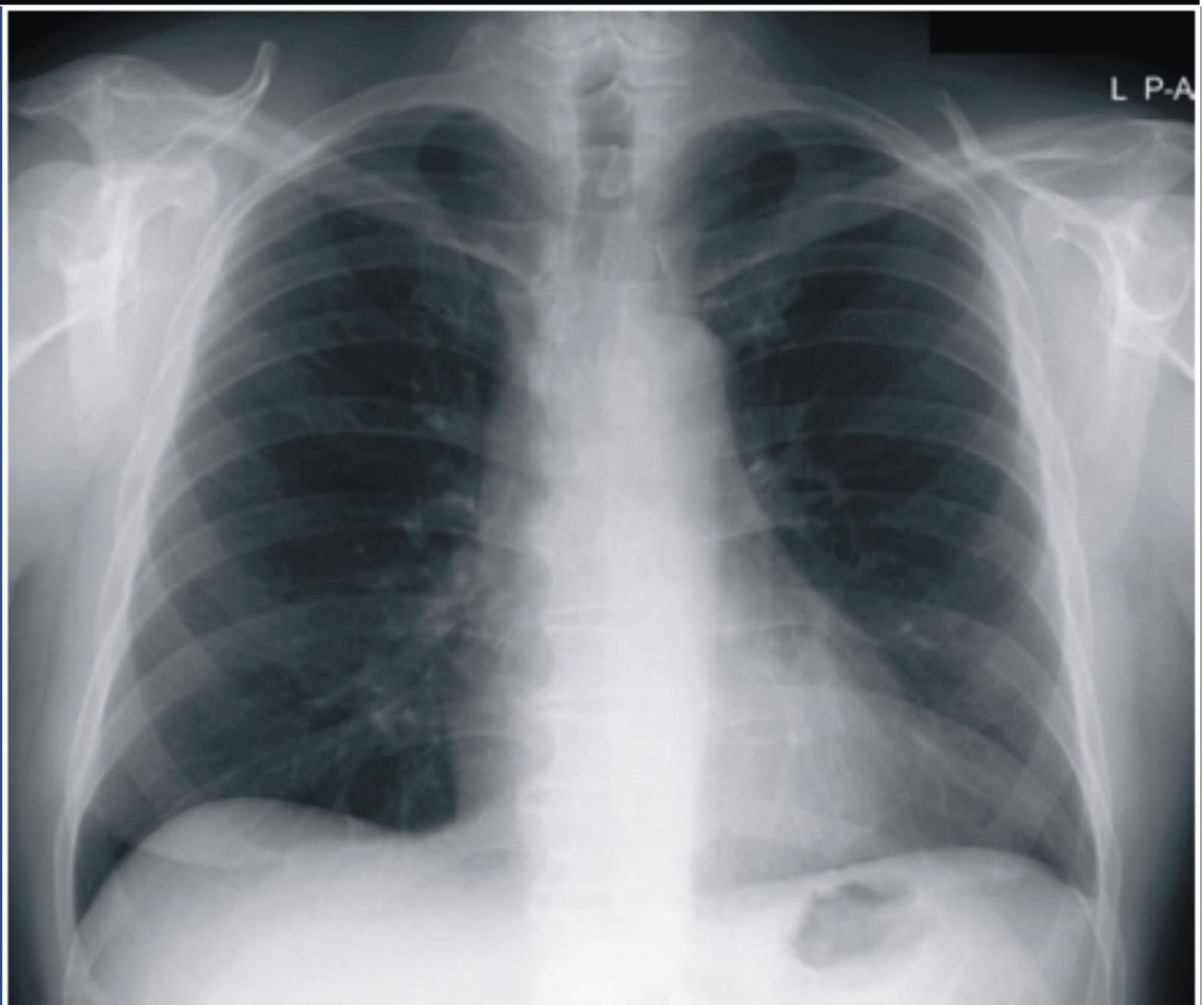
The Association Of Radiographers Of Nigeria
EYE OF MEDICINE

JOURNAL OF THE ASSOCIATION OF RADIOGRAPHERS OF NIGERIA

ISSN: 1115- 7976 Vol 31, Issue 1, November, 2017

The Official Journal of The Association of Radiographers of Nigeria

J A R N



Journal homepage: www.jarnigeria.com

X-Ray Film Reject Analysis as a Quality Indicator in a Tertiary Health Centre in Northwestern Nigeria

Sadiq Abubakar Audu[1], *Miftaudeen Mutiat Nike[2], Ibrahim Rumaysa[3], Mohammed Abacha[1], Umar Abubakar[1], Muftaudeen Basirat[4]

[1] Department of Radiography, Faculty of Clinical Sciences, College of Health Sciences, Usmanu Danfodiyo University Sokoto, Nigeria

[2]Department of Radiotherapy, Usmanu Danfodiyo University Teaching Hospital, Sokoto, Nigeria

[3]Department of Radiology, Usmanu Danfodiyo University Teaching Hospital, Sokoto, Nigeria

[4]Department of Radiology, Kwara State Specialist Hospital (Sobi), Nigeria.

Corresponding author: bintmif@gmail.com**;** +2348094856032

Received: 15, June 2017. Received in revised form: 18 September, 2017. Accepted 16 October, 2017

ABSTRACT

Objective: To assess the rate of rejects in routine radiography as a quality control measure. **Methods:** Retrospective study was carried out on radiographs obtained from two conventional diagnostic rooms of the Radiology Department at Usmanu Danfodiyo University Teaching Hospital, Sokoto, for a period of six months (July-December 2016). All rejected radiographs were analyzed under uniform viewing conditions. All images with good diagnostic quality, those carried out for special examination and mammograms were excluded. Data were collected and entered into database for analysis.
Results: The overall reject rate was found to be 16.4% with chest contributing the (7.1%). The major cause of reject was inappropriate collimation (18.1%).
Conclusion: A total of 16.4% reject was noted in the study conducted, which was above the recommended level given by World Health Organization (WHO).
Keywords; X-ray film, reject film,, quality assurance, quality Control.

Introduction

X-rays are used to expose patient body parts for the purpose of diagnoses in radiology department in which case both the patient and staff involved are irradiated to unpredictable levels of radiation doses [1]. Good image quality warrants selecting adequate exposure factors, thus decreasing these factors only compromises the radiographic procedure as a whole. Quality assurance and control programs aims at producing images of good quality for diagnostic purposes [1, 2].

The main objective of quality assurance (QA) program is to produce x-ray films of uniform diagnostic quality [3]. Quality control (QC) procedures are procedures that are either used in testing or monitoring and/or maintaining radiological equipments. Patients x-ray films therefore, serve as quality control check and are considered as a routine part of assessment program [4]. Film reject analysis arises as a result of the ardent need to identify errors involved in rejecting and retaking patient image for diagnostic quality purposes which often subjects them to excess radiation doses at extra cost.

Reject analysis serves to checkmate image retakes so as to checkmate over irradiation of patients. It is indeed considered as an important quality control tool [1].

X-ray film is still in use for various radiological procedures at Usmanu Danfodiyo University Teaching Hospital. It is a known fact that any examination utilizing ionizing radiation can predispose patients to various radiation risks. Some of these risks may manifest after decades (stochastic response) while others will be immediate manifestation (non-stochastic/ deterministic response) [5, 6].

Rejecting and repeating x-ray films that has no or low diagnostic value will result to further irradiation to patients and radiation personnel [1,7]. Exposure to little amount of radiation also expose patients to long-term health hazards like radiation-induced genetic effects (mutation), leukemia, and cancer (lung, breast, thyroid, bone, prostate, liver, esophageal, cervix, pancreas, colon, head & neck e.t.c) according to the Linear-No-Threshold (LNT) model. These biological effects randomly occur in even a single radiation exposure at any dose. There is no safe dose for a stochastic effect [5,8].

Cancer, being one of the deleterious hazards of radiation exposure as stated by the LNT model, is one of the leading causes of death in Africa, especially in Sub-sahara region [9-11]. Other effects of radiation exposure like skin erythema, infertility, and cataract are unlikely to occur at the diagnostic level, but often observed at large amount of exposure to radiation at a time [2]. Other schools of thought have available and accessible experimental and epidemiological evidences that assume that adaptive/protective mechanisms can be stimulated by low-dose radiation, which can prevent both spontaneous and toxicant-related cancers as well as other adverse health effects. The more recent theory stated that 'radiation exposure benefits tend to outweigh the detriments, for doses within the protective zone' [12].

Implications of reject/repeat films arouse substantial concern. This includes wastage of 'Image acquisition' resources, tangible time and energy; resulting in low patient out-put, increase patient waiting-time and decrease in generated revenue for the management [13].

Nigerian Nuclear Regulatory Authority (NNRA) mandated a quality control program (one of which is reject analysis) as a fundamental necessity for Radiology departments [15]. This is to ensure safety of staff and patients from possible radiation hazards. The researchers of this study realized that reject/repeat analysis has not been carried out for years in this centre, thus, the need for the study.

The aim of the study is to delineate causes of reject/repeat films in order to come up with solution(s) that will improve staff efficiency, service delivery, dose optimization and generated revenue. Hopefully LNT hypothesis on 'low-dose risk' will be reconsidered for scientific validity.

Material and Methods

A total of 287 rejected films were accumulated retrospectively for a period of 6 months (July – December, 2016) and scrutinized to ascertain the the reasons for reject. The films were obtained from the 2 conventional diagnostic rooms of Radiology department, Usmanu Danfodiyo University Teaching Hospital, Sokoto State of Nigeria.

The x-ray machines used for the 2 rooms were from the same manufacturer (GE Rad-12 x-ray tube with an added filtration of 1.0mmAl, 0.6 focal spot size and a maximum and minimum tube voltage of 150kVp and 40kVp, 0.5-25.2 mAs and make use of Agfa-gevaert (calcium tungsten screen, 200 speed) and Mediphot cassette (rare earth screens 400 speed). The automatic processor used was Colenta 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 three experienced radiographers working collectively on a viewing box under same condition of room lighting and temperature. Data collected were recorded on a data capture sheet.

Data was analyzed using descriptive statistics. Film reject rate was calculated in percentage using the following formula:

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

Result

The overall reject rate for the period of study was calculated to be 16.4%. Chest x-rays had the highest number of both request (750) and rejected (126), respectively and with a reject rate of 7.1%. This was followed by spine, lower limb and skull. The least requested and rejected procedure was PNS with a reject rate of 0.1% as shown in Table 1.

No collimation (amongst other reasons for reject) ranked the highest with a percentage rate of 18.1% for reasons in which x-ray films were rejected; closely followed by over exposure, under exposure, no or improper marker, anatomical cut-off and rotation. The least reason for reject was positioning error with a reject rate of 0.3% as shown in Table 2.

Table 3 shows body part examined with their corresponding reasons for reject, in which case, anatomical cut-off had the highest followed by over exposure, then under exposure, followed by improper/no marker. Positioning error showed the least occurring reason for reject.

It is to be noted that the discrepancy noted in the total number of rejected films in Tables 2 and 3 was due to the absence of the column for unexposed processed film with a total of 9 films in Table 3 but existing in Table 2. This was not included because the films were only exposed to either white light or to x-rays and as such no body part was involved and therefore, they were not classified as seen in Table 3. Table 4 shows how the value in this study varies from previous studies. Reject rate in Northern Nigeria is seen to be very high, followed by that of Ghana. Other parts of the world have an acceptable reject rate.

Discussion

Reject/Repeat analysis is one of the quality control (QC) necessary to be carried out regularly in a standard Radiology Department as recommended by NNRA [15].

The present study returned a reject rate of 16.4% which is higher than the recommended value for a standard Radiology department; 5% - 10% as stated by WHO and CRCPD [13,20]. The cause of high reject rate in Nigeria can be associated with the use of manual/automatic processors, inadequate update of skill for Radiographers and shortage of competent radiographers.

No collimation (amongst other reasons for reject) constituted the highest reason for repeat. The cause of which can be associated with inexperienced personnel (students and intern) carrying out the exposure without supervision (due to Radiographers acute shortage). Improper selection of exposure factors that result in either over- or under-exposure ranked the second highest reason for reject/repeat (16.3% and 13.6% respectively) which could also be due to the same reason above, misalignment of x-ray tube and lack of regular quality control program. Absence of or improper marker and anatomical cut-off as reasons for reject had comparable values of 12.9% and 12.4%, respectively.

Rotation, poor breathing, motion blur could be as a result of communication barrier between patients and radiographers, worn out or old x-ray machine in use. Lack of regular QC can be linked to fogging, chemical stain and roller marks. Chest x-ray has the highest value of reject repeat (750 used films, 125 reject with 293 causes) at the rate of 7.1%. Being one of the vital examinations for

routine check-ups for numerous clinical investigation like medical fitness, pre-operative, cancer, hypertension, HIV/AIDS, TB, amongst others, it is expected to have the highest request, which is in tandem with other studies [14-19]. The common causes of reject are no-collimation, improper exposure factors and rotation. These can be associated with personnel error, severity of patient disease condition, patient age (pediatric and geriatric) and inadequate communication with patients prior to examination.

Table 1: Rate of reject based on radiographic examination and number of films used

Body part	Number of films used	Number of rejected films	Reject rate (%)
Skull	120	21	1.2
Sinuses	46	8	0.5
Mandible	43	8	0.5
PNS	3	1	0.1
Spine	408	67	3.8
Chest	750	126	7.1
Abdomen	80	13	0.7
Pelvis	70	12	0.7
Upper limb	60	7	0.4
Lower limb	188	24	1.4
Total	**1768**	**287**	**16.4**

Table 2: Reasons for film reject

Reasons	Rejected films	Percentages (%)
No collimation	122	18.1
Over exposure	110	16.3
Under exposure	92	13.6
No/improper marker	87	12.9
Anatomical cut-off	84	12.4
Rotation	52	7.7
Fogged	46	6.8
Artifact	22	3.3
Poor breathing	17	2.5
Inadequate/chemical stain	14	2.1
Blurring	10	1.5
Unexposed processed	9	1.3
Doubly exposed	4	0.6
Roller marks	4	0.6
Positioning error	2	0.3
Total	**675**	**100**

Table 3: Distribution of body part examined with their corresponding reasons for reject

	Reasons for reject														
Anatomy examined	**NC**	**OE**	**UE**	**I/NM**	**ACO**	**R**	**FOG**	**ART**	**PB**	**Ch S**	**B**	**DE**	**RM**	**PE**	**TOT**
Skull	5	8	8	3	4	6	6	9	-	2	-	-	-	1	52
Sinuses	5	8	-	6	2	-	5		-	-	-	4	-	-	30
Mandible	-	4	-	7	7	-	5	2	-	6	2	-	-	-	33
Pns	2	-	1	4	-	8	1		-	-	-	-	-	-	16
Spine	1	25	30	22	34	-	6		-	-	8	-	-	-	126
Chest	99	37	30	28	25	30	16		17	6	-	-	4	1	293
Abdomen	10	14	7	10	2	-	7	6	-	-	-	-	-	-	56
Pelvis	-	7	10	-	2	8	-	5	-	-	-	-	-	-	32
UL	-	3	3	5	5	-	-		-	-	-	-	-	-	16
LL	-	4	3	2	3	-	-		-	-	-	-	-	-	12
Total	122	110	92	87	84	52	46	22	17	14	10	4	4	2	**666**

Key:
NC: no collimation; **OE:** over exposure; **UE:** under exposure; **I/NM:** improper/ no marker; **ACO:** anatomical cut-off; **R:** rotation; **PB:** poor breathing; **Ch S:** chemical stain; **B:** blur; **DE:** double exposure; **RM:** roller mark; **PE:** positioning error; **Tot:** total

Table 4: Comparison of reject rate with earlier studies

S/N	Study	Year	Reject Rate (%)	Place of Study
1.	Present Study	2017	16.4	Sokoto, Nigeria
2.	Sadiq et al. [14]	2017	29.34	Maiduguri, Nigeria
3.	Owusu-Banahene et al.[1]	2014	14.1	Accra, Ghana
4.	Ofori et al. [12]	2013	19.4	Ghana
5.	Jabbari et al. [6]	2012	7.20	Umia, Iran
6.	Nwobi et al [15]	2011	24	Maiduguri, Nigeria
7.	Osahon et al [16]	2016	8.9	Benin, Nigeria
8.	Teferi et al. [17]	2010	3.1	Addis Ababa, Ethiopia
9.	Eze et al. [18]	2008	8.86	Edo, Nigeria
10.	Abubakar et al. [19]	2015	26.04	Maiduguri, Nigeria

Conclusion

This retrospective study shows a reject rate 16.4%. Implications are increase patient waiting time, decreased revenue and low patient out-put. The common causes of reject/repeat are lack of collimation and improper exposure factors, both due to radiographers error or lack of QC program for equipment and processor.

Recommendations

Installation of computed radiography (CR), regular QC/QA activities on all equipments, quarterly repeat analysis program, continuous professional development (CPD) for radiographers and strict supervision of students and intern radiographers are some of the possible ways of reducing the number of rejected radiographs.

Conflict of interest and sponsorship: Nil

References

1. Owusu-Banahene J., Darko EO., Hasford F., Addison EK., Okyere AJ. Film Reject Analysis and Image Quality in Diagnostic Radiology Department of a Teaching Hospital in Ghana. *Journal of Radiation Research and Applied Sciences*. Available online @ http://dx.doi.org/10.1016/ j.jrras. 2014.09.012
2. International Commission on Radiological Protection. Recommendation of the International Commission on Radiological Protection. Oxford, UK: Pergamon Press 1990.
3. Geijer H., Beckman KW., Andersson T & Persliden J. Radiation Dose and Image Quality with a Flat Panel Amorphous Silicon Digital Detector. *European Radiology, 2001; 11(2 suppl. 1), S280.*
4. Almen A., Loof M., & Mattsson S. Examination technique, Image Quality and Patient Dose in Pediatric Radiology: A survey including 19 Swedish Hospitals. *Acta Radiologica,* 1996. Pp. 337-342
5. Saia D.A. Radiography Prep. 5th ed. NY: McGraw-Hill (2009), Pp. 231-252.
6. Jabbari N., Zeinali A., Rahmatnezhad L. "Patient Dose from Radiographic Rejects/repeats in Radiology centers of Urmia University of Medical Sciences, Iran" *Health* (2012), 4. Pp. 94-100. *1 Jan.,2017*<http://dx.doi.org/10.4236/ health. 2012.42015>
7. Yousef M., Edward C., Ahmed H., Bushara L., Hamdan A., Elnaiem N. "Film Reject Analysis For Conventional Radiography In Khartoum Hospitals" *Asian Journal of Medical Radiological Research* (2013), 1(1).
8. World Health Organisation, "Cancer Mortality and Morbidity" Global Health observatory (GHO) Data, 2016. www.who.int/entity/gho/en
9. Ahmedin J., Freddie B., David F., Meg O., Jacques F., Melissa C. and Maxwell D.P., "Cancer Burden in Africa and Opportunities for Prevention". *Cancer* (2011). *11 Jan., 2017* <www. Wiley online library.com
10. Abdulkareem F. "Epidemiology and Incidence of Common Cancers in Nigeria". Cancer Registration and Epidemiology Workshop (2009).
11. Vaiserman A. M. "Radiation Hormesis: Historical Perspective and Implications for Low-Dose Cancer Risk Assessment" *Dose-Response* (2010), 8. Pp. 172–191.
12. Ofori K.E., Antwi K.W., Arthur W., Yeboah A.C., Tetty D.K. "Analysis and Economic Implications of X-ray film Repeat/reject in Selected Hospitals in Ghana". *West African Journal of Radiology* (2013), 20 (1). Pp. 14-18. *Jan.11,2017.*<www.wajradiology.org/ searchresult>
13. Conference of Radiation Control Program Directors (CRCPD), 2009. Quality assurance collectible (QA Collectible), Sponsored by CRCPD committee on quality assurance in diagnostic x-ray (H-7), repeat analysis.
14. Sadiq A.A., Miftaudeen M.N., Mohammed A., Akpaniwo G.M., Girei A., Garba I., Nwobi IC. "Reject-Repeat Analysis of Plain Radiographs as a Quality Indicator at

University of Maiduguri Teaching Hospital (UMTH)" *European Journal of Pharmaceutical and Medical Research (*2017), 4(2). Pp. 188-191.

15. Nwobi I. C. , Agwu K. K. , Garba I. , James P. "Analysis Of Rejected Films at the University Of Maiduguri Teaching Hospital (UMTH)" *Nigerian Journal of Medical Imaging and Radiation Therapy (*2011), 1(2). Pp. 23-26.
16. Osahon O.D., Asemota O. I., Olajide B. O. and Igbinovia O. J. "Analysis of Rejected Films of Selected Examination in a Tertiary Radio-diagnostic Center In Benin City, Edo State, Nigeria." *Palgo J.Med.Medical Sci. (*2016) 3(1). Pp. 38-41. *Jan. 11*, 2017 <http://www.palgojournals.org/PJMMS/Index.htm>
17. Teferi S., Zewdneh D., Admassie D., Nigatu B., Kebeta K. "X-ray film Reject Rate Analysis at Eight Selected Governmental Hospitals in Addis Ababa, Ethiopia, 2010". *Ethiop.J. Health Dev. (*2012), 26(1). Pp.54-59. *March 29, 2017* <www.ajol.info>
18. Eze K.C, Omodia N, Okegbunam B., Adewonyi T., Nzotta C.C. "An Audit of Rejected Repeated X-ray Films as a Quality Assurance Element in a Radiology Department" *Nigerian Journal of Clinical Practice, (*2008), 11(4). Pp. 355-8. *March 29, 2017* www.ncbi.nlm.nih.gov
19. Abubakar A., Muhammad I.G., Gunda N.M, Nwobi I.C., Yusuf M., Luntsi G., Muhammad G.M., Shettima A.B. "Assessment of X-ray Film Reject Rate in Two Tertiary Healthcare Institutions in Northeastern Nigeria" T*he International Journal of Science & Technoledge, (*2016), 4(8). Pp. 54-56. *March 29, 2017* <www.theijst.com>
20. World Health Organization (WHO). Workshop on Quality Assurance in diagnostic Radiology, Geneva, October 1980 (20-24).

How to cite: Sadiq AA, Miftaudeen MN, Ibrahim R, Mohammed A, Umar A, Muftaudeen B. X-Ray Film Reject Analysis as a Quality Indicator in a Tertiary Health Centre in Northwestern Nigeria. J Assoc Rad Niger, 2017; 31 (1): 38 – 44