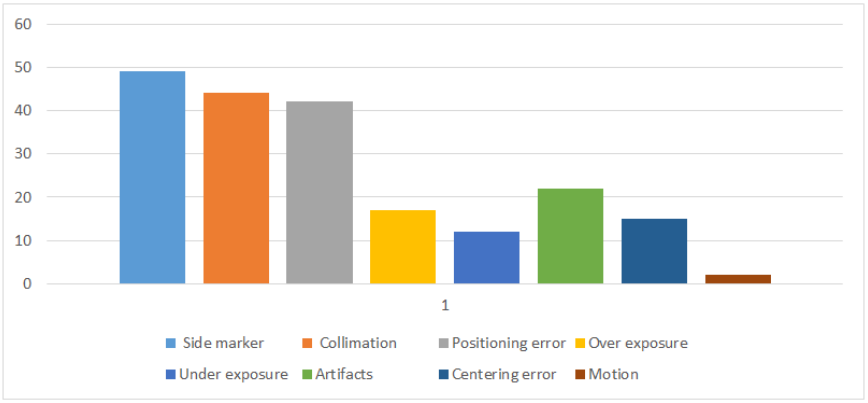


**Fig-2: Show the causes of rejection or repeated image**

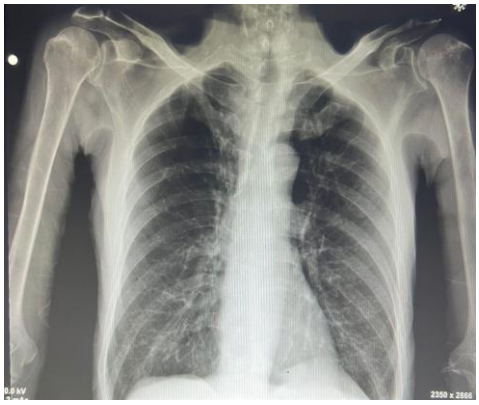

**Fig 3: Shows Chest X-ray image with determined a collimation, cut and missing side marker made a repeat a necessary (Costphrenic angle cut)**

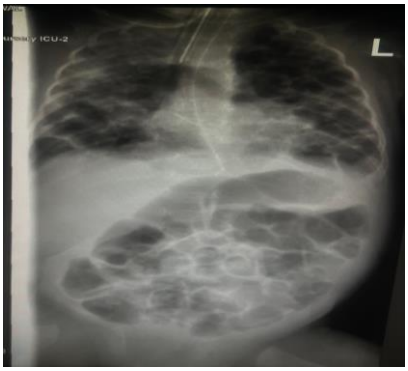

**Fig 4: Shows Chest and abdomen X-ray image required repeat due to an anatomy Cut off (Symphysis pubis)**

**Fig 5: Shows Abdomen X-ray image required repeat due to an Anatomy Cutoff, Off Center and collimation**

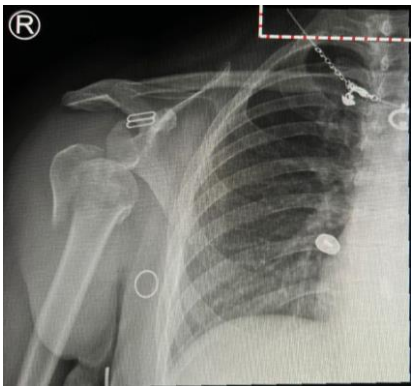

**Fig 6: Shows Shoulder X-ray image required to repeat due to an artifact and Bad patient preparation**

## DISCUSSION

The need for reject analysis has been challenged by the introduction of digital radiography (DR) because of low reported reject rates and because criteria for improperly exposed images were lacking. Most DR systems include quality control (QC) workstations that are capable of modifying the appearance of images before release, and also of deleting poor images before they are analyzed.

The main advantages of reject/repeat rate analysis are enhanced department skills, lower department costs, and lower patient doses. As the number of repeats remain low, the proportion of time which patients should go through undertaking imaging procedures declines. This will result in patient contentment and the radiology department will be able to diagnose additional patients at the same time. Furthermore, when repeated imaging procedure is minimized, the cost related to film, processing, work of staff, as well as the depreciation of the X-ray machines decreases remarkably [9].

The current study found that chest x-ray was registered as the highest exams ( 38 % ) while the lower extremities were (19 % ), Abdomen ( 9%),Spine, pelvis and upper examination ( 8% )for each exam, Chest and abdomen ( 6% ), Cranium and Paranasal sinuses registered as the lowest exams repeated as (4%) Fig 1. In contrast Ayşegül Yurt *et al*., [10] found that chest radiograms (38% in adults and 10% in children) while the lowest rate was observed in cranial (3%). The reject/repeat rate in the chest radiograms of our study was above the 6.9% rate reported by Hoffman ER *et al*., However, our results for the lower extremity (19%) and upper extremity (8%) radiograms were considerably lower than the results of Hoffman ER *et al*., which were 59.1% for lower extremity and 25.4% for the upper extremity [11]. The reject/repeat rates we obtained concerning the anatomical regions were consistent with the results of Jones AK *et al*., [12]. The high reject/repeat rate obtained in the chest radiograms may be due to the difficulty in positioning for this region. Another study done by Fathi Awad *et al.*, [13] reported that the highest reject and repeat rate was found to be chest X-rays. The most frequent reason for rejection and repetition of patient exams was found to be patient positioning.

Results of the repeat rate by exam are presented in Fig 2 the major factors contributing the causes of rejection were anatomical side marker, followed by collimation and positioning error our study in agreement of Fathi Awad *et al*., [13] reported that (position 36.36%, over exposure 27.27%, under exposure 27.27% and motion 9.09%). Itis clear that imaging procedures due to position error represents the highest cause of repeat rate the positioning errors beside the considerable inequality in radiographer reject rates

suggest that the standards of image quality in the radiology department may not be harmonious [5, 7, 10]. Many studies discussed that the most encountered errors arose from technicians were positioning error (36.11%) of the patient. The present result for positioning error consider high same with the results of Andersen ER *et al*., (77%), Hoffman B *et al*., (51.3%) and Lin CS *et al*., (56.05%) while consistent with the results of Akhtar W *et al*., [14]. Positioning error was the most encountered problem in the CR systems too [14]. Collimation error was determined as another technician error increasing reject/repeat rates. In the present study, it was 13.1% whereas Hoffman ER *et al*., reported a collimation error of 6.4% [15]. These results may be due to the deficiency of technicians to reflect theoretical knowledge on collimation adequately to the routine practice.

## CONCLUSION

The study has shown that, the highest reject rate was for chest exams and the most frequent causes for reject are collimation, position and anatomical side marker further training programs are needed to minimize positioning errors and thus making the significant contribution in reducing the rejection rate. The goal is to maintain the continuity of quality control efforts in DDR and to sustain training programs for the technicians in order to ensure reliability in the diagnostic evaluations and to reduce the repeat/reject rate.

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