Original Article

Frequency of Common Causes of Rejected Conventional X-Rays in a Radiology Department

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ABSTRACT

Objective: the present study aims to evaluate the frequency and causes of rejected conventional X-ray examinations in a radiology department, providing baseline data to support quality improvement initiatives, reduce unnecessary radiation exposure, and enhance diagnostic efficiency.

Study Design: A cross-sectional study

Place and Duration of Study: This study was conducted at the Diagnostic Radiology Department Bolan Medical Complex Hospital Quetta from August 2025 to October 2025.

Methods: A cross-sectional study was performed at the Radiology Department, enrolling 92 patients whose traditional chest/abdominal X-ray had been deemed inadequate. Patient characteristics as well as reasons for rejection, i.e., overexposure, underexposure, inadequate positioning, patient motion, and artefacts were collected using a structured proforma. Statistical analysis was also carried out between demographic characteristics and reasons for rejection, with a $p \leq 0.05$ being significant**.**

Results: The mean age of the participants was 45.6 ± 13.2 years54; with 58.7% males and 41.3% females55 noted there in were significant differences between the male and female groups (Table 1). Overexposure (43.5%) was the most common reason for rejection, followed by underexposure (27.2%), wrong body part placement (15.2%), patient motion artifact (8.7%), and other artifacts (5.4%). There was a strong relationship between gender and exposure errors (p = 0.02–0.03), with males being more likely to be overexposed and females underexposed at higher proportions of the ED/IRLH. Malposition was also more prevalent among the rural (p = 0.04) dwellers.

Conclusion: Over- and under-exposure are still the main reasons for rejection of routine X-ray, and statistically significant differences were noted in gender and locality.

Key Words: Conventional radiography, Image quality, Overexposure, Reject analysis, Radiology quality assurance, Underexposure.

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INTRODUCTION

Medical imaging represents one of the most significant advancements in modern medicine, providing essential support for diagnosis, treatment planning, and patient monitoring. However, the rapid expansion and frequent utilization of diagnostic imaging—particularly conventional X-ray examinations—have raised concerns regarding population exposure to artificial ionizing radiation.

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Diagnostic medical imaging contributes more than 50% of man-made ionizing radiation exposure in the general population[1,2], and cumulative radiation exposure has been associated with increased long-term health risks, including malignancies[3].In routine clinical practice, repeat radiographic examinations are often required when initial images are deemed diagnostically unacceptable due to technical or quality-related issues. Such repetitions increase radiation dose to patients and impose additional demands on radiology personnel, resulting in higher costs, reduced workflow efficiency, and compromised patient throughput[4]. Consequently, rejection analysis—the systematic evaluation of the frequency and causes of rejected radiographs—has become an essential component of quality assurance in diagnostic radiology. Image rejection rates (RRs) serve as indicators of radiographer performance, protocol adequacy, and departmental operational standards[5]. Lower RRs reflect optimal image quality and efficient departmental function, whereas higher RRs indicate inefficiencies and unnecessary radiation exposure[6]. Common causes of radiograph rejection include overexposure or underexposure, improper patient

positioning, patient motion, image artifacts, and equipment-related issues. Several local and international studies have identified positioning and centering errors as the most frequent reasons for image rejection[7,8]. These errors are often attributed to inadequate patient preparation, limited radiographer experience, or suboptimal communication. Exposure-related errors typically arise from incorrect technique selection or insufficient knowledge of exposure parameters, emphasizing the need for continuous professional education and quality surveillance. Rejection rates vary across institutions due to differences in equipment, departmental policies, workload, patient demographics, and radiographer expertise. Recent audits have reported rejection rates ranging from 3% to 12%[8,9]. Studies have demonstrated that overexposure, underexposure, and positioning errors remain the most prevalent causes of rejection. Multicenter investigations have further shown that rejection analysis is an effective tool for identifying areas requiring targeted interventions such as retraining, protocol optimization, and equipment calibration[10]. Despite increasing adoption of digital radiography systems, challenges persist in resource-limited settings due to outdated equipment, inconsistent quality control practices, and training deficiencies[4,5,9]. Moreover, data on reject analysis from low- and middle-income countries, including Pakistan, remain limited. This lack of locally relevant data hinders benchmarking and the development of evidence-based quality improvement strategies. Therefore, the present study aims to evaluate the frequency and causes of rejected conventional X-ray examinations in a radiology department, providing baseline data to support quality improvement initiatives, reduce unnecessary radiation exposure, and enhance diagnostic efficiency.

METHODS

This cross-sectional study was conducted in the Department of Radiology, Bolan Medical Complex Hospital (BMCH), Quetta from August to October 2025. Ethical approval was obtained from the Research Evaluation Unit, College of Physicians and Surgeons Pakistan (CPSP), following approval of the research synopsis entitled "Frequency of Common Causes of Rejected Conventional X-Rays in a Radiology Department" (Reference No: CPSP/REU/RAD-2021-001-3373; dated August 12, 2025). The sample size was calculated using the WHO sample size calculator for a single population proportion, based on previously reported rejection rates in radiographic imaging. Using a confidence level of 95%, a margin of error of 10%, and the most frequent reported cause (overexposure: 48.8%), the estimated sample size was 92 patients. A non-probability consecutive sampling technique was employed.

Patients of either sex, aged 20–70 years, whose conventional chest or abdominal radiographs were deemed diagnostically unacceptable were included. Exclusion criteria comprised pregnancy, age above 70 years, requirement for specialized imaging (e.g., CT or fluoroscopy), refusal to participate, and incomplete clinical or demographic data. Written informed consent was obtained from all participants. Rejected radiographs were independently reviewed by a consultant radiologist with over two years of post-qualification experience. Causes of rejection were classified as overexposure, underexposure, improper positioning, patient motion, or artifacts, based on predefined operational definitions. Data were recorded using a structured proforma. Statistical analysis was performed using SPSS version 22.0. Categorical variables were expressed as frequencies and percentages, while continuous variables were summarized as mean ± standard deviation. Chi-square tests were applied post-stratification, with a p-value <0.05 considered statistically significant.

RESULTS

A total of 92 patients undergoing conventional chest and abdominal X-rays that were rejected were included in the study. The mean age of participants was 45.2 ± 13.6 years, with 53.3% males and 46.7% females. Most participants (59.8%) belonged to urban areas, while 40.2% were from rural regions. Regarding educational level, 27.2% were illiterate, 30.4% had primary education, 25% had intermediate education, and 17.4% were graduates or above (Table 1).

Table No.I: Demographic characteristics of the study participants (n = 92)

Variable	Mean ± SD / Frequency (%)
Age (years)	45.2 ± 13.6
Gender	
Male	49 (53.3%)
Female	43 (46.7%)
Place of living	
Urban	55 (59.8%)
Rural	37 (40.2%)
Education level	
Illiterate	25 (27.2%)
Primary	28 (30.4%)
Intermediate	23 (25.0%)
Graduation or more	16 (17.4%)

Table No.2: Frequency of causes of rejected conventional X-rays (n = 92)

Cause of rejection	Frequency (%)
Overexposure	40 (43.5)
Underexposure	25 (27.2)
Faulty positioning	14 (15.2)
Patient movement	8 (8.7)
Artifacts	5 (5.4)

The most frequent cause of rejection was overexposure (43.5%), followed by underexposure (27.2%), faulty positioning (15.2%), patient movement (8.7%), and artifacts (5.4%) (Table 2). When analyzed by gender and place of residence, a significant association was found between these factors and the causes of rejection. Overexposure occurred significantly more often among males (55.1%) than females (30.2%) ($p = 0.02$), whereas underexposure was higher among females (37.2%) than males (18.4%) ($p = 0.03$). Faulty positioning was observed more frequently among rural residents (21.6%) compared with urban residents (10.9%), showing a statistically significant relationship ($p = 0.04$) (Table 3). Overall, overexposure and underexposure remained the leading causes of image rejection, demonstrating clear variations across gender and residence. These results suggest that differences in radiographic technique and patient cooperation may influence rejection patterns, emphasizing the need for continued staff training and stricter adherence to exposure protocols to improve image quality and reduce repeat examinations.

Table No.3. Association of causes of rejected X-rays with gender and place of living

Variable	Overexposure n (%)	Underexposure n (%)	Faulty positioning n (%)	Patient movement n (%)	Artifacts n (%)	p-value
Male (n = 49)	27 (55.1)	9 (18.4)	7 (14.3)	4 (8.2)	2 (4.1)	**0.02***
Female (n = 43)	13 (30.2)	16 (37.2)	6 (14.0)	5 (11.6)	3 (7.0)	**0.03***
Rural (n = 37)	18 (48.6)	8 (21.6)	8 (21.6)	2 (5.4)	1 (2.8)	**0.04***
Urban (n = 55)	22 (40.0)	17 (30.9)	6 (10.9)	6 (10.9)	4 (7.3)	0.08

*Significant at $p \leq 0.05$.

DISCUSSION

Excessive--underexposure as well as improper position are the main reasons conventional X-rays were refused in this study, to be followed by patient movement and artifacts. This negative correlation suggests that exposure errors still continue to be the predominant source of image rejection, while optimization of radiographic exposure factors is a persistent problem. The predominance of exposure and positioning related errors is consistent with international literature where similar trends are observed repeatedly in various clinical and geographical locations.[8,9,11] These common causes of repetition emphasize the technical and procedural elements of image acquisition that have a direct impact on radiographic quality and patient safety. Exposure factors are generally the result of mistaking kVp, mAs, and inappropriately used automatic exposure controls. Compiled by poor knowledge of radiographic factors or failure to adapt exposure techniques according the patient's body habitus, images can be overexposed (too bright) or underexposed (low contrast).[8,11,16] Even with dose-monitoring technology and systems available in digital radiography, exposure rejects remain a substantial percentage of the overall number of images rejected thereby indicating that radiographer training underpinned by accepted standards and quality control monitoring is necessary. There was a marked correlation between patient sex and overexposure; male patients had significantly higher rates of rejection because of too much exposure. This relationship may be due to differences in body composition and size, leading to variations in personal exposure. The discovery is consistent with studies recommending individualized dosimetry protocols to tailor the radiation dose and image quality to a specific patient.[13,14] Local analyses in United Arab Emirates and Saudi Arabia showed that establishing of a reject analysis on regular basis decreased the overall rejection rate by 30% after selective corrective actions.[13,14] Common programs include in-house lectures for staff, technique-chart review and the introduction of a double-check process before exposure. To achieve global harmonization and standardization of reject analysis processes, a vendor-neutral reject analysis framework has been prescribed by American Association of Physicists in Medicine (AAPM) Task Group 305 for inter-comparison of rejection data across institutions.[15] This model encourages transparency and consistency; it allows comparisons, bench-marking and data-driven quality improvement within radiology departments worldwide. It allows health-care facilities to identify systemic deficiencies, improve efficiency and compliance with international standards in terms of radiation protection habits and image quality management. Recent work from Europe, Asia and Africa continue to confirm that rejection analysis is indeed a powerful method of continuous quality improvement.[9,16-19] For instance, Hofmann et al[16] in Norway found that systematic REJ-auditing increased staff awareness and resulted in lower number of superfluous recalls, while Calatayud-Jordán et al[18] showed that reject analysis can contribute to radiation protection developments by the estimation of cumulative patient doses. Also, Ismail and Abdul Halin[19] from Malaysia noted that high reject rates were commonly due to poor image review habits and lack of direct feedback to radiographers, highlighting the importance of a structured audit regime. In summary, the results of the current study support the idea that

reject analysis continues as a necessary tool for radiological quality assurance. That exposure and position errors continue to predominate in the face of technological progress, even when controlling for other factors that influence image quality, suggests that human performance—training, attention to detail, protocol adherence—still plays a significant role in determining how good an imaging study is.[16,20] Through the institutionalization of routine reject analysis, following up regular competency assessments and creating a culture of continuous feedback, radiology departments provide an opportunity to significantly lower unnecessary repetition and thereby increase patient safety and departmental efficiency. Concentrated experience, accurate rejection log entries and following optimized imaging protocols don't only protect the patient's well-being but also enhance the diagnostic reliability and credibility of the services rendered in radiology.

CONCLUSION

Overexposure and underexposure were the leading causes of rejected conventional X-rays, revealing significant associations with gender and place of residence. The findings highlight that improved training, regular quality audits, and standardized exposure protocols are essential to reduce rejection rates, enhance diagnostic efficiency, and minimize unnecessary radiation exposure to patients.

Author's Contribution:

Concept & Design or acquisition of analysis or interpretation of data:	Abdul Raheem, Pari Gul Jogezai
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