PJ PALGO JOURNAL OF MEDICINE AND MEDICAL SCIENCE

ISSN 2476-8340
Volume 3 Issue 1,March,Page 38-41
http://www.palgojournals.org/PJMMS/Index.htm
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ANALYSIS OF REJECTED FILMS OF SELECTED EXAMINATION IN A TERTIARY RADIODIAGNOSTIC CENTER IN BENIN CITY, EDO STATE, NIGERIA.

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Accepted 22 March ,2016

A study involving a reject film analysis of rejected radiographs in the X-ray Department of a public teaching hospital in Benin City was conducted. The objectives of the study were to: evaluate image quality, determine the reject rate in conventional radiology procedures and ascertain the causes of defects on the rejected films. The authors collected rejected films for a period of three months using a multipurpose-designed data collection form. Film radiographs collected were sorted out in order of film sizes and examination types. Six different film sizes were used during this period and about 36 different X-ray diagnostic examinations were considered. A total of 8074 X-ray films were collected during the study period. 719 radiographs were rejected. Chest radiographs were the most frequently rejected accounting for (11.7%). The most frequently rejected size was the 24×35cm accounting for (28.1%). The most frequent cause of film rejects was due to exposure factor (41.6%).

Keywords: Rejected films, radiograph, radio-diagnoses, image quality.

INTRODUCTION

The discovery of X-ray has proved to be beneficial to man. These benefits have been greatly utilized for medical diagnostic and therapeutic purposes. The most widespread use of radiation in medicine remains diagnostic radiology which involves imaging with X-rays. It is generally accepted that irradiation for medical purposes is associated with some hazards but in most cases the benefit to patient outweighs any detrimental effects (Federal Office for Radiation Protection (FORP, 2012)). Biological effects of radiation can be grouped into deterministic and stochastic effect (Khong et al.,2013). Health physics is concerned with protecting people from the harmful effects of ionizing radiation while allowing its beneficial use in science, medicine and industry (Eze et al.,2008 and Alemu, 2005). An important goal in diagnostic radiography is to obtain radiographs of optimum diagnostic quality, reduce repeat exposures and optimize man hour. Unfortunately, certain factors either singly or in combination, make attainment of the much desired goal of obtaining radiographs of optimum diagnostic quality impossible in some instances. The production of high quality radiograph is an intricate process considering the high level of image quality required. Exposure of patients to X-ray, a key factor in the production of quality radiographs also involves some risks of radiation hazard. These risks become inevitable as patients are made to repeat radiation exposures as a result of rejection of film radiographs. A reject image is described as an image that does not provide diagnostic information to clinical questions because of low image quality and thus the image has to be retaken. Repeat rate is the percentage of images that have been repeated due to errors or poor image quality (Teferi et al., 2010). Correct film processing techniques are with minimum dose to patient (Eze et al., 2013). Factors impacting on image quality are radiographic contrast, processing of films, sharpness of images, patient movement, speed of systems, etc (Ofori et al., 2013). Reject analysis provides relevant information that would help achieve an effective reduction in radiation exposure and unnecessary cost, while proving acceptable image quality (Akintomide et al.,2010). Studies have shown that most radiographs are rejected because of wrong patient positioning, patient or equipment motion and also the selection of the wrong exposure factors (Akintomide et al.,2010

,Neill, 2000 and Luzanne, 2010).

MATERIALS AND METHODS

In this study, a quantitative comparative descriptive study involving the collection of rejected radiographs over a period of three months from December 2013 to February 2014 in the X-ray department of tertiary hospital where this study was carried out. A total of 8,074 films were collected on a weekly basis from four (4) X-ray rooms. The radiographs collected were sorted out in film sizes and types of examination. Six different film sizes were used during this period and about 36 different X-ray diagnostic examinations were noted. The rejected radiographs were grouped into the following categories for the purposes of film fault analysis: (1) Incorrect exposures: under exposure, over exposure, under penetration and over penetration (2) Personnel fault: Positioning, Collimation, Artefacts, Processing, dark room/storage, Fog (light, chemical or aging) and (3) Equipment: Faulty printer. Analysis of the results was done using descriptive statistics, tables, bar charts and percentage by sizes and frequency of film rejection. The film reject rate was calculated using (eq.1):

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

RESULTS AND DISCUSSION

The results obtained in this study are presented Tables 1-3. During the three months period of this study, data were collated and analysed as shown in Table 1. A Total of 8074 X-ray films were exposed and processed during the study period while 719 radiographs were rejected. The highest examination being chest X-rays (n=2000) and the lowest being Hysterosalpinogram (n=123). The chest X-rays (CX) has the highest rate of repeat (11.7%) in which 233 out of the 2000 CX examinations were retaken. The second highest rate of repeated examination is that of the cervical spine (CS) (9.8%) in which 84 examinations were retaken out of a total number of 850 CS examinations that was done. The third highest rate of film reject is that of the mammograms accounting for (9.7%) of total rejects in which 44 examinations were repeated out of a total of 450 examinations. The Pelvic has the lowest rate of reject accounting for 3.7% of total reject. The miscellaneous radiographs include bladder, intravenous urography (IVU), post nasal space (PNS), shoulder, thoracic spine, baby gram, finger, and unidentified radiographs.

Table 1: Rate of repeated examinations.

Radiographic examination	Number of films	Number of repeated films	Percentage (%) of repeated films
Chest	2,000	235	11.3
Lumbar spine	1,306	98	7.5
Cervical spine	850	84	9.8
Lower limbs	800	74	9.3
Skull	700	63	9.0
Mammography	450	44	9.7
Upper limb	349	20	5.7
Pelvic	531	20	3.7
Foot	200	18	9.0
Abdomen	146	11	7.5
Hysterosalpinogram (HSG)	123	11	8.9
Miscellaneous	619	51	8.2
Overall	8,074	719	8.9%

A radiograph can be rejected for several reasons, for the purpose of this study, film faults were classified into 6 groups namely; wrong exposure 299(41.6%), operators' fault 280(38.9%), mechanical equipment fault 49(6.8%), darkroom/storage 36(5.0%), processing 35(4.9%), patient motion 20(2.8%).The most frequent cause for film rejects was due to wrong exposures accounting for 299(41.6%) followed by operators' fault accounting for 280(38.9%). The lowest cause of film reject observed in this study is due to patient motion accounting for 20(2.8%). Table 2 gives a brief summary of the causes of film reject.

Table 2: Frequency of causes for film reject

Cause of reject	Number of films Rejected	Percentage rate (%)
Wrong exposure	299	41.6
Operators' causes	280	38.9
Mechanical equipment	49	6.8
Darkroom/Storage	36	5.0
Processing	35	4.9
Patient Motion	20	2.8
Total	**719**	**100**

Table 3: Causes of film reject in terms of film sizes.

Cause	35× 43cm	35× 35cm	30× 40cm	24× 30cm	18× 24cm	15× 40cm	Total
Positioning	10	11	13	41	18	2	95
Patient motion	4	8	1	5	2	-	20
Under exposure	12	5	12	16	12	4	61
Over exposure	21	11	21	15	-	5	73
Black film	4	2	7	3	-	-	16
White film	4	2	2	-	-	1	9
Fog darkroom	11	5	6	6	2	3	33
Fog cassette	-	-	-	-	-	3	3
Equipment	6	3	2	10	1	2	24
Collimation	24	22	11	30	13	6	106
Processing	3	6	6	17	3	-	35
Others	18	13	9	10	-	2	52
Artifact	6	6	3	6	6	-	27
Over penetration	23	22	5	13	3	2	68
Under penetration	24	24	6	30	10	3	97
Total	170	140	104	202	70	33	719

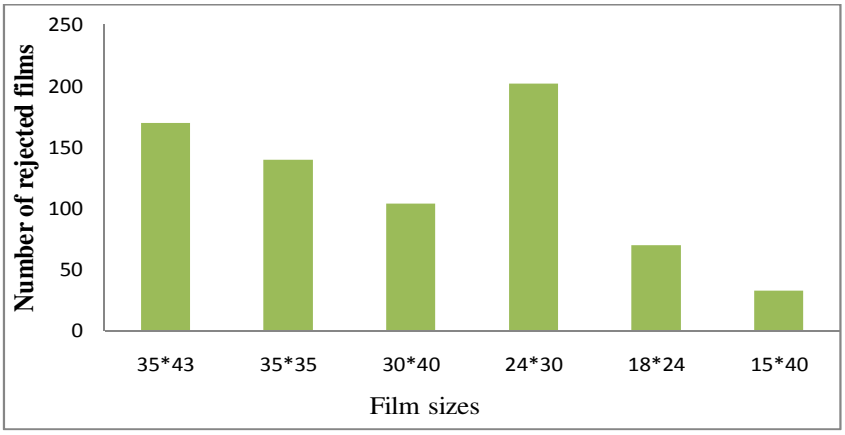

Fig.1: Number of rejects by film size

Six different sizes of radiographs were collected as shown in Table 3. A total of 719 films were rejected with the highest film size rejected being 24×30cm (28.1%) and the lowest being 15× 40cm (4.6%).Despite the high utilization of the 35×43cm and 35×35cm film sizes, the reject rates for these particular film sizes are lower with (23.6%) and (19.5%) respectively. This means that high film usage does not lead to high reject rate. Considering the frequency of

examinations rejected, chest radiographs were the most frequently rejected accounting for 233(11.7%).The results of the present study show that the overall reject rate was 8.9 % which is within the range of values obtained in the following publications; 8.87 % in Irrua (Edo State, Nigeria) (Eze et al., 2008), 9-13.2% in Germany (Lewentat and Bohndorf, 1997), 6.6-9.9% in UK (Weatherburn et al., 1999) and 6.4-15% in Norway (Gadeholt et al., 1989). The high frequency of rejected chest film was attributed to the chest being the most frequently performed radiographic examination. The most frequent film faults were those due to wrong exposures such as: under exposure, over exposure, under penetration and over penetration. Incorrect exposure selection, may also be classified as personnel error, since the incorrect setting of exposure factors by operators may produce a non-diagnostic radiograph. The other major factor in positioning, alignment and collimation errors is the light field or X-ray field misalignment. Another factor may be that the operators did not communicate to the patients the importance of maintaining the desired position whilst the radiograph is being taken. Lack of identification, markers, choice of film size, and the presence of artefacts may indicate a lack of concentration by the operators whilst performing X-ray examination. The presence of exposed films without images may indicate a confusion of the cassettes by the operators which can lead to increased staff work load, wastage of chemical and machine depreciation. Patient fault, although not frequent, included poor patient respiration, patient motion which accounted for 2.8% of the total film rejected.

CONCLUSION

Film repeat is important if the preceding film is of low quality or if the film does not provide the necessary radiographic criteria for diagnosis. It is desirable to reduce the rate of film repeat hence the exposure to unnecessary radiation and the associated cost of service and wastage of resources. It is recommended that causes for film rejects identified in this study suggest regular continuing professional trainings with respect to radiographic technique for operators. The hospital management should consider starting quality assurance programme so that, factors adversely affecting ALARA principles can be identified for appropriate corrective measures.

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