ejpmr, 2017,4(2), 188-191

SJIF Impact Factor 4.161

EUROPEAN JOURNAL OF PHARMACEUTICAL AND MEDICAL RESEARCH

www.ejpmr.com

Research Article

ISSN 2394-3211

EJPMR

REJECT-REPEAT ANALYSIS OF PLAIN RADIOGRAPHS AS A QUALITY INDICATOR AT UNIVERSITY OF MAIDUGURI TEACHING HOSPITAL (UMTH)

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Article Received on 08/12/2016 **Article Revised on 28/12/2016** **Article Accepted on 18/01/2017**

ABSTRACT

Objective: To determine the level of improvement of reject rate, persistent main cause of repeated films and re-occurring most common projection(s). ***Methodology:*** A prospective design was carried out on radiographs of poor image quality collected from the 3 conventional diagnostic rooms for a period of 9 months (April – December, 2011) at the Radiology department, University of Maiduguri Teaching Hospital. All radiographs with good diagnostic image quality, those used for contrast study and mammograms formed the exclusion criteria. ***Result:*** The reject rate was found to be 29.34%, Chest radiograph has the highest reject (12.19%), over and under exposure contributed to about 24.28% and 36.2% respectively. Anatomical cutoff ranked the next (21.91%) and motional blur (0.14%) the least. ***Conclusion:*** The study has outlined reasons why radiographs were rejected and the rejected rate for the period of study to be 29.34% which is almost 5x greater than the recommendation given by World Health Organization (WHO)[11] on radiation protection, Conference of Radiation Control Program Directors, (CRCPD)[3] and Quality assurance for Radiographers and Radiological Technologist, this calls for immediate rectification strategies like knowledge update, repairs and frequent quality assurance measures in place.

KEYWORDS: *reject-repeat, quality indicator, analysis, radiographs.*

INTRODUCTION

A program that is put in place to analyze radiographs (x-ray films) also referred to as reject-repeat film analysis provides a framework to manage x-ray film used, monitor equipment performance and measure the effectiveness of the facilities quality assurance and above all serves to control the dose received by patients.[1-3] It is a program which reflects areas of weakness of both radiographic and radiologic practices in a department and serves to improve quality assurance procedure when properly harnessed.[4]

One of the fundamental necessities of Nigerian Nuclear Regulatory Authority (NNRA) for a radiologic department to carry on dispensing ionizing radiation, be it diagnostic or therapeutic is an evidence of quality control program. Reject analysis is used as a quality indicator.[3]

Poor image film quality which are rejected by sorting radiographers and radiologist often end up been repeated[5], which is by far in contrast with the key principles in protecting an individual exposed to ionizing radiation viz; justification of radiological request, standardization of procedures and optimizing protection measures.[6]

Researchers have been carrying out studies to evaluate image quality and to find out possible causes of producing sub-optimal images in diagnostic facilities. In a report, which shows about 20% of x-ray examinations conducted in the United Kingdom in the year 2000, were clinically useless for the management of patients.[7]

Several studies have been conducted on rejected-repeated x-ray films at the department of Radiology, University of Maiduguri Teaching Hospital (UMTH) and in fact, in a recent study conducted by Sale, (2009)[8] showed that the repeat rate was 26.1% and has been stipulated to be less than 10% in a standard Radiology department.[3,9]

The aim of this study therefore was to analyze rejected-repeated plain x-ray films between April – December, 2011 which will serve as a quality indicator at University of Maiduguri Teaching Hospital (UMTH).

MATERIALS AND METHODS

A total of 7410 rejected films were acquired prospectively for a period of 9 months (April – December, 2011) and analyzed for their reasons of reject. These were obtained from the 3 conventional diagnostic rooms and stored in archives after granted consent by the research and ethic committee of the hospital.

The x-ray machines used for the 3 rooms were of the same making (***GE Rad-12/Diamond x-ray tube*** with an added filtration of **1.5mmAl, 0.6-1.2** focal spot size and a maximum tube voltage of **150kVp**) and make use of ***Agfa-gevaert*** (calcium tungsten screen, 200 speed) and ***Kodak X-omat cassette*** (rare earth screens 400 speed). The automatic processor used was ***Mediphot 903*** working for 90second at a temperature range of 33-38˚C.

All radiographs considered to be of poor diagnostic quality were collected and analyzed by the chief Radiographer and three other senior radiographers on a viewing box under same condition of room lighting and temperature. All data collected were recorded on a data captured sheet for reasons of reject for each of the diagnostic room.

Region of body examined included the skull, chest (Pediatric and Adult), extremities, spine, abdomen and pelvis. Reasons for the rejection included positioning errors, anatomical cut-off, artifacts (roller marks, static marks, dentures, weave-on, braziers, necklaces, ear-rings etc), exposure reasons (over, under and doubly exposed radiographs), rotation, fogging, blurring and others (unexposed processed films, absence of markers and poor breathing). Data was analyzed using SPSS 16 and descriptive statistics was used. Film reject rate was calculated using the formula below,

$$\text{Reject rate} = \frac{Number\ of\ films\ rejected}{total\ number\ of\ films\ used} \times 100$$

RESULTS

Chest radiograph has the highest number of requested projections with a total reject rate of (12.19%), followed by spine (5.33%), then sinuses (2.71%) and PNS having the least reject (0.30%) as shown in table 1 below.

The reasons of film reject in the study conducted were under exposure (36.21%), over exposure (24.28%), rotation (4.65%) and artifact (3.53) with the least common as motional blur (0.15%) as shown in table 2 below.

Table 3 shows the distribution of body part examined with their analogous reasons for reject in the period of study.

NB. A single radiograph can have more than one reason for been rejected and so the difference observed in the total number of rejected films in table 1 and the other tables below.

Table 1: Rate of Reject based on Radiographic Examination and the number of films used

Body parts	No. of films used	No of Rejected films	Reject rate (%)
Chest	4171	1557	12.19
Spine	2130	680	5.33
Sinuses	801	346	2.71
Lower limb	2199	266	2.10
Abdomen	848	241	1.89
Skull	786	237	1.86
Pelvis	235	158	1.24
Upper limb	1215	142	1.12
Mandible	327	76	0.60
PNS	65	38	0.30
Total	**12777**	**3741**	**29.34**

Table 2: General reasons of film reject at University of Maiduguri Teaching Hospital (UMTH) for the period of the study

Reasons	Rejected films	Percentages (%)
Under exposure	1527	36.21%
Over exposure	1024	24.28%
Cut off	924	21.91%
Rotation	196	4.65%
Artifacts	149	3.53%
Others	137	3.25%
Fogging	124	2.90%
Positioning error	92	2.19%
Double exposure	24	0.57%
Patients fault	15	0.36%
Blurring	6	0.15%
Total	**4218**	**100**

Table 3: Distribution of Body Parts Examined with their Corresponding Reasons for Reject

Reasons for Reject / Body part examined	P. E	P. F	C-O	Artefact	O.E	U.E	D.E	Fog	Rotation	Blur	Others	Total
Chest	9	10	405	40	410	686	9	69	74	3	26	**1741**
Spine	5	3	126	36	190	335	3	17	5	1	6	**727**
Sinuses	44	0	62	7	59	125	2	3	87	1	4	**394**
LL	4	0	33	12	121	109	0	3	6	0	3	**291**
Abdomen	1	2	95	21	70	90	3	8	0	0	1	**291**
Skull	7	0	102	7	62	61	4	15	22	0	92	**372**
Pelvis	9	0	42	15	61	29	1	5	0	0	1	**163**
UL	4	0	19	10	32	68	2	1	0	0	2	**138**
Mandible	5	0	28	1	19	24	0	3	2	1	2	**85**
PNS	4	0	12	0	0	0	0	0	0	0	0	**16**
Total	**92**	**15**	**924**	**149**	**1024**	**1527**	**24**	**124**	**196**	**6**	**137**	**4218**

Key:
P.E: Positioning error
P.F: Patients fault
O.E: Over exposure
U.E: Under exposure
D.E: Double exposure
LL: Lower limb
UL: Upper limb

DISCUSSION

Radiographs of diagnostic value show optimum definition and good image contrast, however maximum sharpness is obtained when movement, geometric and photographic blurring are kept uniformly low. A higher repeat rate reflects a serious fault in the equipment, technique or processing and this results in increase patient dose.[10]

In the study conducted, the reject-repeat rate was found to be 29.34% which is by far greater than the laid down World Health Organization criteria of 5%[11] and in another study, a reject rate should not be more than 10% in a standard Radiology department.[3,9]

The study revealed a high reject with chest x-ray having the highest value (12.23%) and majorly due to improper exposure factors (under exposure – 36.21% and over exposure – 24.28%) and mostly attributed to radiographers fault followed by anatomical cutoff. This is in congruent with the findings of Nwobi et al., 2008[4], Tabari et al., 2009[6] and Abdulsalam et al., 2004.[12] These faults noted had to occur due to reduced number of radiographers having to attend to large number of patients and the lack of quality control (QC) test on the processor which resulted in producing over or under processed films.[4]

Chest radiograph showed the highest number of both requested (4171) and rejected 1557 (12.19%) in the 3 conventional rooms which is in part as a result of the fact that most requested examinations were chest. This finding is also in agreement with the findings of Tabari et al., Patients who come for chest are either indicated with HIV/AIDS, TB, Metastasis, or patient on drainage procedures. These patients often come to the department frail and often difficult to assume the necessitated positions resulting in repeat.

The study also showed that the examination based on body part that is least requested was Post Nasal Space (PNS) with a total repeat of 38 (0.30%).

Other factors like anatomical cut-off, rotation and presence of artifacts also formed a significant reasons why films were rejected during the period of the study.

CONCLUSION

The overall reject rate was found to be 29.34% which is by far above the recommendation of WHO (5%) and CRCPD (5-10%). Radiographers fault (improper exposure factors) and equipment fault were the bulk of the reason for reject.

Recommendation

As part of recommendation, it is worthy to note that this study was conducted during the training period of students and intern radiographers which indicated their difficulties in exposure factor selection. Exposure chart were provided but inadequate technical skills and equipment fault contributed to the high reject rate observed.

Knowledge update and repair measures or purchase of newer automatic processors with episodic and/or frequent quality assurance program should be put in place which will aid in minimizing radiation exposures to patient, staff and the general public.

Servicing engineers should be made available and called upon whenever the need arises to have regular checks on the automatic processors and the x-ray machines.

Digital imaging systems will also transform and reduce the percentages of image rejects/retakes from 10-15 to 3-5%.[13]

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