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

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17 *Riyadh, Kingdom of Saudi Arabia.*

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19 *Authors' contributions*

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

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randomly 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.

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Keywords: Electromagnetic Waves; Chest X-ray; Radiological Finding; Medical record.

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1. INTRODUCTION

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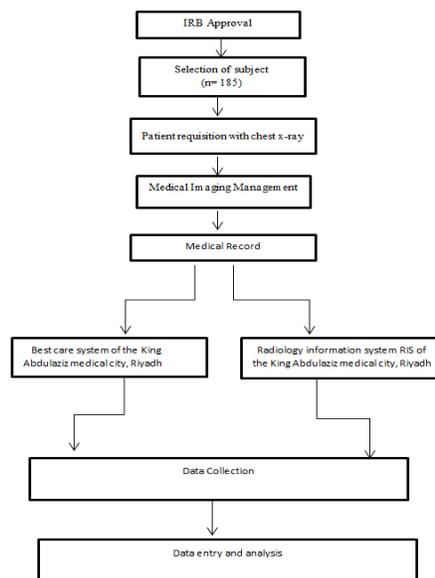
A simple way to detect pathology in the human body is by X-ray imaging. X-rays are electromagnetic waves that can pass through a patient's body quickly and X-ray imaging is relatively harmless because the dose is carefully monitored. Ionizing radiation related examinations are capable to cause a harmful 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) 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.(26) 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.

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2. MATERIAL AND METHODS

This study was conducted at King Abdul–Aziz Medical City (KAMC), one of the largest medical cities in Riyadh, which is under the administration of the Ministry of the National Guard Health Affairs (NGHA). 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 Stratified Random Sampling technique was used. The data for subjects who underwent chest X-rays during the period from January to December 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 and the ratio between the abnormal and normal radiological finding of the subjects. Appropriate statistical tests were used based on the types of variables and the data.

Figure 1: Outline of the study



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3. RESULTS

Demographic characteristics: It is reported that overall 55.1% of 185 patients were female and 44.9% were male. The data for 185 patients who underwent chest X-rays were analyzed. All of the subjects were aged over 14 years and seen as outpatients at the Radiology Department of King Abdul–Aziz Medical City. 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

108 contrast, patients in the 15 to 20 years and 91 to 100 years age groups comprised only 6.5%
 109 and 2.2% of the study sample

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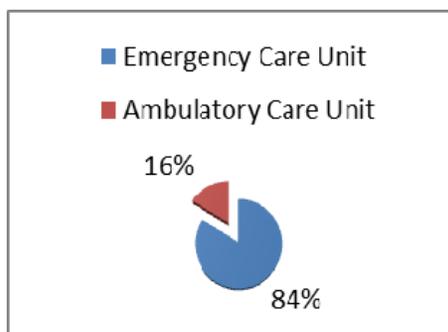
Table1. Demographic characteristics amongst the patient visiting King Abdul-Aziz Medical City (n=185), Riyadh, Saudi Arabia, 2017

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 y	22 (11.9%)
81-90 y	13 (7%)
91-100 y	4 (2.2%)

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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



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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 1.6% and Cough,

133 Palpitations, Nasogastric tube, Fever, pneumothorax, Vital Signs, Lymphadenopathy and
 134 follow up cases were represented by 1.1% while Neck swelling, Upper abdominal pain,
 135 Hospital Admission, Cholangitis, Infection, Leg swelling, Dysphagia, Chronic obstruction
 136 pulmonary disease, Follow-up, Post-operation were 0.5% of the total population.

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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	1.6
Pneumonia	3	1.6
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

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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 total number of patients (185), 135 (73%) had no related diseases, 40 (21.6%) had lung disease, six (3.2%) had heart disease and four (2.2%) 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	30 (16.1%)
Negative	155 (83.9%)
Related Diseases	
None	135 (73%)
Lungs	40 (21.6%)
Heart	6 (3.2%)
Bones	4 (2.2%)

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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 (1.6%). Two patients were affected by pneumonia (1.1%), while

161 pneumothorax, unknown lung disease, cancer, compression fracture, spinal degeneration
 162 and left para-tracheal soft tissue density were each identified in one patient (0.5%).

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

Radiological Pathology	Number & Percentage of subjects N=185	
	No.	%
None	136	73.5%
Prominent bronchovascular markings	4	2.2%
Cardiac silhouette enlarged	5	2.7%
Pulmonary edema	4	2.2%
Infection	3	1.6%
Hyperinflation	3	1.6%
Pleural effusion	15	8.1%
Osteopenia	1	0.5%
Atelectasis	3	1.6%
Cardiomegaly	3	1.6%
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%

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4. DISCUSSION

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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 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, dysphagia, and pre-stent operation, post-operation, follow-up and chronic obstructive pulmonary disease. According to the consensus opinion of

183 the American College of Radiology-expert panel realized that the daily-routine radiographs
184 are indicated for patients with acute cardiopulmonary problems and for patients receiving
185 mechanical ventilation. (21) Furthermore in another study, consensus was reached that
186 CXRs should be considered routinely after certain procedures (for example, insertion of
187 feeding tube, endotracheal tube, central line catheter, and chest tube). (22) Our results also
188 indicate that (73.5%) of the patients were reported as no radiological impression or
189 pathological finding on the radiograph as per the clinically-relevant reports from the PACS
190 (picture archiving and communication system), with positive findings in only 26.5% of the
191 patients. In relevant to previous study a total of 65 ICUs was received the questionnaire and
192 it was reported that chest radiographs are considered essential for verification of the position
193 of invasive devices (81%) and for diagnosing pneumothorax, pneumonia or acute respiratory
194 distress syndrome (82%, 74% and 69%, respectively) There is notable lack of consensus on
195 chest radiography practice in the Netherlands. (23)

196 In a study of the prevalence and characteristics of abnormal pre-operative chest X-rays
197 in 960 patients undergoing elective surgery, Dej-arkom et al. (7) reported positive findings in
198 50.5% of the sample. It can be speculated that the high incidence of abnormalities identified
199 in chest radiographs was because some of the patients underwent cardiothoracic and
200 cardiac catheterization. In another study it was stated that radiological finding was the
201 decrease in abnormalities presumed to be present on CXRs. Indeed, a 30% reduction in
202 expected predefined findings was observed. (24) Furthermore, in another study, the safety of
203 abandoning routine CXRs in critically ill patients remains uncertain and mandates further
204 investigation. (25) In view of the fact to similar study, there is lack of consensus on chest
205 Radiography and the value and effectiveness of quality in daily routine chest radiography
206 may doubt. (23)

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209 **4. CONCLUSION**

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

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224 **ETHICAL APPROVAL:**

225 See IRB approval appendix (I)

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228 **COMPETING INTERSETS**

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230 Authors have declared that no competing interests exist.

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299 practice in adult ICU patients- clinicians' perspective. *BMC Med Imaging*. 2018 Apr 3;
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APPENDIX:

IRB Approval (I)

Data collection form (II)



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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, Abdourhman Abdullah Alkhalafi, Mohammed Abdullatif Al-baijan, Khaled Obaid Alharbi, Mr. Gokulchandra Dinam, Mr. Ziad 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.


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

AA/AS/jbr

27 SEP 2017

Adlan

