X-Ray Film Reject Analysis in Radiology Departments of Port Sudan Hospitals

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Abstract

Patients normally go through repeated X-ray imaging procedures following the initial imaging exams are rejected because of poor image quality. 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 film reject analysis in radiology departments of Port Sudan hospitals. The highest reject and repeat rate was found to be chest X-rays whereas, the major factors contributing to film rejection were found to be position and under exposure.

The differences in reject rates and the high reject rate for some exams show that reject analysis is an important quality assurance tool in radiology department. Future reject analysis needs to be performed regularly including an exposure indicator investigation as well as retrospective study of individual rejected images.

Keywords

X-ray, Reject analysis, Radiology department, Port Sudan

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 [1]. The two major methods for restricting the radiation doses to patients in medical imaging are to avoid unnecessary examinations as well as to make sure the doses from examinations are no larger than required. In addition, the objective of a radiological examination should be to create images of sufficient quality for the clinical task, not images of unnecessarily high quality if that raise the radiation dose to the patient. However, using too low a dose can also be detrimental, if it ends in images that cause a clinical error or needs to be repeated [2].

Repeat or retake analysis is an essential aspect of a quality management program. It is organized process of categorizing rejected images and find out the nature of the repeated images to minimize or eliminate them in the future. Using repeat analysis, we can obtain important data about equipment and accessory performance, departmental procedures, and the experience level of the technical staff. With this procedure, solutions can be found to reduce repeats and report the efficiency or lack of quality control and quality assurance protocols. Furthermore, radiology departments that have converted to digital imaging can benefit significantly by utilizing a repeat analysis program [3].

A rejected image is a radiograph that is considered inappropriate regarding image quality, by the radiologic technologist directly after acquisition [4,5]. Furthermore, as the rejected images increases, department efficiency and patient satisfaction decreases [6]. It is ordinary to come across patients receive some repeated X-ray radiographs following the first X-ray radiographs are rejected because of poor image quality, therefore subjecting patients to additional cost and radiation exposure. Hence, it is necessary to investigate the causes of film reject and repeat in radiology department. Using reject analysis, we can obtain information that would...
allow us to accomplish efficient reduction in additional
cost and minimize the radiation exposure of patients.
In this context, reject analysis has therefore emerge as
a considerable quality control tool in radiology depart-
ment [7].

There are very few studies that have examined the
reject/repeat rate analysis in radiology departments in
Sudan. Nada, et al. studied the film repeat causes and
reasons for reject films which identified, and the cor-
rective actions were accordingly applied [1]. The au-
thors reported that, 16.64% and 16.11% of the repeat
rate was due to radiographic and processor factors,
respectively. In addition, Mohammed, et al. reported
the film reject analysis for conventional radiography In
Khartoum hospitals and found that, the major reasons
for rejection of films were over- or under-exposure and
patient positioning [8].

The aim of this study is to evaluate the repeat or re-
ject rate of X-ray films so as to achieve details for fur-
ther suggestions on cost and patients radiation doses
in radiology departments of a selected hospitals in Port
Sudan - Sudan. The findings showed in this study can be
utilized by the radiology department to point out draw-
back areas, investigate the causes for such problems
and discover methods of correct them.

To the best of our knowledge, this is the first report
investigating X-ray film reject/repeat rate in Port Sudan
Hospitals.

Materials and methods

Hospitals

This study was conducted in the four major hospitals
in Port Sudan namely: (Port Sudan Teaching Hospital
(PTH), Sea Ports Corporation Hospital (SCH), Police Hos-
pital (PH) and Bawareth Hospital (BAH).

Calculation of X-ray film reject/repeat rate

Reject rate is described as the number of films re-
jected from a particular department and indicated as a
percentage of the overall film utilized:

\[
\text{Reject rate} = \frac{\text{Number of rejected films}}{\text{Number of examinations}} \times 100
\] (1)

Whereas repeat rate; represent the percentage of
clinical X-ray images that must be retaken because of
fault leading to inappropriate quality of image [9]:

\[
\text{Repeat rate} = \frac{\text{Number of repeated films}}{\text{Number of examinations}} \times 100
\] (2)

In each radiology department X-ray films were evalu-
ated by the radiographer, who classified films seen into
accepted or rejected. All rejected and repeated films
were grouped into seven; based on the cause for rejec-
tion. These are:
1. Over exposure
2. Under exposure
3. Patient motion
4. Patient positioning
5. Selection of technique factors
6. Artifact and
7. Others

Statistical Analysis

The statistical analysis of this study was performed
using Origin 8.0 software. Categorical variables are tab-
ulated and expressed as percentages and continuous
variables as means.

Results and Discussion

The main advantages of reject/repeat rate analy-
sis are enhanced department skills, lower department
costs, and lower patient doses. As the number of re-
peats remain low, the proportion of time which patients
should go through undertaking imaging procedures de-
clines. This will result in patient contentment and the ra-
diology 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 [3].

Figure 1 shows the repeat rate by exam type in PTH.
As can be seen in Figure 1, the reasons for image rejection
are position (10.5%), over exposure (21%), motion
(5.2%), artifacts (26.3%) and other (36.8%).

Results of the repeat rate by exam for SCH are pre-
sented in Figure 2 (position 36.36%, over exposure
27.27%, under exposure 27.27% and motion 9.09%). It
is clear that imaging procedures due to position error
represents the highest cause of repeat rate in SCH. 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].

The position error as a cause for reject which report-
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 [11].

Figure 4 shows the reject rate in BH. From this figure we can observe that, positioning errors (31.23%) represents the highest cause of repeated imaging procedures followed by under exposure (18.72%), over exposure (12.51%), artifacts (12.51%) and motion (6.31%). Previous studies showed that major hospitals have a less repeated X-Ray imaging procedures compared to small hospitals. This is primarily because radiology departments in major hospitals have excessive number of patients and everyday imaging procedure that lead to enhanced skills of radiography technologists [12]. Furthermore, large hospitals draw extremely certified imaging technologists which are expected to improve the

| Type of examination | Number of rejected films | Reasons for rejection |
|---------------------|--------------------------|-----------------------|
| Chest               | 23                       | Under exposure, over exposure, position, artifact, motion, other |
| Forearm             | 1                        | Over exposure         |
| Pelvis              | 3                        | Under exposure, artifact |
| Shoulder            | 5                        | Position, under exposure |
| T-Spine             | 2                        | Position, under exposure |
| C-Spine             | 5                        | Over exposure, other  |
| L-Spine             | 2                        | Under exposure, motion |
| Skull               | 4                        | Position, under exposure, artifact |
| Knee                | 1                        | Over exposure         |
| LGI                 | 2                        | Under exposure, motion |
| UGI                 | 1                        | Position              |
| Humerus             | 1                        | Under exposure        |
| Ankle               | 1                        | Artifact              |
| Foot                | 2                        | Position, other       |
| Total               | 53                       |                       |

Table 1: Distribution of reject by various examination type in studied hospitals.
skills of the other technologists working at the same imaging department [12].

From Table 1 we can observe 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 and overexposure due to improper selection of technique factors.

**Conclusion**

The study has shown that, the highest reject rate was for chest exams and the most frequent causes for reject are position and under exposure.

Quality image of X-rays are found to be related to quality control measures, perfect selection of exposure factors during radiography and patient position. Hence, it is recommended that, investigation of the rejected films should be carried out regularly as part of the overall quality assurance program of the hospital in order to determine the significance of the problem and also to discover the causes.

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