Reject rate analysis in radiography in Primary health care corporation, Qatar

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Abstract

Background: The optimum objective of a radiographic study is to provide images that can be diagnostic to assist in the management of the patient; on the other hand the ionizing radiation exposure received by the patient should be minimized. A rejected radiograph image is a poor quality image that does not provide the necessary information to help clinical diagnosis, subsequently it is repeated. Analysis of image rejection is an important part of the quality assurance programs for a radiology department to determine the reason for rejection which can assist to arrange for proper radiographer training as well as help smooth workflow and consequently reduce the ionizing radiation to the patients.

Aim of work: The current study aims to analyze the image reject rate for radiographs at PHCC and determine the reasons for rejection.

Material & Methods: The data was retrospectively collected from January 2020 to December 2020 to include all rejected images. The reject rate per each reason, anatomical area and health centers were analyzed.

Results: The total sample size was 581 rejected cases with overall reject rate of 0.78 %. The most frequently recorded causes for image rejection were patient movement during the procedure or non-cooperative patient (37.86%) and off-center study (21.17%). The frequency of image rejection was higher in some studies such as spine (24.44%), chest (23.41%), and lower extremities examination (18.24%).

Conclusion: The reject rate in PHCC radiology department is within the accepted limits of quality control and assurance studies. However, it is highly important to carry on quality improvement projects with proper training and education based on utilization of regular reject analysis and feedback tool.

Key words: Radiography-Reject rate- Images-Quality- ALARA

Abbreviations:
ALARA: As Low As Reasonably Achievable
IAEA: The International Atomic Energy Agency
PHCC: Primary Health Care Corporation
HC: Health center

Background and Aim of the Work

The optimum objective of a radiographic study is to provide images that can be diagnostic to assist in the management of the patient; on the other hand the ionizing radiation exposure received by the patient should be minimized. A rejected radiograph image is a poor quality image that does not provide the necessary information to help clinical diagnosis, subsequently it is repeated (1-7). This repeat will increase the radiation dose received by the patient, which is not coinciding with the ALARA principle (patient's exposure to ionizing radiation should be As Low As Reasonably Achievable); additionally this will reduce patient satisfaction and increase departmental costs (8-11).

Quality is the measurement that leads the organization to achieve its desired outcomes. Some quality indicators are applied in radiology departments to improve the effectiveness and to rule out any error or defects which thus can improve services to achieve the required goals (2-4).

Analysis of image rejection is an important part of the quality assurance programs for a radiology department to determine the reason for rejection which can assist to arrange for proper radiographer training as well as help smooth workflow and eventually reduce the ionizing radiation to the patients (5,7,8-11). The International Atomic Energy Agency (IAEA) (1) recommended areject rate within 5% to 10%.

The Australian Code of Conduct for medical radiation practitioners states that it is the responsibility of the medical radiation practitioner to promote the safe use of radiation. This includes justifying, limiting the dose and optimizing the exposure while still acquiring quality diagnostic images (2-4).

Primary Health Care Corporation (PHCC) is responsible for providing, facilitating access to and delivering a range of coordinated health and community care services to the population of Qatar. This occurs through a wide range of programs, services and partnerships. Measuring the performance of the programs and services of the organization is crucial for all levels of management in order to harness, direct and support teams and individuals to engage in delivering the organization's mission and objectives (12).

In PHCC, a performance indicator report is released on a monthly basis. The diagnostic imaging key performance indicators (KPIs) are highly valuable data points and measurement tools that can be used to monitor and evaluate the quality of services provided by a radiology operation. Reject rate is one of the important released KPIs. The current reject rate in PHCC is generally below the standard international reject rate, however there is still a need to elaborate more about the reason for rejections
The vision of PHCC is to be the leader in transforming the health and wellbeing of people's lives in Qatar. PHCC now provides the radiography service to date.

This study can identify the rate and reasons for image rejection in primary health care radiology department. This can help in arrangement of plans to reduce the rejection rate thus reduce department expenses and patient radiation exposure doses.

The current study aims to analyze the image reject rate for radiographs at PHCC and determine the reasons for rejection.

Material and Methods

The study was approved by the Research subcommittee of PHCC research department (reference number PHCC/DCR/2020/08/95).

No informed consent was needed as all the data were de-identified. The data was retrospectively collected from January 2020 to December 2020 to include all rejected images. The data was extracted from PHCC's shared folders anonymously. The image overall reject rate was calculated. The reject rate per each reason, anatomical area and health centers were analyzed. No sampling is required for this study. All images rejected were included in the study; no exclusion was done.

The variables:
Data was delivered in an Excel sheet. Statistical analysis was done using IBM SPSS version 23 computer software. The average reject rate was calculated by dividing the total number of rejected images by the total number of images acquired in the same period and expressed as percentage along with the standard deviation. The data was expressed as percentages in order to assess the reasons and anatomical area for image rejection. The REPORT statement, which is an extension of the STROB statement checklist (international, collaborative initiative of epidemiologists, methodologists, statisticians, researchers and journal editors involved in the conduct and dissemination of observational studies, with the common aim of Strengthening the Reporting of Observational studies in Epidemiology) specially designed to assure the quality of reporting of secondary data analysis was followed during analysis and writing of the research paper. There was no direct contact with study participants. Therefore, no physical and mental discomfort, harm, and danger arose from research procedures. The investigators abided by the ethical rules and regulations of MOPH concerned with research.

Results

Sample size and overall reject rates:
The total sample size was 581 rejected cases. They were collected from examinations done over 12 months from January 2020 to December 2020. Overall reject rate was 0.78 %.

Reasons for image rejection:
The identified reasons for image rejection are shown (Table 1, Figure1):

The most frequently recorded causes for image rejection were patient movement during the procedure or non-cooperative patient (37.86%), off-center study (21.17%), presence of artefact (16.5%), improper positioning (12.7%); while other reasons included forgetting to use grid (5%), patient is not well prepared (3.6%), while machine breakdown was the reason in only (0.2%).

Reject rates per anatomical area:
The reject rate per different types of examinations is shown in (Table 2, Figure 2).

The frequency of image rejection was higher in some studies, such as spine (24.44%), chest (23.41%), lower extremities examination (18.24%), while it was in upper extremities study (12.74 %), skull (10.84%), pelvis (5.68%), and abdomen (4.65%).

Health Center reject rates:
Individual health centers reject rate were analyzed (Figure 3). These data showed a considerable variation in the reject rates among different health centers.

Reject rates per month:
Individual months reject rate were analyzed (Figure 4). These data showed a drop in April 2020 (2.4%) and May 2020 (1.5%) while the rest of 1st 2020 quarter and 3rd quarter had a very close rejection rate.

Table 1: Reason for image rejection

Reason for image rejection.	Number of images	%
Patient movement	220	37.9
Off centered	123	21.2
Foreign body/Artefacts	96	16.5
Improper position	74	12.7
Grid problem	29	5
Patient is not well prepared	21	3.6
Machine Breakdown	10	1.7
Not recorded	6	1
Connection Breakdown	1	0.2
Wrong marker	1	0.2
Total	581	100

Table 2: Image rejection in different anatomical areas

Reason for image rejection.	Number of images	%
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Machine Breakdown	10	1.7
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Connection Breakdown	1	0.2
Wrong marker	1	0.2
Total	581	100

Figure 1: Reason for image rejection

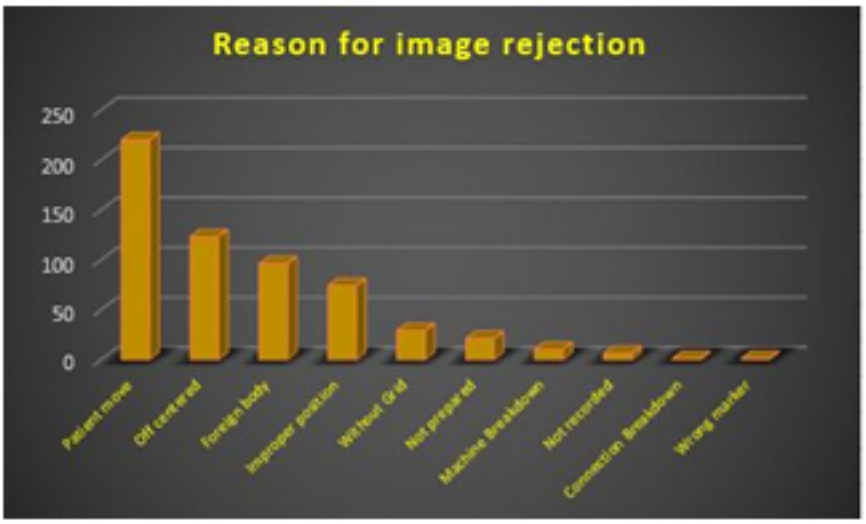


Figure 2: Image rejection in different anatomical areas

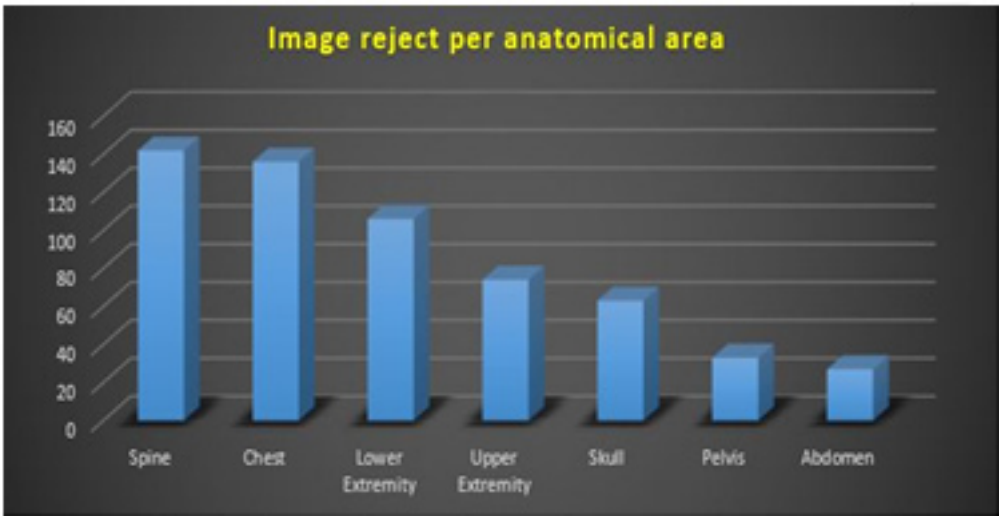


Figure 3: Image rejection in different HCs

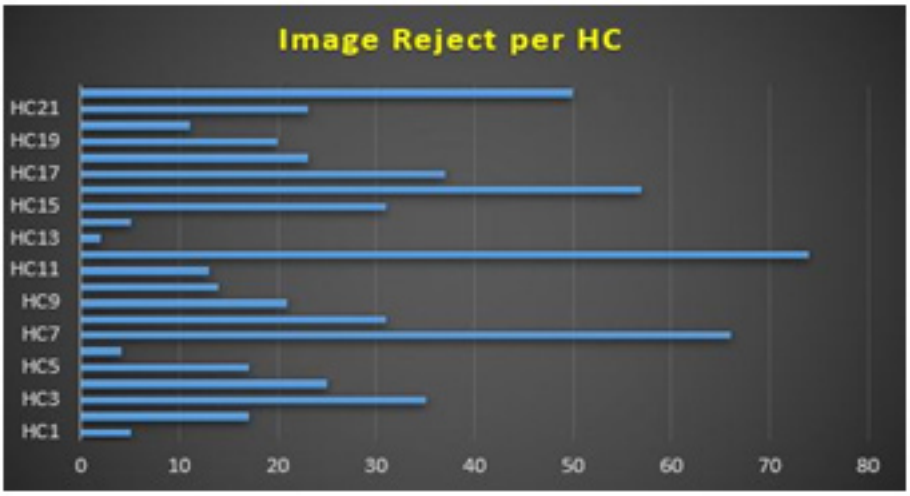
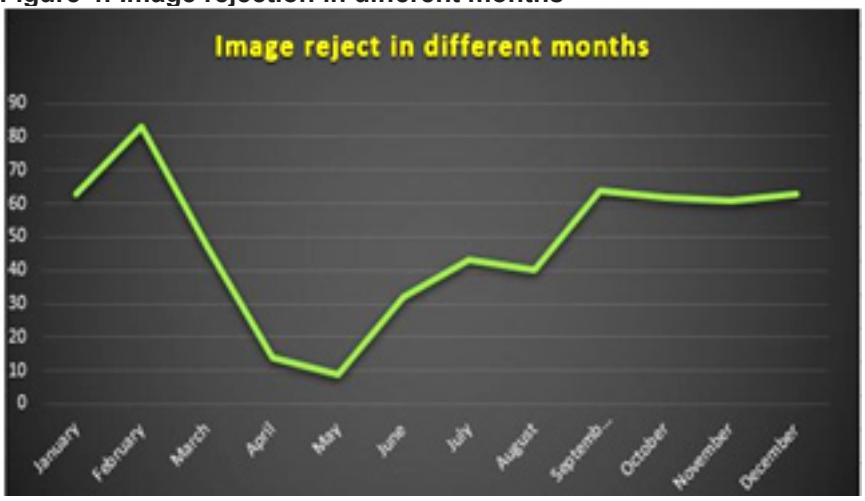


Figure 4: Image rejection in different months



Discussion

As the rejected images are not transferred to the radiologists for reporting their high ratio can affect the radiation dose the patient receives and passively influence the radiology department performance (13).

The aim of image rejection analysis is to find out the areas which need improvement as well as to identify the limitations in the performance, therefore be able to help in drafting some recommendations that can be helpful in improving the performance and empower the future analysis of image rejection.

Moving from conventional radiography to digital radiography was theoretically expected to reduce the reject rate from 10-15% down to 3-5 %. This was supported by several studies' results (14-18), while it was not the case in other situations (11,13,19,20).

Previous reports showed some overall hospital's rejection of 1- 1.2% (10, 21) while some other studies were higher (4.8-11%) (9,11,19).

In a study conducted on a large sample size of (98,503 images) over 6 months the reject rate was about 9% which is towards the higher end of reject rates reported for DR and higher than CR reported average (5%) (13,15,22). This was comparable to film-screen studies (8-16%) (14,22,26) yet this study may be representing reject rates in radiography done in the emergency department.

In the current study the reject rate was 0.78% which is below the WHO recommendation of 5% (18) and below 2% which is that expected in the DR department (15).

Upon analysis of the cause of image rejection in the current study, it was found that the most common causes are patient movement during the procedure or non-cooperative patient (37.86%), off-center study (21.17%), presence of artefact (16.5%) and improper positioning (12.7%).

Positioning error was the most encountered problem in the CR systems too (13,14,17,23,24).

In a previous study (9,11,13,25) the most common cause was error in 'positioning' and 'anatomy cut-off', while in older film-screen radiography the exposure error was on top of image rejection reasons. In current CR and DR systems, the position error was reported in an earlier study (10) the most common technical reason for rejection was error in patient positioning (36.11%) while it constituted a higher percentage in some other studies (51-77% (9-11,19).

A study by Dunn and Roger (26) found that radiologists are more lenient with image quality and can accept up to half of images that are rejected because of positioning error by technologists. In line with this also, another study conducted by Nol et al (14) assumed that the increased prevalence of positioning error can be attributed to less communication between radiologist and radiographer regarding the quality of images.

Another technical error in the collimation error, in a previous study (10) it was 13.1% while it was about 6.4% in another study (11).

These errors can be attributed to inability of the technicians to apply their theoretical knowledge in the practice to achieve proper collimation.

Some types of examination can have higher rates of image rejection than others. t+This was confirmed in the study of Dunn and Rogers (26) who found that reject rates are sensitive to the type of examination and claimed that using a single average reject rate as a quality indicator can have some misrepresentation of the actual performance. In some earlier studies (10, 13) the highest reject was in the chest radiograph (38% in adults and 10% in children) while the least was in cranial (3%), the lower extremity (15%) and upper extremity (8%). In another study (11) it was 59.1% for lower extremity and 25.4% for the upper extremity (8).

In a study of Zhang (27) he noticed that radiographers prefer higher exposure to have a higher image quality. Foos et al (23) attributed the reduction of exposure errors to improvement in detector systems in CR machines and this was encouraged as it results in keeping patient dose in line with the ALARA principle (13,27-28).

While in the current study exposure errors were not a significant reason in image rejection, yet it is recommended in a future study to consider the exposure index analysis as in DR as there may be a possibility of over-exposure of patient by more than the average as claimed in previous studies to be 5-10 times the average (8,13,27).

In the current study, when rejected images of different individual examinations were analyzed, some anatomical regions showed a higher image rejection. The reject rate per different types of examinations is shown in (Table 2, Figure 2). The frequency of image rejection was higher in some studies such as spine (24.44%), chest (23.41%), and lower extremities examination (18.24%), while it was in upper extremities study (12.74 %), skull (10.84%), pelvis (5.68%), and abdomen (4.65%).

This identifies these areas to be of potential concern that may need additional focused training on these specific examinations to lower the image rejection and radiation dose delivered to the patient.

In the current study the reject rate was variable among different health centers. This also can indicate that the image standard quality may be not consistent among different health center radiographers so improvement can be achieved through regular feedback in order to have standard technical aspects and image quality achieved among different radiographers.

Reject analysis is an accurate efficient tool that can collect the feedback and keep these standards.

In the current study, individual months reject rate were analyzed. These data showed a drop in April 2020 (2.4%) and May 2020 (1.5%) likely attributed to reduced workflow due to COVID-19, while the rest of 1st 2020 quarter and 3rd quarter had very close rejection rate.

There were some limitations in the current study such as data are collected manually from technologists and not exported from the automatic dedicated reject analysis software, so there was possibility to miss some data as not recorded by them so it is recommended in future studies to export data periodically through dedicated software. In this way we can avoid any data loss or incorrect categorization by radiographer. Access to rejected images can verify the rejection cause retrospective. This could be done by having a dedicated folder for rejected images on PACKS (Picture Archiving and Communication System).

Conclusion

This result showed that the reject rate in PHCC radiology department is within the accepted limits of quality control and assurance studies.

However, it is highly important to carry on quality improvement projects with proper training and education based on utilization of regular reject analysis and feedback tool.

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