Original Research Article

Assessment of the Quality of Plain Postero-Anterior Chest Radiographs Seen in a North-West Nigerian Tertiary Hospital

ABSTRACT

Objectives: *To determine the quality of chest radiographs of adult patients x-rayed at Usmanu Danfodiyo University Teaching Hospital (UDUTH) in accordance with Committee of European Commission (CEC) guidelines on quality criteria and to determine the most common factor that affects the radiographs.*

Materials and methods: *The data was collected retrospectively from the hospital archives using a data capture sheet.*

Results: A total of *266 radiographs were assessed and the age of patients whose radiographs participated in the study ranged from 20-80years. Also, a greater number of male patients 147(55.3%) participated in the study than female patients 119(44.7%). Results from the study revealed that 194(72.93%) and 225(84.59%) radiographs had correct placement of patient details and anatomical marker respectively. Adequate inspiration was achieved in 223(83.83%) radiographs with presence of artifacts seen in only 17(6.39%) radiographs. Thrown-off scapulae out of lung fields was seen in 174(65.41%) radiographs while adequate penetration was demonstrated in 209(78.57%) radiographs. Fog was seen in 16(6.02%) radiographs and rotation was recorded in 86(32.33%) radiographs. Additionally, blurring and darkroom processing faults affected*

9(3.38%) and 42(15.79%) radiographs respec. The most common cause of poor quality chest radiographs was found to be inadequate collimation affecting 110(41.35%) radiographs.

Conclusion: *In terms of overall quality, only about 41(15.41%) radiographs met all criteria for a standard chest radiograph according to committee of European commission.*

NUMBER SECTIONS ACCORDINGLY

1.0 INTRODUCTION

1.1 Background of the study

Chest radiography is the most common examination used as one of the initial steps to diagnose pulmonary disease, including respiratory infections (Eugene and Robin, 2010) [1]. The role of chest radiography has gained increased importance in trauma cases, routine check-ups, disease conditions and metastatic problems. The rationale behind this study is that many faulty diagnoses by chest radiography, may be associated with inappropriate radiological techniques and application, and that improvement of imaging quality of chest radiography benefits not only the patients infected by disease, but also those suffering from various pulmonary diseases. In terms of detection and treatment of pulmonary diseases, poor imaging quality may be more harmful to patients than having the patients not diagnosed through x- ray procedures . Chest radiograph with poor image quality can cause misdiagnoses or require repeated examinations, wasting economic resources and exposing patients to unnecessary radiation. Conversely, providing high quality image of chest radiograph benefits anyone who will be examined by x-ray, and the precise control of these x-ray images is an important task for the radiographers.

Quality assurance (QA) refers to the planned and systematic activities implemented in a quality system so that quality requirements for a product or service will be fulfilled

(Gloria and Hani, 2012) [2]. It is the systematic measurement comparison with a standard, monitoring of processes and an associated feedback loop that confers error prevention. Quality assurance in chest radiography is a system designed to continuously improve the quality of chest radiographs at a health facility, and it can be achieved through organized efforts by all staff members involved in taking or reading the chest radiograph. It comprises quality control, quality assessment, and quality improvement (Noha, 2015) [3]. Quality control includes all quality control efforts routinely performed by staff at each health facility such as regular maintenance or checking of x-ray equipments, accessory devices, chemicals and consumables.

3.0 **2.0** MATERIALS AND METHOD.

A retrospective descriptive study design was used for the study. A secondary data source was adopted which was recorded using data capture sheet. The data were obtained from the archives of Radiology department of Usmanu Danfodiyo University Teaching Hospital (UDUTH) and were selected based on convenience. The data were obtained by examining the patients' chest radiographs.Seven hundred and ninety four (794) radiographs of patients that underwent chest radiography from january 2017 to may 2018 at UDUTH were collected.

A convenient sampling technique was used for the study with Taro Yamane's formula used for sample size determination which was 266. Postero-anterior chest radiographs of adults were included. All other projections of adult and paediatric cases were excluded. Data was collected via patients' chest radiographs and information like sex and age were recorded. Standard criteria according to the committee of European commission (Okeji *et al.*, 2017) was used to assess the radiographs.

Data was analysed using descriptive statistics mainly percentages and the data were presented using tables, bar and pie charts. Ethical approval was obtained from ethical clearance committee of Usmanu Danfodiyo University Teaching Hospital, Sokoto.

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3.0 RESULTS

A total of 266 chest radiographs were assessed out of which 147 were for male patients (55.3%) while 119 were for female patients (44.7%). This information is captured in table 4.1 3.1

Age distribution of patients as shown in table 4.2 3.2 revealed the age range of patients that participated in the study with age range of 20-35 having the highest participation with 107 radiographs (40.23%) while age range of 66-80 had the lowest participation with 12 radiographs (4.51%).

Table 4.3 above shows the image criteria used in assessing the radiographs with number of radiographs in each criteria marked as ‘Yes’ for positive and ‘No’ for negative. It shows that anatomical coverage occurred more across all respondents with 243 radiographs demonstrating good anatomical coverage(91.35) while presence of blurring occurred less with 9 radiographs been blurry(3.38).Figure 4.1 is a bar chart showing the percentages of radiographs for each criteria with blue depicting ‘Yes’(positive) and ‘No’ depicted by red colour.

The major causes of poor quality affecting all radiographs studied are shown in table 4.4.Inadequate collimation was the highest among the major causes of poor quality affecting 110 radiographs (41.35%) while inadequate penetration was the lowest affecting 57 radiographs (21.43%).

Finally, information on criteria met by radiographs as a measure of quality are highlighted in table 4.5. Only 41 radiographs representing 15.41% met all criteria according to European guidelines on quality of chest radiographs while the remaining 84.59% did not. This is demonstrated in figure 4.2.

Table 4.1: Gender distribution of patients

Gender	Number(N)	Percentage(%)
Male	147	55.3
Female	119	44.7
Total	266	100

Table 4.2: Age distribution of patients

Age range	Number(N)	Percentages
20-35	107	40.23
36-50	97	36.47
51-65	50	18.79
66-80	12	4.51
Total	266	100

Table 4.3: Radiograph criteria

Criteria	Yes (%)	No (%)	Total (%)
Patient details	194(72.93)	72(27.07)	266(100)
Anatomical marker	225(84.59)	41(15.41)	266(100)
Anatomical coverage	243(91.35)	23(8.65)	266(100)
Full inspiration	223(83.83)	43(16.17)	266(100)
Presence of artifact	17(6.39)	249(93.61)	266(100)
Scapulae out of lung fields	174(65.41)	92(34.59)	266(100)
Adequate penetration	209(78.57)	57(21.43)	266(100)
Fog	16(6.02)	250(93.98)	266(100)
Rotation	86(32.33)	180(67.67)	266(100)
Blurring	9(3.38)	257(96.62)	266(100)

Adequate Collimation	156(58.65)	110(41.35)	266(100)
Darkroom processing faults	42(15.79)	224(84.21)	266(100)

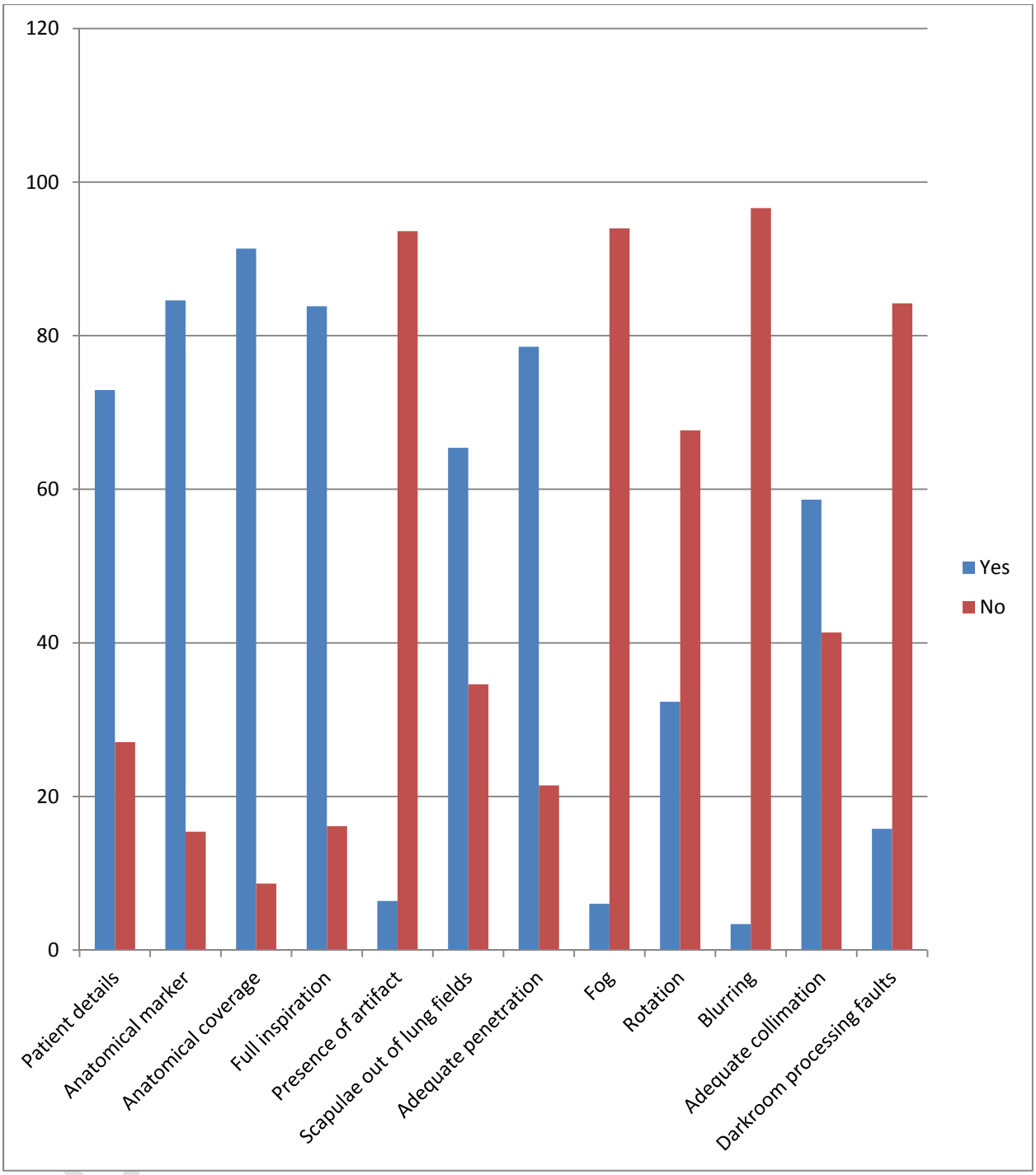

Figure 4.1: Image criteria

Table 4.4: Major causes of poor quality radiographs

Causes of poor quality	Percentages (%)
Inadequate collimation	41.35
Scapulae out of lung fields	34.59
Rotation	32.33
No patient details	27.07
Inadequate penetration	21.43

Table 4.5: Criteria met by radiographs

Number of radiographs	Number of criteria met	Percentages
41	12	15.41
45	11	16.92
72	10	27.07
50	9	18.80
32	8	12.03
17	7	6.39
7	6	2.63
2	5	0.75
Total 266		100

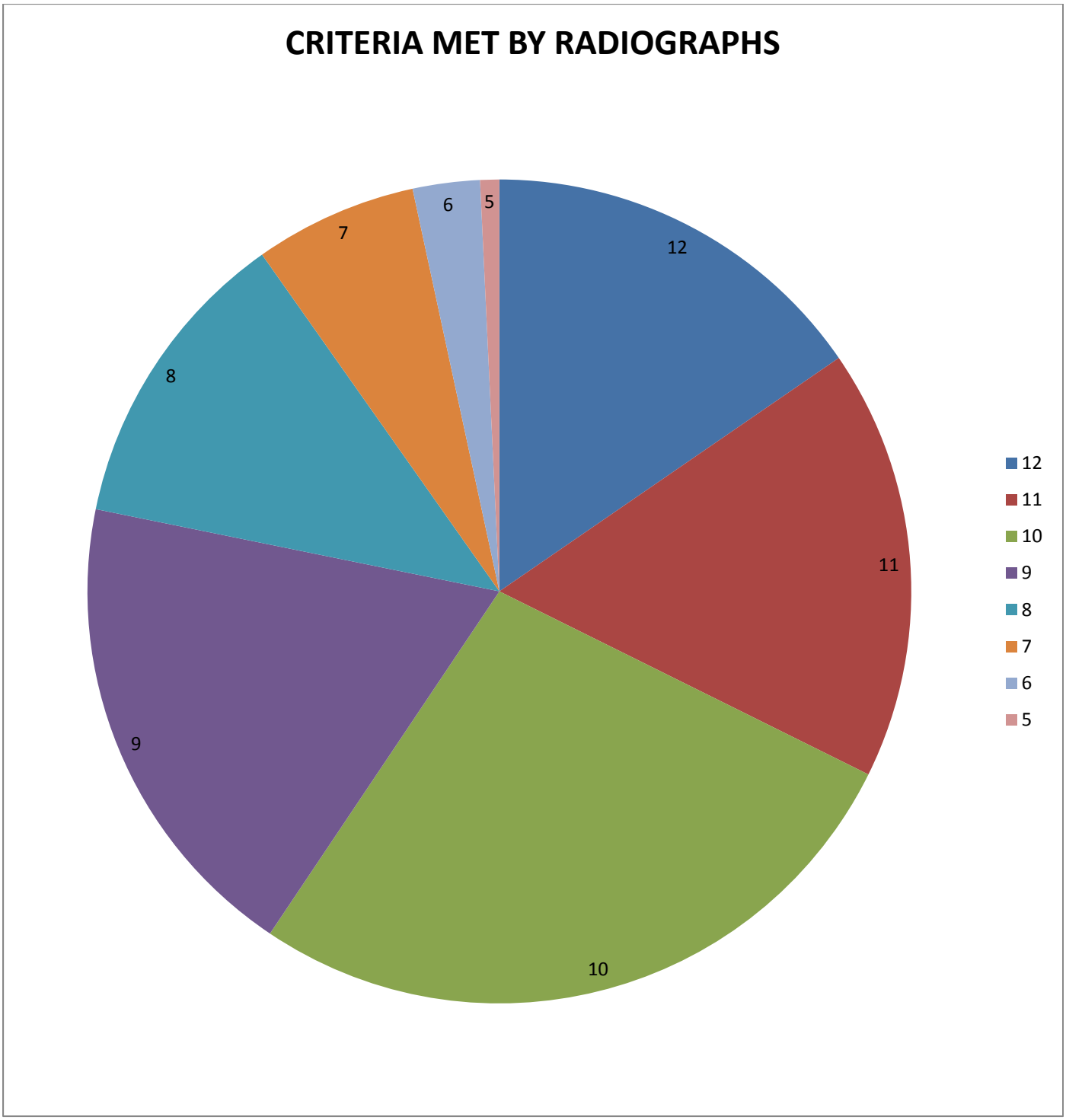

Figure 4.2: Criteria met by radiographs

CHAPTER FIVE

5.0 4.0 DISCUSSION

This study has assessed the quality of postero-anterior chest radiographs using the radiographs of patients obtained from the archive of the department of diagnostic radiology, Usmanu Danfodiyo University Teaching Hospital, Sokoto. The assessment was made with 12 criteria for assessing the quality of chest radiographs according to committee of European commission (CEC) guidelines.

The male patients appeared to be in larger number than female patients during the time of the study. All the chest radiographs used in this work, consists of patients whose age ranges from 20years to 80years, and the radiographs assessed were of examinations performed in the erect postero-anterior position.

Findings from this study revealed that the major cause of poor quality radiographs was inadequate collimation which was seen in 41.35% of radiographs. This is in line with similar studies conducted by Okeji *et al* and Muhammad *et al.* The purpose of collimation is to protect the patient from unnecessary radiation by limiting the beam field to the anatomy of interest, thereby reducing the volume of tissue irradiated. Poor collimation increases the radiation dose to the patients, evoking possibility of stochastic effects of radiation. Poor collimation here can be attributed to radiographers not paying due attention to radiation protection, probably to avoid repeats in case of cut-off. It could also be as a result of inexperience on the part of some of the interns in the department.

Another major cause of poor quality identified was inadequate throw-off of the scapulae seen in 92 radiographs (34.59%). This is in agreement with a study conducted by Okeji *et al* (37.5%).It is important for the scapulae to be thrown-off the lungs field for a good quality chest radiograph to be achieved. It was found that the radiographers found it difficult to rotate the shoulders of sick elderly patients. Another cause of poor throw-off of the scapulae could be attributed to lack of proper instructions given to patients as well as patients shifting in between positioning and exposure. It could also be attributed to the nature of the patient particularly obese patients.

Rotation was another major factor that contributed to poor quality radiographs in this study which was noticed in 86 radiographs (32.3%).This was a similar finding in researches conducted by Mohammed *et al* (35.3%). Okeji *et al,* Ugwuanyi *et al* as well as Chand *et al* in their respective studies also reported rotation as a major cause of poor quality radiographs. The medial ends of clavicle must be equidistant from the spinous process according to CEC guidelines for a radiograph to be devoid of rotation. Faults could be from improper positioning or improper instructions given to patients. Condition of the patient also predisposes to rotation as is the case in geriatric patients as well as very sick patients.

Another major cause of poor quality obtained from the research was lack of patient details on 72 radiographs (27.07%) studied. This is contradictory to findings by Ugwuanyi *et al.* Improper identification can be attributed to radiographers and darkroom technicians negligence in ensuring correct placement of patient details on each radiograph processed. This could lead to mix-up and loss of patients' radiographs leading to misdiagnosis and to repeats thereby adding to patient dose respectively.

Also, inadequate penetration was observed in 21.43% of radiographs studied. This was in line with findings by Ugwuanyi *et al* (26.7%), Chand *et al (24%),* and Okeji *et al* (28%). The major cause of inadequate penetration is underexposure as demonstrated by ill-defination of lower intervertebral disc below 9^{th} thoracic vertebra. This could result in the radiograph being repeated adding unnecessary radiation dose to the patient and incurring unnecessary cost to the department.

Finally, in terms of the overall quality of all the radiographs studied according to committee of European commission (CEC) recommendations, only 41(15.41%) radiographs met all the 12 criteria which is also a similar result obtained by Okeji *et al.*

Also, 45 (16.92%), 72(27.07%), 50(18.80%), 32(12.03%), 17(6.39%), 7(2.63%), and 2(0.75%) radiographs met 11, 10, 9, 8, 7, 6,and 5 criteria respectively meaning that about 84.59% radiographs did not meet all the recommended criteria.

CONCLUSION

The study reports that some of the posterior anterior (PA) chest radiographs studied, had rotations, as indicated by the medial ends of clavicles, not equidistant from the spinous process of the vertebral column.

It has been shown that good scapula throw-off was seen in the research work. Again, identification markings of the radiographs, as well as placement of marker were good, albeit some significant number of radiographs, had no identification or anatomical marker placed.

The most common fault affecting the radiographs studied was inadequate collimation with majority of radiographs having either silver lining in less than 3 edges of the radiographs or excessive exposure of the abdomen indicating poor radiation protection. It can be deduced from this study that the skills of the radiographer, as well as state of the equipment, affects the quality of chest radiographs. It was found that in some instances due to economic considerations, chest radiographs that were sub-standard, were accepted in the department. There should be efforts by radiographers to adhere to international standards as outlined in the European guidelines. This would avail the physicians of chest radiographs, of good diagnostic quality, save costs incurred by the department and more importantly prevent unnecessary radiation to patients.

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(PLEASE USE THE JOURNAL ACCEPTED STYLE)

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