

## Film Reject Analysis For Conventional Radiography In Khartoum Hospitals

Mohamed Yousef<sup>1,2\*</sup>, Carolin Edward<sup>1</sup>, Hussin Ahmed<sup>1</sup>, Lubna Bushara<sup>1</sup>, Abdullah Hamdan<sup>2</sup>, Nasreldin Elnaiem<sup>2</sup>

<sup>1</sup>College of Medical Radiologic Science, Sudan University of Science and Technology, P.O.Box 1908, Khartoum, Sudan

<sup>2</sup>Radiologic technology department, college of applied medical science, Qassim university, Buraduh, KSA.

### Abstract

It is not uncommon to encounter patients undergo repeat x-ray examinations after their initial x-rays are rejected for poor image quality thereby subjecting them to excess radiation exposure and avoidable extra cost. This creates a situation which necessitates the need to explore causes of reject and repeat of x-ray examinations. The employment of reject analysis as part of overall Quality Assurance (QA) programmes in clinical radiography and radiology services in the evaluation of image quality is a well-established practice. The role of reject analysis in providing relevant information that would help achieve sound reduction in radiation exposure and cost as well as develop acceptable image quality was explored in this study. To assess the reasons of x-ray films rejection, and to obtain information for further recommendation on quality in Khartoum state hospitals. Prospective and cross-sectional study approaches were employed. Reject rate was measured for seven x-ray departments across all plain x-ray films examinations using a structured format on which relevant data for reject were recorded by investigators (radiologists and a medical technologists). Results were then collected and entered into a database for analysis. Reject rate along with exposure rate was measured across all plain film exams for the hospitals. Analysis has shown that the overall reject rate causes: under exposure (26.8%), over exposure (19.2%), Artifacts (18.7%), patient motion (5.7%), position (23.8%), processing (3.4%) and duplication (2.4%). The major reasons for rejection of films were over- or under-exposure and patient position problems. The study showed the importance of a QA programme in order to deliver high-quality health service to patients.

**Key Words:** Artifacts, Reject Analysis, Conventional Radiography, exposure, Processing.

### INTRODUCTION

Film reject analysis is a well-established method of quality control (QC) in diagnostic radiology.<sup>[1]</sup> The employment of reject analysis in the evaluation image quality has quite a long history quality control (QC) in diagnostic radiology.<sup>[2]</sup> A reject film is a film that does not add diagnostic information to clinical analysis because of poor image quality.<sup>[1,3]</sup> Analysis of rejected films yield information about the efficiency of an X-ray department and is the basis for QC and education of the radiographer.<sup>[1,4-7]</sup> Furthermore, it gives an indication of the sources of radiographic errors and highlights areas where improvement can be made.<sup>[3]</sup> Rejected films are responsible for an unnecessary increase in radiation dose to the patient population.

Film use analysis separates nondiagnostic films into two basic areas: repeat films and all other films. REPEAT FILM is defined as a film that was not acceptable and required an additional exposure to the patient. Even if the film is kept (not put in the reject bin), it should be counted as a repeat if it resulted in additional exposure to the patient. ALL OTHER FILMS includes test (QC) films, clear films, and any others that do not fit the definition of "repeat film."<sup>[8]</sup> The employment of reject analysis in the evaluation of image quality and equipment quality has quite a long history. It is an important component of quality assurance programs.<sup>[9]</sup>

The role of reject analysis is providing relevant information that would reduce cost and radiation exposure.

### Address for correspondence\*

**Mohamed Yousef**

College of Medical Radiologic Science, Sudan University of Science and Technology, P.O.Box 1908, Khartoum, Sudan

both for patients and personnel from radiation hazards.<sup>[10]</sup> Diagnostic radiology service delivery departments would be able to identify potential problem areas, scrutinize the reasons for these problems and come up with ways to rectify them. These explanations, therefore, explicitly show that reject analysis is an integral part of standard radiology service evaluation, which is the basis for optimization of radiology and reasonable budgeting and planning of service delivery.

The objectives of this study were to assess the reasons of x-ray films rejection, and to obtain information for further recommendation on quality in Khartoum state hospitals.

### MATERIALS AND METHODS

**Study Population**-x-ray films of patients from seven hospitals of Khartoum state were included. Data were collected from conventional radiography examinations where the cause of the rejection were collected. Throughout the period of the study, there was no formal policy in all hospitals for defining films as rejects. The decision to reject or accept a radiograph was done by the radiographer based on his professional judgment, experience and point of view. In the few cases where the radiographer was uncertain, the decision was made by the radiologist. The rejected films were classified into one of the following categories:

(1) Exposure error (over- or under-exposure): If incorrect exposure factors have been used, the film density may be too light or too low to demonstrate the body part of interest.

(2) Field size misplacement: This occurs when the body region of interest is not seen completely on the X-ray image. The patient has not been positioned correctly so that the body area of interest is imaged adequately. This may also occur due to movement of the patient.

(3) Artifacts: Artifacts have many different causes.

Examples of these causes are improper handling of the unprocessed film or defects of the films.

(4) Processing problems: Processing problems may occur because of static build-up during the processing, physical damage resulting in the film emulsion bearing the image being removed, or incorrect developer conditions (chemistry, temperature, impurities etc.).

(5) Others. All other causes of defects such as scratched film were classified in this category.

Finally, based on the above-mentioned criteria, data collection was done for the investigation of the causes of film rejection. The collected data were compiled at the end of each week and entered into a computer for analysis at the end of the study period.

Reject film: an x-ray film considered useless and discarded based on the recommendations of the International Atomic Energy Agency (IAEA).

Exposed films = Total number of reject films + total number of repeat films

a) The total number of films = exposed films + rejected films

b) Reject rate (%) = (Number of rejected films / Total number of films used) \* 100

c) Causal reject rate (%) = (Number of rejected films for a specific cause in one hospital / Total number of films rejects for a specific cause) \* 100

**Data Analysis:** Data were collected in standardized formats as recommended by the National Radiation

Protection Authority (NRPA), and the International Atomic Energy Agency (IAEA). Rates and proportions were calculated and presented in table form. Moreover, costs of examinations and rejects were estimated.

**RESULTS**

The reject rate by examination type and cause broken down into the three top reasons: under exposure (26.8%), over exposure (19.2%), Artifacts (18.7%), patient motion (5.7%), position (23.8%), processing (3.4%) and duplication (2.4%).

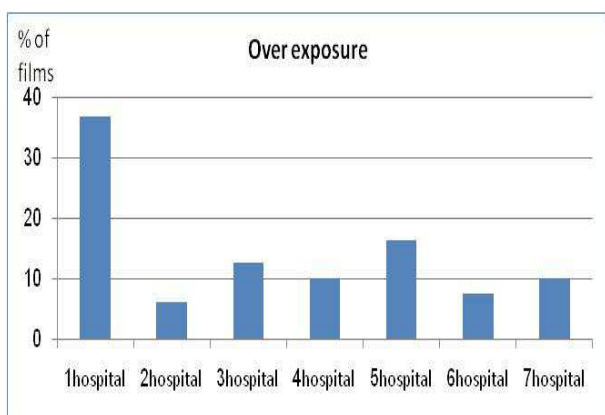


Figure (1) shows of films against the hospitals



Figure(2) shows over exposure image

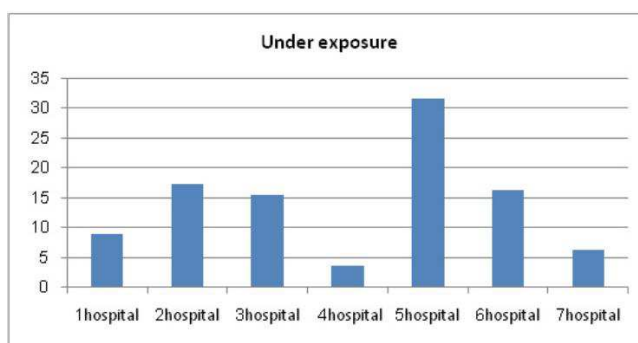


Figure (3) shows the percentage of the film rejects due to under exposure the film rejects due to under exposure



Figure(4) shows under exposure image

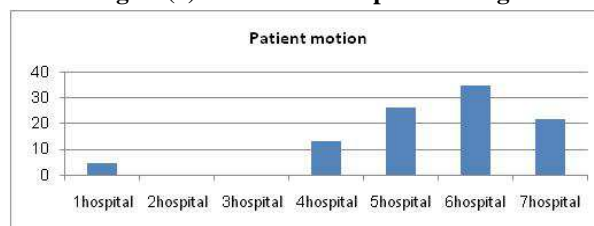


Figure (5) shows the percentage of the film rejects due to patients' motion problem

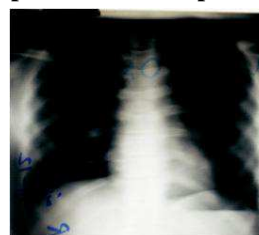


Figure (6) shows patients' motion problem

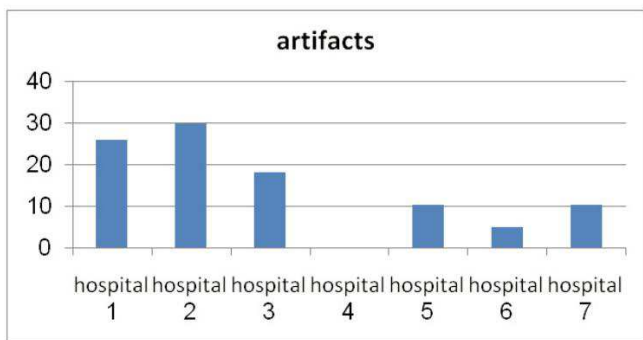


Figure (6) shows the percentage of the film rejects due to artifacts problem



Figure (7) shows artifacts problem

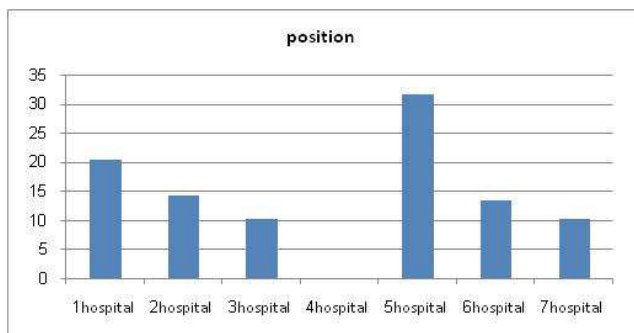


Figure (8) shows the percentage of the film rejects due to patients' position problem.



Figure (9) shows patients' position problem

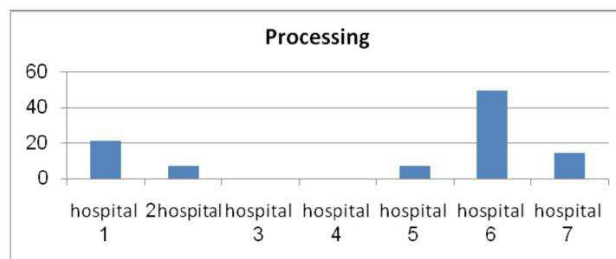


Figure (10) shows the percentage of the film rejects due to processing problem.



Figure (11) shows processing problem



Figure (12) shows the percentage of the film rejects due to double exposure problem.



Figure (13) shows double exposure film.

## DISCUSSION

Accurate exposure is one of the important (decisive) factors providing a good quality image with high resolution. High-resolution image means an image that shows good structural detail. Under-exposure results in soft film and drop out the detail and over-exposure gives a dark film with decreased resolution. Both the type of radiation to which the person is exposed and the pathway by which they are exposed influence health. Because children are growing more rapidly, there are more cells dividing and a greater opportunity for radiation to disrupt the process. Fetuses are also highly sensitive to radiation. The resulting effects depend on the systems which are developing at the time of exposure. Analysis of data has provided that the highest main reason for reject being over exposure (22.8%) which could either be due to machine fault, or operator's technical limitations, and our finding corresponded with all other similar studies in terms of type of reject, but causes for reject varied for example, patient positioning was considered the main cause of reject by Duna and Rogers.<sup>[11]</sup> second highest reject at 25.6%, with over-exposure being the main reason.

[Figure 1] shows that hospital 1 was highest rate with over exposure problem that mean there was problem in the machine used in this hospital. under exposure results in soft film and drop out the details. Analysis of data has provided that the highest reject reason rate is that of under exposure (26.8 %) which could either be due to machine faults or operator's technical limitations.

The cause of motion which the rate is (5.7%) which may be due to long exposure duration or patient move during the exposure. Artifacts problem due to light leaks to the cassette or during processing when the film upload or download from the cassette the percentage was (18.7%). Hospital 1, hospital 2 and hospital 3 had high rate of artifacts problem that indicate for problem in those hospitals, this problem can be in dark room or cassette [Figure 6].

The reject rate of position faults is (23.8%) which can cause of improper position of patient. In some cases the collimation not properly adjusted which caused this problem. Figure (8) shows that the position problem is one of common reason of rejection in hospital 1 and hospital 5.

The percentage of processing was (3.4%). And the possible cause of this problem was processor malfunction or in processor chemicals, Figure (10) shows hospital 6 with highest rate of processing problem which indicates to processor malfunction. No rejected film with processing problem in hospital 3 and hospital 4 that indicate to proper cassette and proper processing procedures. In some cases, manual processing cause this problem. Duplication or double exposure happened when the film exposed to radiation more than one time or mixing between exposed or unexposed cassettes (2.4%) Figure (12) shows hospital 1 had high rate of duplication problem, the radiographer exposed film to radiation twice.

Comparison with other figures from other causes show that individual rejects by type varied from 2.2 % (Czech) to 11.02% (Ghana) and 13.6% (Brazil) with many others falling between there ranges.<sup>[12]</sup>

A study conducted in the United Kingdom,<sup>[11]</sup> advocates that prior viewing of radiography may reduce reject rates significantly; while other studies conclude that ineffective in-house QA programs and in adequate regular training programs form a major explanation for avoidable film wastage and possibly elevated patient doses to achieve maximum benefit, all levels of management and technical staff must support and participate in the operation of a well-defined programme on a conclusion basis.<sup>[13-17]</sup>

The present study mainly found that under-exposure and to a lesser extent image processing as well as patient motion to be the main reasons of reject. These could be due to suboptimal x-ray machine performance, poor technical skill with an element of inattentiveness, which could be the major reasons when individual reject rates are seen. The overall reject is within the accepted range. However, this will only be speculation as the above reasons have not been included in the study and need further independent investigation.

The study has given some gross and basic input into the common problems of quality of radiography service, and recommends that a regular, and continuous quality assurance (QA) programmes should be instituted at all levels of the department and that of hospital management for effective health service delivery, safe patient dose reduction, and sound resource management.

## CONCLUSION

Achievable of high image quality was necessary to produce correct diagnosis. these causes of film rejection should be considered as a big problem for patient, departments, and radiologists.

The programme of quality control test for the departments is very important to avoid occurrence of these causes of film rejection. The reject analysis program must be created and applied for all hospitals as one of the essential safety program in radiology department. The system must be checked periodically with restricted rules to ensure the radiological standards. When this system applied to all hospitals patients, personnel and surrounding environment will be protected against the hazards of any excess radiation dose. Analysis of ? lm reject is an easy and inexpensive method to gain information about the performance of an X-ray department.

Finally a large scale study at country level in order to reach plausible conclusion as to whether other factors such as equipment fault, or individual skill and performance may influence film reject rates and overall quality of service.

## REFERENCES

1. Peer, S., Peer, R., Walcher, M., Pohl, M. and Jaschke, W. Comparative reject analysis in conventional ? lm screen and digital storage phosphor radiology. *Eur. Radiol.* 9,1693–1696 (1999).
2. Zewdeneh, D., Teferi., S and Admassie, D. X-ray reject analysis in Tikur Anbessa and Bethzatha hospitals. *Ethiop. J. Health Dev.* 22(1), 63–67 (2008)
3. Weatherburn, G. C., Bryan, S. and West, M. A comparison of

- image reject rates when using ? lm, hard copy computed radiography and soft copy images on picture archiving and communication systems (PACS) workstations. *Br. J. Radiol.* 72, 653–660 (1999)
4. British Institute of Radiology. Assurance of Quality in Diagnostic X-ray Departments. BIR (1988).
  5. International Atomic Energy Agency. Radiation protection in diagnostic radiology. IAEA (2003).
  6. Arvanitis, T. N., Parizel, P. M., Degryse, H. R. and De Schepper, A. M. A reject analysis: a pilot programme for quality management. *Eur. J. Radiol.* 12, 171 (1991).
  7. Mazzaferro, R. J., Balter, S. and Janover, M. L. The incidence and causes of repeated radiographic examinations in a community hospital. *Radiology* 112, 71 (1974).
  8. Conference of Radiation Control Program Directors, Inc. (CRCPD) 1030 Burlington Lane, Suite 4B Frankfort, KY 40601 [www.crcpd.org](http://www.crcpd.org), July (1986).
  9. IAEA, Radiation Protection in Diagnostic Radiology, (2003).
  10. International Commission on Radiation Protection, Recommendation of the International Commission on Radiological Commission, ICRP PUBLICATION 60, Pergamon on Press Oxford. (1990).
  11. Dunn, M A, Rogers, A T; X-ray Film Reject Analysis as a Quality Indicator, *Radiography*,(1998);4:29-31.
  12. International Commission on Radiation Protection, Recommendation of the International Commission on Radiological Commission, ICRP PUBLICATION 60, Pergamon on Press Oxford. (1990).
  13. Muhugora W E; Nyanda A M; Ngaile J E; Lema U S; Film Reject Rate Studies in Major Diagnostic X-ray Facilities in Tanzania, National Radiation Commission P.O. Box 74 Arusha, United RepublicOf Tanzania.
  14. Radiation Protection in Diagnostic Radiology, Guideline, IAEA course material. (2003).
  15. Film Use Analysis, Guideline; CRCPD (Reference in Radiographic Control Programme Directorate),(1986).
  16. Gadelhalt J; Geitjang J T; Gottlin J H; Asp T; Continuing Reject/Repeat Film Analysis Programme; *European Journal of Radiology*; 1089;9(3):137-41.
  17. Mariam M; Reject Analysis, Dissertation Presented to the Society of Medical Radiographer (Malta), (1997).