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EVALUATION OF POSITIONING ERRORS FOR IN ROUTINE CHEST X-RAY AT BEIT JALA GOVERNMENTAL HOSPITAL

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ABSTRACT

The chest examinations are the most examination make in the all radiology department examination. This study tried to recognize three different error types related the chest X-ray examination including positioning, technical, and communication using the chest radiograph. A group of radiologic technologists (RTs) (radiographer; n=11) and one radiologist (n=1) estimated a bank (n=3344) of adult CXR that consisted a range of errors. A Statistical Package for Social Sciences (SPSS) (version 21; IBM, Armonk, NY) was used to analyse the frequencies and percentage for each error. The optimality of the CXR examinations reaches to 50%, and that is due to several reasons, most importantly related positioning error 53% then technical error with 30% and the communication error with 17%. With poor training and overload, the RTs should take a training course to improve the abilities and the skills their performance.

KEYWORDS: Radiography; Radiological Technologist; Chest X ray; Radiologist.

INTRODUCTION

Diagnostic imaging plays an essential role in health care and support the clinicians to provide the suitable diagnosis and treatment for the patients. Even rapidly increasing of medical imaging technologies such computed radiography (CR), digital radiography (DR), and other modalities, the conventional chest x-ray radiography (CXR) is still an essential examination in the lung diseases [1,2]. However, in the government hospitals in Palestine using CR and DR modalities to perform the diagnostic information's in conventional radiography.

CXR is considered as a vastly used all X-ray examinations; and it used for evaluation of chest diseases [3]; it is considered as a routine performed before and after any surgeries in most hospitals as a routine workup [4]. Moreover, the cost of chest examination is comparatively low also it has a little radiation risks [5].

The problems with the use of CXR concerns of visual interpretation. A lot of previous studies shown that the interpretation accuracy is changing with observer error [6,7]. This error in CXR distributed between three reasons; a) Positioning Error which can be defined as any errors occurring during the examination including wrong patient body alignment such as rotation and tiltation, and wrong cauterized between the patient and the image Bucky; b) Technical Error that related any

problems which related to the x-ray machine such as vibration of tube anode, insufficient of electricity current to provide tube current, problem inside the Bucky itself.; c)Communication errors which are occurring due to insufficient instruction provided from radiographer to the patient, and it may be happened especially with uncooperative patients.

There are no literature studies show the error causes in CXR exam. Thus, this article concerning to determine the percentage errors for CXR exam including technical, positioning, and communication errors to know the reasons of these errors and to provide some recommendation to solve these problems.

MATERIALS AND METHODS

2.1.Study Design

The study was based in a Beit Jala governmental hospital with a catchment area of 250,000 patients and 80 beds, 11 full time radiographic technologist(RTs) currently employed to do all of the plain film radiographs working onto two device x-ray machines Phillips Diagnose 55/Super 50CP (Phillips Corp., Holland) and Computed radiology (CR) Monitor).

RTs provide 7 days covered the radiology department inside the hospital, four of them available from 8:00 am to 3:00 pm from Sunday to Thursday working inside the department using both of devices. At least two radiographers are available from 3:00 pm to 10:00 pm every day and one of them available from 10:00pm to 8:00 am in whole days.

2.2.Case Selection

This study is considered as an exploratory study using successive randomly Stratified random sampling (SRS) of adult CXRs, which is carried out for the patients file. The SRS sample means that the selections of the files are randomly chosen for the patients who already made the chest examination.

All patients had an anteroposterior (AP) or posterior-anterior (PA) projections, including mobile examinations which also used the same machines (chest examination at the same patient bed), while the lateral CXR are not routinely examination in this study. The sample included 3344 adult patients at the time between 1st of April to 31th of October 2015 were selected. The patients in this study included the person who was referred by a hospital-based clinician (inpatient, outpatient, and patient who reaches to emergency department), also this study excluded the chest examinations before and after this period, also it excluded the children and paediatric patients.

The chest examination was taken in a second full inspiration using a fixed distance 180 cm from source (X-ray machine) to the image receptors (SID) to minimize the magnification in the heart and to reduce the beam divergence effect. The patients are exposed to 100-120 kVp and 2-3.2 mAs for normal patients.

2.3.Participants

The radiographers who do the CXR qualified with different experiences; this experience distributed between 2 to 15 years. The radiologist who does the evaluation for the CXR examination has 10 years' expert in diagnostic. The participant radiographers had completed Bachelor degree in medical imaging course from different educational institutes. The 11th of radiographer and one radiologist were recruited. The practice years and the number of CXR interpreted were collected from each participate radiographer.

2.4.Test Methods

All of chest examinations digitized into Digital Imaging and Communications in Medicine (DICOM) images, where the images were viewed on Picture Archive and Communication System (PACS) using software IQ viewer 2.8.0.101 (pixel spot size of 100 μm, 12 bit per pixel, image size of 2016×2048 pixels).

A bank (n=3344) of CXR examinations were done by the participant radiographers (n= 11) and radiologist (n=1), who give the results for the examinations with optimal or suboptimal cases. The result data for each case was archived into a pre format, the radiologist was required to determine all cases into three optimality score (1-optimal, 2- suboptimal with one error, 3- suboptimal with two errors) to form a mark rating for all CXR examinations. All of participants cannot modify or edit the images after make the CXR exam. However, the radiographer participants can access to the other previous CXR.

2.5.Analysis

All of data was analysed using the Statistical Package for Social Sciences (SPSS) (version 21; IBM, Armonk, NY), Frequencies and descriptive statistics were used to measure percentages.

2.6.Ethics statement

The study followed the ethical principles of the Government hospitals in Palestine. The surveillance protocol was approved by Beit Jala governmental hospital. All patients registered in surveillance (or their guardians) provided written informed consent.

RESULTS

The image bank consisted 3344 cases, with random choosing for the cases. The results of this study distributed into two groups; the first group concern for the percentage of each positioning, technical, and communication from all samples, the second group concerns of the percentage for optimal imaging related the whole samples, also it carried out the percentage of the errors in the samples with one, two or three errors together.

Sources of the bias were determined including the selection of the image cases, the standard reference, the observer measurements [9]. The cases have been selected for most suitable radiography details. The reference standard was followed to the criteria in TEXTBOOK OF RADIOGRAPHIC POSITIONING AND RELATED ANATOMY book [10]. The measurements have been calcified into three groups as mention before.

3.1 First group

The randomly samples which is chosen are 3344 chest examinations from over all 14489 radiographic examinations, the figure 1 shows this percentage between the CXR with 23% over all 77% for all examinations.

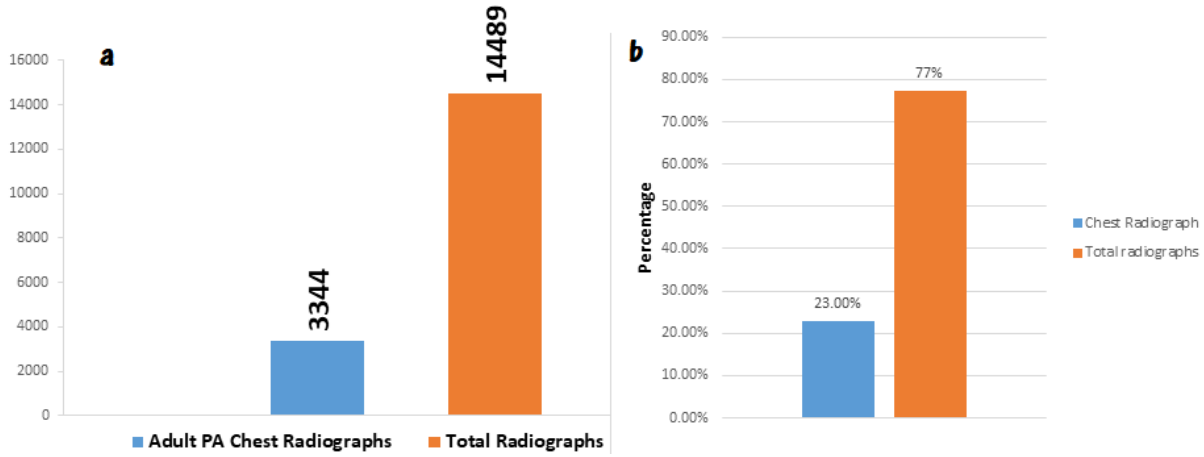

Fig 1. The sample selection; a) the number of CXR examintion for over all radiographic examinations, b) the percentage of CXR examination from over all radiographic examinations.

For the positioning error in the chosen samples are summarized in the table 1, while the table 2 provides the information's for the technical error, and the table3 given the data for the communication error.

Table 1. The number and percentage for positioning error

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Negative	2255	67.4	67.4	67.4
	Positive	1089	32.6	32.6	100.0
	Total	3344	100.0	100.0	

Table 2. The number and percentage for technical error

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Negative	2728	81.6	81.6	81.6
	Positive	616	18.4	18.4	100.0
	Total	3344	100.0	100.0	

Table 3. The number and percentage for communication error

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Negative	2986	89.3	89.3	89.3
	Positive	358	10.7	10.7	100.0
	Total	3344	100.0	100.0	

The figure 2 below shows the frequencies of each errors and the percentage for them.

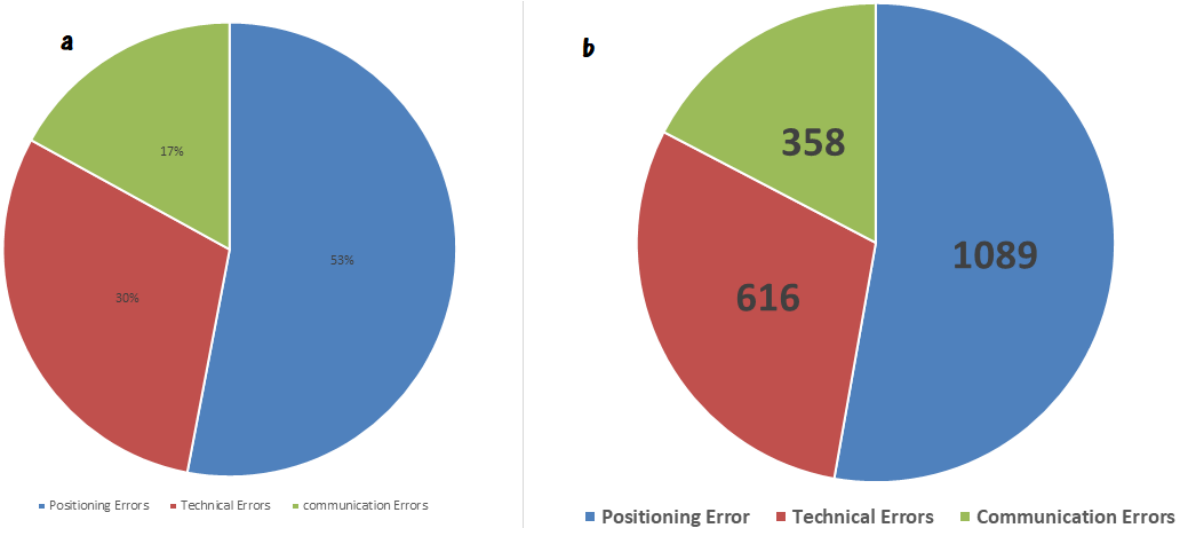

Fig 2. The errors distribution in the sample; a) the error percentage inside the sample, b) the number of error sample related the type of errors.

3.2 Second group

In this group the optimal imaging with the percentage and the examination with one, two or three errors were summarized as the following:

The table 4 shows the frequencies of the optimal imaging in the whole sample, while figure 3 shows the percentage of this optimality inside the sample.

Table 4. The number and percentage for optimal CXR in the sample.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	negative	1667	49.9	49.9	49.9
	positive	1677	50.1	50.1	100.0
	Total	3344	100.0	100.0	

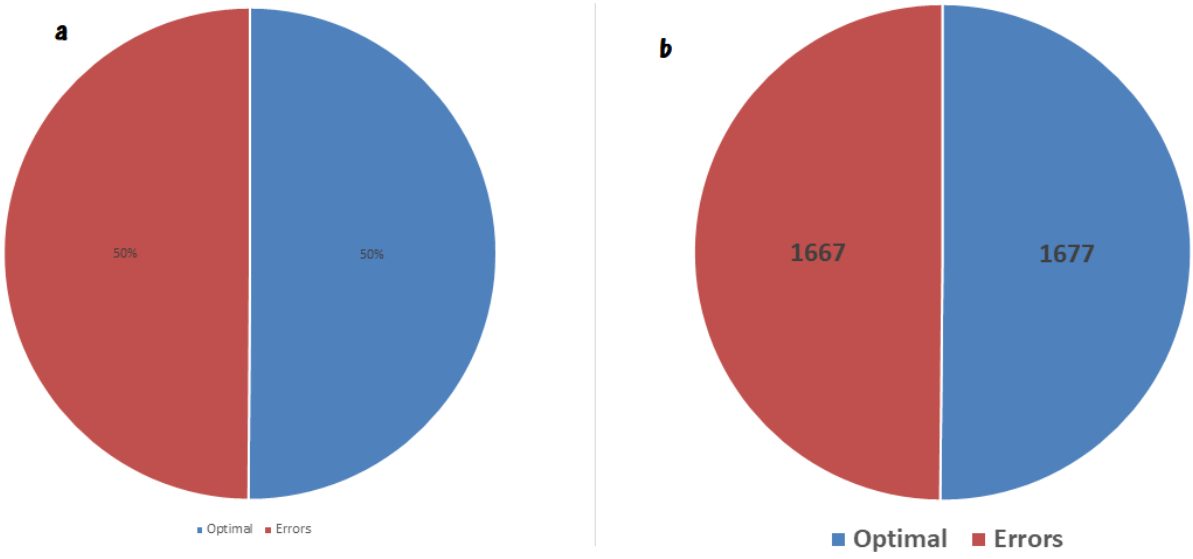

Fig 3. The optimal CXR in the sample; a) the percentage of the optimality, b) the number of optimal imaging in the whole sample.

The following table 5 summarized the number and percentage of the imaging which have at least one error from the errors which mention before, while the figure 4 shows these results.

Table 5. The number and percentage of radiographs that have one error

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Negative	2080	62.2	62.2	62.2
	Positive	1264	37.8	37.8	100.0
	Total	3344	100.0	100.0	

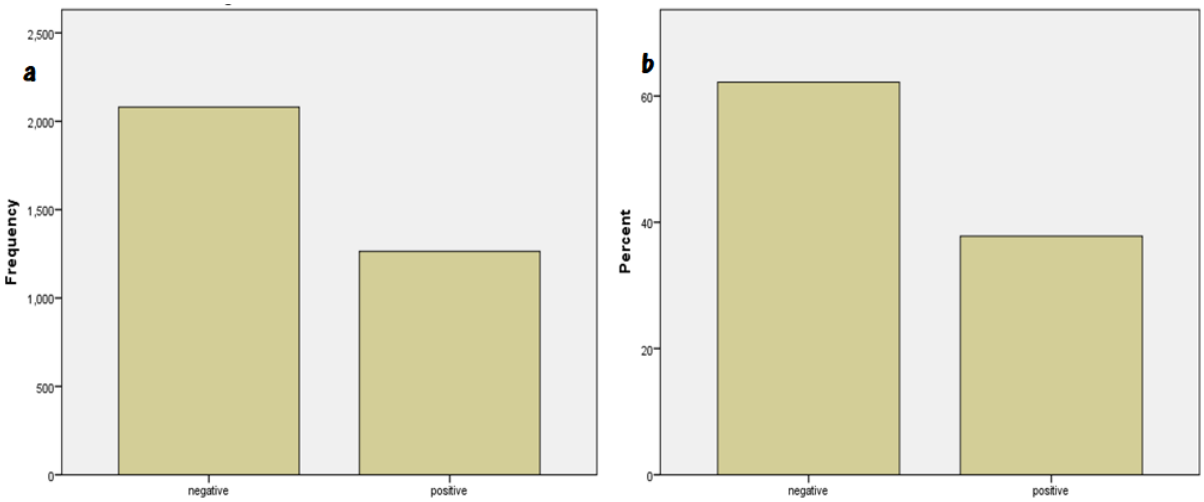

Fig 4 The imaging with one error; a) the number of the examination comparing with whole sample, b) the percentage of the one error examination in the sample.

Finally, the number of examinations which have two errors were summarized in Table 6, and figure 5 shows this results.

Table 6. The number and percentage of radiographs that have two errors

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Negative	2958	88.5	88.5	88.5
	Positive	386	11.5	11.5	100.0
	Total	3344	100.0	100.0	

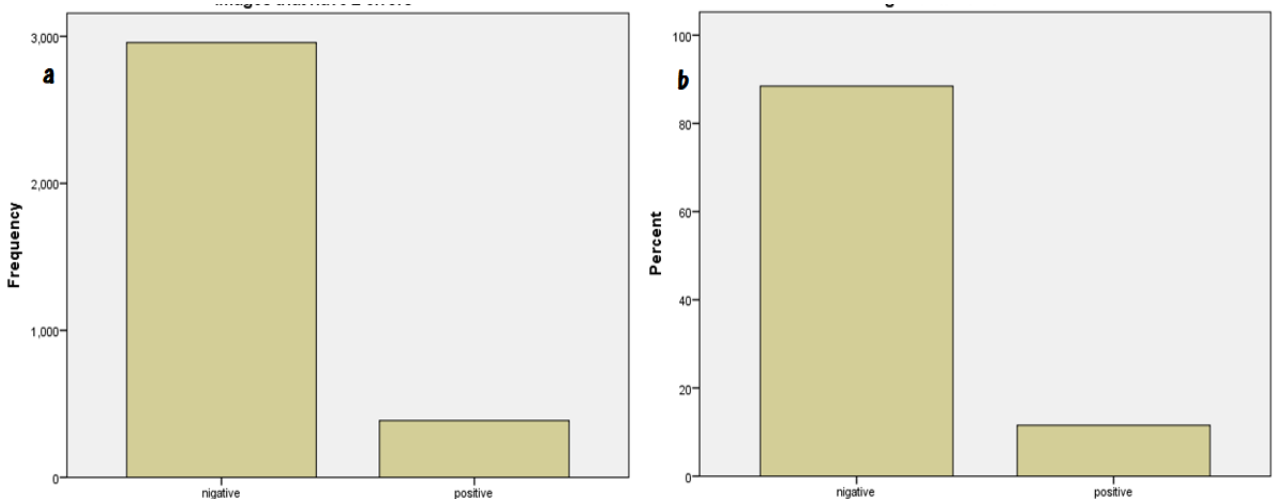

Fig 5 The imaging with two errors; a) the number of the examination comparing with whole sample, b) the percentage of the one error examination in the sample.

DISCUSSION

Before submitting a radiograph for interpretation, the perfect examination positioning should be obtained, any changing in position would increase the mistake of diagnosis especially the variation of more than 1 cm which affect to the lung appearance [11].

All of data above shows a lot of problems inside the radiology department at Bet Jala governmental hospital, and that's return to many reasons; the most important reason is the overload working [12], and that was noticed in all period of day especially in the morning time between 8:00 am to 3:00 pm, where the department receive more than 80 patients in this period. Thus, the radiographer must work under this load with quickly works, and this already leads to decrease the concerning for the image quality, also this leads to decrease the intention for the patients. This result shows in the optimal image comparing with all radiographic imaging, where this optimality reaches only to 50%, that means every two patients one exam is right and the other is wrong.

The other reason related these errors is the positioning error and that is due to the fast working through the RTs during the patient preparation, as this problem has received the greatest percentage of errors more than 53% comparing with technical error 30% and communication error with 17%, perhaps the reasons related to the culture inside the Bethlehem city where this city has a lot of the rural persons and this make the communication with them is more difficult.

CONCLUSION

CXR are a complex radiographs imaging and it is mainly used to determine the patient's pathways. The current study focused on the CXR errors in the Beit Jala governmental hospitals. The errors cause due to the uncooperative patient, bad instructions from radiographer to the patient & Defect in the X-ray equipment. We recommend the Health Ministry in Palestine to provide training Courses for radiologic technologist, semi-annual maintained for x ray equipment's, and increasing the staff members to covered the overload working.

This study has many insufficient such as the study focused just only to the CXR and don't take other examinations, and the period of study relatively short. In the future studies, the researcher can have carried out this study to do it with other hospitals and make compare with the current study.

Conflict of Interest

The author has no conflict of interest.

Disclosure

The author did not receive any type of commercial support in forms of either compensation or financial support for this study.

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