FILM REJECT ANALYSIS IN RADIOLOGY DEPARTMENT OF A TEACHING HOSPITAL IN NORTH-EASTERN NIGERIA

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ABSTRACT

BACKGROUND: Film Reject Analysis (FRA) is a key quality control tool in conventional medical imaging departments and it provides a valuable tool in assessing patient dose.

OBJECTIVES: To determine the film reject rate, reasons for the reject and the radiographic examination involved in film reject

METHODOLOGY: A prospective cross-sectional study was employed where 733 rejected radiographs was used . These were obtained from the archives of radiology department ATBUTH Bauchi after consent was obtained from the ethical clearance committee of the hospital. Rejected films were analyzed and classified according to radiographic examination which includes plain abdomen, chest, contrast studies, extremities, pelvis, skull/mandible/sinuses and spine. Moreover, the reasons for the reject were also categorized as overexposure, underexposure, rotation, positioning error, poor breathing, fog, rollers, static marks and others (absence of anatomical marker, finger marks, and loss of patient's details). Data was analyzed using SPSS version 20.0 software, descriptive statistics such as frequency, mean, mode were generated. Film reject rate was also computed.

RESULTS: Out of the 733 rejected radiographs, the overall film reject rate was 9.62% with chest X-ray having the highest number of rejected films 191(26.47%) while plain abdomen has the highest number of reject rate 27.54%. The most common causes of film reject were overexposure, underexposure, fog and rotation representing 216(29.47%), 146(19.92%), 131(17.87%) and 128(17.46%) respectively.

CONCLUSION:

KEYWORDS: Film reject, rejected rate, Radiographs, Radiology, Quality assurance.

INTRODUCTION

Film reject analysis is a planned and systematic action necessary to provide adequate confidence that a product or service will satisfy the given requirements for quality of image or radiograph[1]. Conventional X-ray is one of the important diagnostic modalities being used worldwide in the healthcare services despite being associated with some radiation exposure to the patients[1]. The objectives of film reject analysis is to minimize patients exposure, cost reduction, high throughput, better image quality, identifying main errors, putting measures to reduce them and information for teaching and research[2]. The International Commission on Radiation Protection (ICRP) recommends that medical exposures should be kept as low as reasonably achievable considering economic and social factors and one way of achieving this is through film reject analysis[1].

The Conference of Radiographic Control Programme Directorate (CRCPD'S) Committee on Quality Assurance (QA) recommends a higher reject rate of 10%[2]. The production of high quality radiograph is an intricate process considering the high level of image quality required[1]. The aim of radiography is to obtain images which are adequate for the clinical purpose with minimum radiation dose to the patient. If optimum performance is to be achieved, assessment of image quality must be made to balance against patient dose. X-rays are known to cause malignancies, therefore are potentially dangerous. It is therefore essential and mandatory to reduce the radiation dose to patients in diagnostic radiology to the barest minimum[2]. The employment of reject analysis in the evaluation of image quality is an important component of quality assurance programs. Reject/repeat film analysis is a sort of subjective evaluation of image quality where images judged to be of poor quality are categorized according to cause. This program is a useful and well-established method for quality control in diagnostic radiology and provides valuable information about the efficacy of a department[3]. The role of reject analysis in providing relevant information that would help achieve sound reduction in cost and radiation exposure both for patients and personnel cannot be overemphasized[4]. Even though strict application of quality assurance programme is not available in most institutions in the developing countries, accurate assessment of radiographic film repeats and documentation of the reasons for the repeats are accepted as adequate criteria for quality assurance in radiography. 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[5]. This study aims to determine the factors responsible for film rejection or repeat and the radiographic examination involved in film rejection in Abubakar Tafawa Balewa University Teaching Hospital (ATBUTH), Bauchi, Nigeria.

MATERIALS AND METHODS

A prospective cross-sectional study was employed where 733 radiographic films were reviewed because they were considered of no diagnostic value. A total of seven hundred and thirty three (733) radiographs rejected within the period of one (1) year (August, 2015 to July, 2016) were analyzed. These were obtained from the archives of radiology department ATBUTH Bauchi after consent was obtained from the ethical clearance committee of the hospital. Each film was assessed on viewing box under similar viewing conditions of room light and temperature. The evaluation was done by the chief radiographer and four other radiographers. Rejected films were analyzed and classified according to radiographic examination of body parts which includes but is not limited to abdomen, chest, contrast studies, extremities, pelvis, skull/mandible/sinuses and spine. Moreover, the reasons for the reject were also categorized as overexposure, underexposure, rotation, positioning error, poor breathing, fog, rollers, static marks and others (absence of anatomical marker, finger marks, and loss of patient's details). Data were analyzed using SPSS version 20.0 software, descriptive statistics such as frequency, mean, mode were generated. Film reject rate was calculated using equation below:

$$\text{Rate of Reject} = \frac{\text{Number of rejected films}}{\text{Total number of films used}} \times 100 \quad \text{..... equation 1}$$

RESULTS

The results obtained in this study are presented in Table 1-4 and Figure 1-2. Out of the total of 7616 radiographic films that were exposed and processed during the study period, 733 radiographs were rejected. The highest examination being chest (n=2160) and the lowest examination being abdomen (n=559). Abdomen has the highest percentage of repeat (27.54%) in which 154 out of 559 radiographs were retaken, followed by spine examination (11.3%) where 58 examination out of the total 696 spine examinations were retaken.

Table 1: Rate of Reject for Radiographic Examination

Radiographic examination	Number of films used	Number of films rejected	Reject rate (%)
Chest	2160	191	8.84%
Skull/mandible/sinuses	756	43	5.68%
Extremities	792	38	4.79%
Abdomen	559	154	27.54%
Pelvis	898	90	10.02%
Contrast studies	1755	159	9.05%
Spine	696	58	11.3%
Total	**7616**	**733**	**9.62%**

Table 2 and Figure 1 below shows the common subjective reasons for rejecting films with their percentages in ATBUTH, Bauchi. Some of the major reasons for rejection of films are overexposure, underexposure, fog and rotation representing 216(29.47%), 146(19.92%), 131(17.87%) and 128(17.46%) respectively. Moreover, very few of the rejected radiographs 5(0.68%) were due to static marks.

Moreover, the distribution of rejected films according to radiographic examination shows 191(26.05%) were chest X-rays, followed by contrast studies 159(21.69%) and abdomen 154(21.0%) respectively as shown in Table 3 and Figure 2.

Table 4 presents the distribution of radiographic examination and the reasons for reject. Contrast studies radiographs, abdomen and chest were mainly involved due to overexposure and fog respectively. Each representing 61, 54 and 41 respectively.

Table 2: Common Reasons for rejecting Films in ATBUTH, Bauchi

Reasons for Reject	**Number of Rejected Films**	**Percentage (%)**
Overexposure	216	29.47
Underexposure	146	19.92
Rotation	128	17.46
Positioning error	34	4.64
Poor breathing	19	2.59
Fog	131	17.87
Rollers	15	2.05
Static marks	5	0.68
Others	39	5.32
Total	**733**	**100**

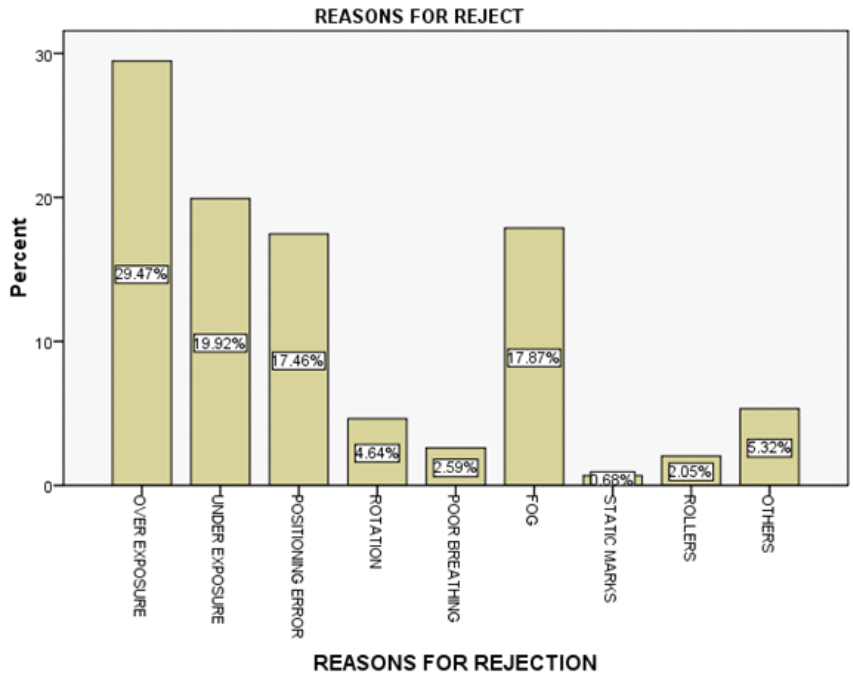

Fig 1: The Distribution of Reasons for Film Rejection with their Corresponding Percentages

Table 3: Distribution of Rejected Films according to Radiographic Examination

Radiographic examination	Number of rejected films	Percent. (%)
Chest	191	26.06
Skull	43	5.87
Extremities	38	5.18
Abdomen	154	21.01
Pelvis	90	12.28
Contrast studies	159	21.69
Spine	58	7.91
Total	**733**	**100**

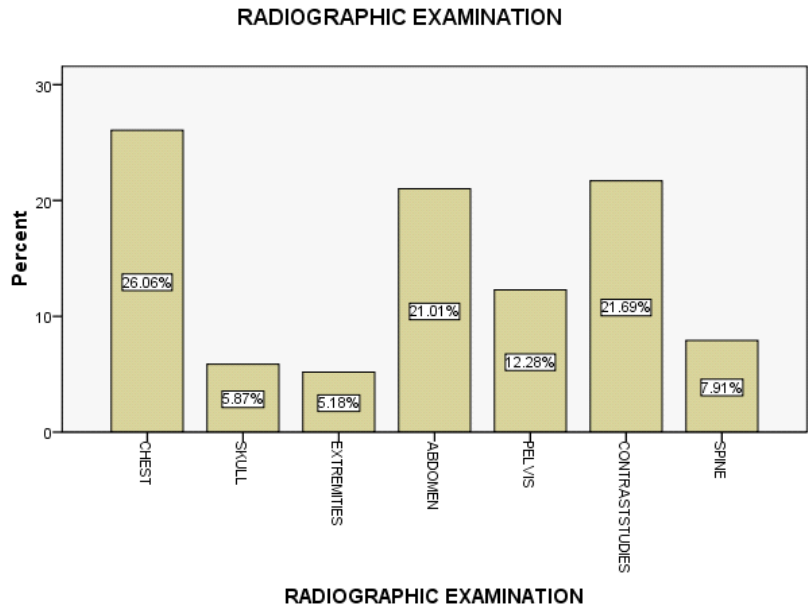

Fig 2: A Bar Chart showing the Distribution of Radiographic Examination with their Corresponding Percentages

Table 4: The Distribution of Radiographic Examination with their Corresponding Reasons for Reject

Reasons for Reject	Over Exposure	Under Exposure	Positioning Error	Rotation	Poor Breathing	Fog	Static Marks	Rollers	Others	Total
Radiographic Examination										
Chest	33	34	34	23	19	41	5	5	7	191
Skull	8	6	1	1	0	19	0	0	8	43
Extremities	18	14	2	0	0	3	0	1	0	38
Abdomen	54	24	33	1	0	30	0	2	10	154
Pelvis	23	20	20	1	0	19	0	1	6	90
Contrast Studies	61	32	38	7	0	12	0	5	4	159
Spine	19	16	10	1	0	7	0	1	4	58
Total	216	146	128	34	19	131	5	15	39	33

Table 5: Comparison of Present Study with other Previous Studies

S/N	Study	Overall Reject Rate	Place of Study
1.	Present Study	9.62%	Bauchi, North Eastern Nigeria
2.	Okhuomaruyi et al[1]	8.9%	Benin, South Western Nigeria
3.	Eze et al[5]	8.86%	Edo, South Western Nigeria
4.	Zawdeneh et al[4]	4.94%	Tikur Anbessa, Ethiopia
5.	Teferi et al[8]	3.1%	Addis Ababa, Ethiopia
6.	Banahane et al[2]	14.1%	Accra, Ghana
8.	Jabbari et al[3]	7.20%	Umia, Iran

DISCUSSION

A diagnostic radiology facility is any facility in which an X-ray system is used to irradiate any part of the human body for the purpose of diagnosis and the quality of information obtained from radiographs is dependent on a number of factors[2].

The overall rate of reject in this present study was 9.62% this is in line with the range of values obtained in other previous study such as 8.9% in Benin, Okhuomaruyi et al[1]. and 8.86 % in Irrua Edo State,Eze et al[5]., South Western Nigeria. Similar studies in some African countries have been reported such as 4.94% in Ethiopia, Zewdeneh et al[4]., 3.1% in Ethiopia, Teferi et al[8]., 14.1% in Accra Ghana, Banahane et al[2] and other countries of the world such as 7.2% in Umia Iran, Jabbari et al[3]. The most common causes of film rejection found in this study include overexposure, underexposure, fog and positioning errors. These finding is in line with the findings in Ghana, Maiduguri (North Eastern Nigeria) and Kano (North Western Nigeria) of Banahene et al[2], Nwobi et al[6]., and Tabari et al[7].,who reported that overexposure and positioning errors were most occurring reasons for rejection of radiographs in their study areas. The similarity in the reported studies may be attributed to adoption of similar methodology in this present study. However, it is in contrast with the study of Ezeetal[5], who reported that the greatest cause of rejects was radiographer's faults. This variation may be attributed to adoption of different categories for rejection of radiographs in the study. Furthermore, lack of quality control QC test is another factor that may cause over or under developed radiographs as no quality control program is carried out in the darkrooms. The high level of fog may be attributed to white light leakage, inefficacy of safe light, prolong film handling time among others.

The radiographic examination with the highest number of reject rate in this study was abdomen 27.54% and extremities 4.79% being the lowest. This in contrast with the study of Banahene[2] et al., who reported that cervical spine 57.1%, has the highest reject rate and lumbar spine 7.7% account for the lowest rate of reject, and Tabari et al[7] who reported chest radiographs account for the highest rate of reject. The variation may be as a result of misalignment of the X-ray tube with the potter bucky tray during radiographic exposure, body habitus, manipulation between exposure parameters such as kilovoltage and milliampere second.

Other causes which may be attributed to the rejection of radiographs at ATBUTH may be due to the small number of trained and qualified radiographers in the hospital as most of the radiation workers were X-ray technicians who are currently preparing to upgrade to Bachelors of Radiography Programme in the university.

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RECOMMENDATION
Film reject/repeat analysis programme (RAP) should be conducted quarterly and the department should have a quality assurance (QA) team that will conduct quality (QC) control programme.

CONCLUSION
This study has showed that the film reject rate at ATBUTH is within the range of values obtained in some studies within this country Nigeria. This provides baseline for further studies.

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