Assessment of clinical outcomes of outpatients following chest X-ray imaging performed at King Abdul–Aziz Medical City, Saudi Arabia, Riyadh

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Authors' contributions

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Authors' contributions

This work was carried out in collaboration between all authors. Authors AA and OGS designed the study, performed the statistical analysis, wrote the protocol, wrote the first draft of the manuscript and responsible to correspond with the journal. Authors ZA, FZ, ALA, FSA and AAA managed the analyses of the study, data collection and assisted in data management. Authors MMA and KOA managed the literature searches. All authors read and approved the final manuscript

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ABSTRACT

Background: Chest X-ray imaging is one of the most commonly performed daily routine investigations in many of the hospitals and diagnostic centers around the globe. Many people have chest X-rays before surgery, although a diagnosis is made based on the findings in only a few cases and each procedure adds to the radiation dose accumulation. According to the American college of Radiology (ACR), most CXR radiograph are less effective and should only be recommended based on the appropriateness criteria including elderly and high risk patients. Nevertheless the issue of replacing X-rays with other technique remains uncertain and mandates further investigation. To aim of this study was to assess and identify the clinical outcomes of outpatients following chest X-ray imaging performed

Materials and Methods: In total, the data for 185 patients (83 men, 102 female; age range 15 to 90 and above) who underwent chest X-rays were analyzed. This is a retrospective quantitative study design and data was collected from medical records using convenient

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sampling technique held at King Abdul–Aziz Medical City, Saudi Arabia, Riyadh in Radiology Department from September, 2017 to March, 2018

Results: Analysis of the collected data of a total of 185 patients revealed that 73.5% of the patients had negative radiological findings, while 26.5% had positive radiological findings. The majority of patients were females, comprising 55.1% of the total sample size, while 44.9% were male patients.

Conclusion: From the results of our study, we conclude that that most cases had negative radiological findings regardless of the gender. The daily routine chest radiograph can be avoided by replacing other imaging modalities.

Keywords: Imaging modalities; Chest X-ray; Radiological Finding; Medical record.

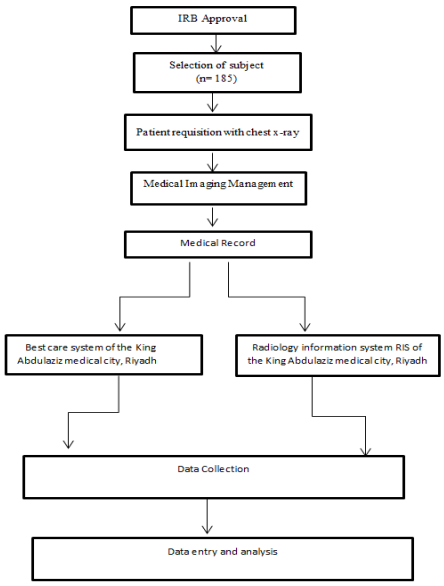
1. INTRODUCTION

A simple way to detect pathology in the human body is by X-ray imaging. X-rays are electromagnetic waves that can pass through a patient's body quickly and X-ray imaging is relatively harmless because the dose is carefully monitored. Ionizing radiation related examinations are capable to cause a harmful effect to the human body thereby the alternate way of replacing X-rays with other technique to avoid the possibility of damage caused by X-rays still a justifiable issue. (1-2). Chest X-rays are one of the most commonly performed examinations in many hospitals and diagnostic centers around the globe. (3) Previous studies of the rate of X-ray examinations indicated that 48 million chest X-rays have been performed over the years. Chest radiography is the most frequently done examination among the intubated and mechanically ventilated patient. It is also performed both pre- and post-operatively to identify abnormalities of the lungs and airways, heart and blood vessels and bones. (4) On the other hand, the dose received by the patient that might lead to biological effects is a cause for concern. Many people had a chest X-rays before surgery, although a diagnosis is made based on the findings in only a few cases and each procedure adds to the radiation dose accumulation. Furthermore, some hospitals require every patient to have a chest X-ray. For those patients who did not obtain a diagnosis from the X-ray, the risk of radiation damage remains, even at low doses. (5) According to data collected for 2014, among 1,787 pre-operative chest X-rays performed in patients undergoing elective surgery, there was no official report for 827 of the films. Moreover, these data revealed that cardiovascular disease referring to the most common pathologies (45.8%) identified by chest X-rays, followed by systemic disease (17.7%) and healthy patients aged over 45 years (16.8%) respectively. One study showed that chest X-rays did not affect the decision of radiologists to refer patients for surgery. The Royal College of Radiologists published the first major review of the pre-operative chest radiograph, which showed that this type of imaging did not alter the decision made to undergo elective non-cardiopulmonary surgery in 10,619 operative or anesthetic patients. (6-10) The probability of abnormalities detected in chest X-rays increases with the age of the patient. (11-13) One study showed that the chances of having chronic disorders, such as cardiomegaly and chronic obstructive pulmonary disease, increased with ages. (14) It is also noted that the physician should order a minimum number of routine test based on the age, history and physical examination findings that are likely vulnerable to have abnormal results. (15-16) Studies in First-World settings suggest that routine pre-operative investigations are of minimal usefulness nevertheless Chest X-ray is being considered to be most frequently performed examination in Emergency department (ED) patients. (17-20).

A huge number of chest radiograph are done in medical centers across the Saudi Arabia annually mainly in the ICUs, these could cause a heavy logistic and financial burden.(21) The overall aim of the study is to provide the empirical evidence of the diagnostic chest X-ray imaging on the importance of diagnosing different pathologies and their outcomes in clinical setting performed at King Abdulaziz Medical City ; and to what extent the policy in place could be modified in favor of using on demand instead of current daily routine practice.

2. MATERIAL AND METHODS

Figure 1: Outline of the study



Research design:

This is a retrospective quantitative study design based on the availability of the medical records.

The study was carried out through:

Technical Design:

The technical design includes: the setting, sample size determination and statistical analysis

Setting:

This study was conducted at King Abdul–Aziz Medical City (KAMC), one of the largest medical cities in Riyadh, Saudi Arabia which is under the administration of the Ministry of the National Guard Health Affairs (NGHA).

Sample Size determination and statistical analysis:

Referring to our study setting and subject, chest X-rays were performed in the Radiology Department of the Emergency and Ambulatory Care Units. All chest X-rays were performed in male and female outpatients aged over 14 years. According to the NGHA data, the number of subjects visiting the Emergency and Ambulatory Care Unit of the Radiology Department for chest X-ray is estimated to be 3,096 per month with a 7% margin of error and 95% confidence level. The minimum sample size required was 185, calculated using the Rao soft online sample size calculator. The convenient sampling technique was used. The data for subjects who underwent chest X-rays during the period from September, 2017 to March, 2018 were collected using a suitably structured form. The collected data were entered into Microsoft Excel spreadsheets and transferred to SPSS version 22 for statistical analysis. Descriptive statistics were used to explain the demographic characteristics of the subjects according to availability of the records in the picture archiving communicating system (PACS) of the Radiology Department. Frequencies and percentages were also used to represent the information regarding the usefulness of pre-operative chest X-rays, most common diseases affecting chest radiographs

3. RESULTS

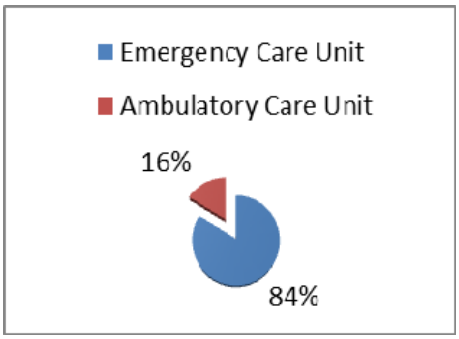
Demographic characteristics: The data for 185 patients who underwent chest X-rays were analyzed. Most of the patients were aged from 61 to 70 years (22.8%), followed by the group aged from 51 to 60 years (16.8%). By contrast, patients in the 15 to 20 years and 91 to 100 years age groups comprised only 6.5% and 2.2% of the study sample

Table1.Demographic characteristics amongst the patient visiting King Abdul-Aziz Medical City (n=185), Riyadh, Saudi Arabia, 2017

Demographic Characteristics	Number & percentage
Gender	
Male	83 (44.9%)
Female	102 (55.1%)
Age (y)	
15-20	12 (6.4%)
21-30	21 (11.4%)
31-40	20 (10.8%)
41-50	21 (11.4%)
51-60	31 (16.8%)
61-70	41 (22.8%)
71-80	22 (11.9%)
81-90	13 (7%)
91-100	4 (2.2%)

Sample according to variable of X-ray unit: Data were collected from 30 patients in the Ambulatory Care Unit and 155 in the Emergency Care Unit 155 patients, representing 16.2% and 83.8% of the total sample as shown in the Figure 1.

Fig.2. Distribution of the sample individuals according to the variable of X-rays Unit visiting King Abdul-Aziz Medical City (n=185), Riyadh, Saudi Arabia, 2017



Variable of chief complaint: As shown in the Table 2, the highest proportion with 30.3% of the sample individuals had chest pain, followed by shortness of breath 25.4%, routine cases by 13.5%, pre-operation cases, trauma & pre-employment, and abdominal pain were 4.3%, 3.8%, and 2.2% respectively. Similarly, atelectasis & pneumonia were 1.7% and Cough, Palpitations, Nasogastric tube, Fever, pneumothorax, Vital Signs, Lymphadenopathy and follow up cases were represented by 1.1% while Neck swelling, Upper abdominal pain, Hospital Admission, Cholangitis, Infection, Leg swelling, Dysphagia, Chronic obstruction pulmonary disease, Follow-up, Post-operation were 0.5% of the total population.

Table 2. Distribution of the sample according to the variable of complaint or indication

Chief complaints	**Number & Percentage of subjects N=185**	
	No.	**%**
Chest pain	56	30.3
Shortness of breath	47	25.4
Routine	25	13.5
Pre-operation	8	4.3
Trauma	7	3.8
Pre-employment	7	3.8
Abdominal pain	4	2.2

Atelectasis	3	1.7
Pneumonia	3	1.7
Cough	2	1.1
Palpitations	2	1.1
Nasogastric tube	2	1.1
Fever	2	1.1
Pneumothorax	2	1.1
Vital Signs	2	1.1
Lymphadenopathy	2	1.1
Follow-up	2	1.1
Neck swelling	1	0.5
Upper abdominal pain	1	0.5
Hospital Admission	1	0.5
Cholangitis	1	0.5
Infection	1	0.5
Leg swelling	1	0.5
Dysphagia	1	0.5
Chronic obstruction pulmonary disease	1	0.5
Post-operation	1	0.5

Radiological finding and their related diseases: It reported that in total, 136 (73.5%) of the patients had negative radiological findings which indicate that there were no clinical impression of any pathological finding on the radiograph as per the clinically-relevant reports from the PACS (picture archiving and communication system), while 49 (26.5%) had positive radiological findings. Furthermore, among the number of positive finding 40 (21.6%) had lung disease, 6 (3.2%) had heart disease and 3 (1.7%) had bone diseases.

Table 3. Distribution of the sample according to the variable of Results and their related diseases

Variable	Number & percentage of subjects N=185
Results	
Positive	49(26.5%)
Negative	136 (73.5%)
Related Diseases	
None	136 (73.5%)
Lungs	40 (21.6%)
Heart	6 (3.2%)
Bones	3 (1.7%)

Comorbidities: From the Table 4, it is clearly indicated that pleural effusion was the most common pathology finding (8.1%), followed by enlarged cardiac silhouette in five patients (2.7%), prominent bronchovascular markings and pulmonary edema each identified in four patients (2.2%). Cardiomegaly, atelectasis, hyperinflation and infection were each identified in three patients (1.7%). Two patients were affected by pneumonia (1.1%), while pneumothorax, unknown lung disease, cancer, compression fracture, spinal degeneration and left para-tracheal soft tissue density were each identified in one patient (0.5%).

Table 4. Distribution of the sample according to the variable of comorbidities

Radiological Pathology	Number & Percentage of subjects N=185	
	No.	**%**
None (no disease)	136	73.5%
Prominent bronchovascular markings	4	2.2%
Cardiac silhouette enlarged	5	2.7%
Pulmonary edema	4	2.2%
Infection	3	1.7%
Hyperinflation	3	1.7%
Pleural effusion	15	8.1%
Osteopenia	1	0.5%
Atelectasis	3	1.7%
Cardiomegaly	3	1.7%
Pneumothorax	1	0.5%
Lung Disease	1	0.5%
Cancer	1	0.5%
Compression fracture	1	0.5%
Spinal degenerative	1	0.5%

Left para-tracheal soft tissue density	1	0.5%
Pneumonia	2	1.1%

4. DISCUSSION

In this study, we analyzed data from 185 randomly selected patients in King Abdul–Aziz Medical City, Riyadh. This study is first of its kind in Riyadh city to the best of our knowledge and very few similar studies were available for comparison worldwide. Most of the studies were found to be related to routine chest x-rays in intensive care units and critically ill patients. Based on our study the data were collected from the Emergency Care Unit (83.9%) and Ambulatory Care Unit (16.1%). Most of the patients were female 55.1%, whereas male patients were 44.9%.The main indication for chest X-ray was chest pain (56/185 patients; 30.3%), followed by shortness of breath, routine chest examinations, Pre-operation X-rays pre-employment examination, trauma patients and patients with abdominal pain, atelectasis and pneumonia. The, dysphagia, and pre-stent operation, post-operation, follow-up and chronic obstructive eighth most common indications were palpitation (irregular rapid heartbeat), cough, vital signs, fever, nasogastric tube, lymphadenopathy and pneumothorax. The least frequent indications were neck swelling, upper abdominal pain, and admission, cholangitis, infection, leg swelling, and pulmonary disease. In another study of 797 case records determined the routine chest overall positive yield of 6%; 17% in those over 60 years but only 2% in those under 60 years.(17) The routine chest X-ray investigation may be worthwhile only in older patients. (18).According to the consensus opinion of the American College of Radiology-expert panel realized that the daily-routine radiographs are indicated for patients with acute cardiopulmonary problems and for patients receiving mechanical ventilation. (22) Furthermore in another study, consensus was reached that CXRs should be considered routinely after certain procedures (for example, insertion of feeding tube, endotracheal tube, central line catheter, and chest tube). (23) Our results also indicate that 73.5% of the patients were reported as no radiological impression or pathological finding on the radiograph as per the clinically-relevant reports form the PACS (picture archiving and communication system), with positive findings in only 26.5% of the patients. In relevant to previous study a total of 65 ICUs was received the questionnaire and it was reported that chest radiographs are considered essential for verification of the position of invasive devices (81%) and for diagnosing pneumothorax, pneumonia or acute respiratory distress syndrome (82%, 74% and 69%, respectively) There is notable lack of consensus on chest radiography practice in the Netherlands. In view of the fact to similar study, there is lack of consensus on chest Radiography and the value and effectiveness of quality in daily routine chest radiography may doubt. (24)

In a study of the prevalence and characteristics of abnormal pre-operative chest X-rays in 960 patients undergoing elective surgery, Dej-arkom et al. [7] reported positive findings in 50.5% of the sample. It can be speculated that the high incidence of abnormalities identified in chest radiographs was because some of the patients underwent cardiothoracic and cardiac catheterization. In another study it was stated that radiological finding was the decrease in abnormalities presumed to be present on CXRs. Indeed, a 30% reduction in expected predefined findings was observed. (25) Furthermore, in another study, the safety of abandoning routine CXRs in critically ill patients remains uncertain and mandates further investigation. (26)

4. CONCLUSION

Our study revealed negative radiological findings in 73.5% of the chest X-rays performed at the King Abdulaziz Medical City during the period from September, 2017 to March, 2018. Chest pain and shortness of breath were the most common indications for chest X-rays in the majority of patients. Subsequently, the majority of the radiological findings were related to lung disease especially pleural effusion as the most prevalent condition whereas bone disease was rare. Based on these findings, we suggest replacing X-ray imaging with other examinations, such as medical ultrasound, to minimize the risk to patients of the effects of ionizing radiation. To conclude, similar studies with large samples are required in order to get empirical evidence and it will definitely relieve to some extent towards the financial burden and heavy logistic in the health care sector of Saudi Arabia.

ETHICAL APPROVAL:

See IRB approval appendix (I)

COMPETING INTERSETS

Authors have declared that no competing interests exist.

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APPENDIX:

IRB Approval (I)

Data collection form (II)

Kingdom of Saudi Arabia
Ministry of National Guard - Health Affairs

المملكة العربية السعودية
وزارة الحرس الوطني - الشؤون الصحية

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IRB Office **Memo Ref.No. IRBC/1176/17** **E-CTS Ref. No** **RYD-17-419812-103872**

Study Number: **SP17/208/R**
Study Title: **Assessment of Clinical Outcomes for Outpatient Chest X-Ray Did in King Abdulaziz Medical City, Saudi Arabia, Riyadh**
Study Sponsor: **Non-grant**
IRB Approval Date: **19 September 2017**
IRB Review Type: ■ **Expedited Review** ☐ **Full Board**
Study site(s): **Central Region**

Dear **Dr. Ali Aldhebaib**
Assistant Professor, Radiological Sciences
King Saud Bin Abdulaziz University for Health Sciences

Together with the **Co-investigators**: Adel Ali Alharbi, Faisal Sultan Alotaibi, Abdulrhman Abdullah Alkhulaifi, Mohmmed Abdullatif Al-baijan, Khaled Obaid Alharbi, Mr. Gokulchandra Oinam, Mr. Zyad Almutlaq.

After reviewing your submitted research proposal/protocol and related documents, the IRB has APPROVED the submission.

The approval includes the following related documents:

Document/Title	Version	Date
Research Proposal	01	19 Sep 2017
Data Collection	01	19 Sep 2017

The approval of the research study is valid for **one year** from the above approval to expiration date.

Terms of Approval:

- **Annual Reports:** An Annual report must be submitted for approval to avoid termination/suspension of your research.
- **Financial report:** If your study is funded project, details financial report should be submitted with the scientific report.
- **Final Report:** After completion of the study, a final report must be forwarded to the IRB.
- **Retention of original data:** The PI is responsible for the storage and retention of original data pertaining to the project for a minimum of five years.
- **Reporting of adverse events or unanticipated problems:** The PI is responsible to report any serious or unexpected adverse events or unanticipated problems, which could involve a risk to participants or others.
- **Biological samples:** No biological samples to be shipped out of the Kingdom of Saudi Arabia without prior IRB approval.
- **Participant incentives:** No financial compensation or gifts to be given to participants without prior IRB approval.
- **Storage of biological samples:** All biological samples collected for the purpose of this research must be stored in the KAIMRC related repository.

27 SEP 2017

Dr. Abdallah Adlan
Chairman, Institutional Review Board (IRB)
Ministry of National Guard - Health Affairs

Adl.

AA/AS/jbr

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Demographics					Chief Indication					Finding		Comorbidities			
S. No	Patient ID	Age	Sex	X-ray section	Fever	Cough	Shortness of breath	Chest pain	Others	Positive	Negative	Diseases related to cardiac	Diseases related to lung	Diseases related to bones	Others
1															
2															
3															
4															
5															