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

## ABSTRACT

**Background:** Chest X-ray imaging is one of the most commonly performed examinations in many 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.
**Aims:** To assess the clinical outcomes of outpatients following chest X-ray imaging performed.
**Materials and Methods:** In total, the data for 185 patients (83 men, 102 male; age range 15 to 90 and above) who underwent chest X-rays were analyzed. The study was conducted by collecting a data from medical records using stratified randomly sampling technique held at King Abdul–Aziz Medical City, Saudi Arabia, Riyadh in Radiology Department between September and March 2017 using a retrospective quantitative human study design based on the medical chart review.
**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.

## 1. INTRODUCTION (ARIAL, BOLD, 11 FONT, LEFT ALIGNED, CAPS)

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 .Also, you discuss the issue of replacing X-rays with other technique to avoid the possibility of damage caused by X-rays.[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 X-rays are 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

29 that might lead to biological effects is a cause for concern. Many people had a chest X-rays
30 before surgery, although a diagnosis is made based on the findings in only a few cases and
31 each procedure adds to the radiation dose accumulation. Furthermore, some hospitals
32 require every patient to have a chest X-ray. For those patients who did not obtain a
33 diagnosis from the X-ray, the risk of radiation damage remains, even at low doses. [5]
34 According to data collected for 2014, among 1,787 pre-operative chest X-rays performed in
35 patients undergoing elective surgery, there was no official report for 827 of the films.
36 Moreover, these data revealed that cardiovascular disease referring to the most common
37 pathologies  (45.8%) identified by chest X-rays, followed by systemic disease (17.7%) and
38 healthy patients aged over 45 years (16.8%) respectively. One study showed that chest X-
39 rays did not affect the decision of radiologists to refer patients for surgery. The Royal College
40 of Radiologists published the first major review of the pre-operative chest radiograph, which
41 showed that this type of imaging did not alter the decision made to undergo elective non-
42 cardiopulmonary surgery in 10,619 operative or anesthetic patients. [7-10]The probability of
43 abnormalities detected in chest X-rays increases with the age of the patient. [11-13]One
44 study showed that the chances of having chronic disorders, such as cardiomegaly and
45 chronic obstructive pulmonary disease, increased with ages. [14]
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47 **2. MATERIAL AND METHODS / EXPERIMENTAL DETAILS / METHODOLOGY**
48 **(ARIAL, BOLD, 11 FONT, LEFT ALIGNED, CAPS)**
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50 This study was conducted at King Abdul–Aziz Medical City (KAMC), one of the largest
51 medical cities in Riyadh, which is under the administration of the Ministry of the National
52 Guard Health Affairs   (NGHA).  Referring to our study setting and subject, chest X-rays
53 were performed in the Radiology Department of the Emergency and Ambulatory Care Units.
54 All chest X-rays were performed in male and female outpatients aged over 14 years.
55 According to the NGHA data, the number of subjects visiting the Emergency and Ambulatory
56 Care Unit of the Radiology Department for chest X-ray is estimated to be 3,096 per month
57 with a 7% margin of error and 95% confidence level. The minimum sample size required was
58 185, calculated using the Rao soft online sample size calculator. The Stratified Random
59 Sampling technique was used. The data for subjects who underwent chest X-rays during the
60 period from January to December were collected using a suitably structured form. The
61 collected data were entered into Microsoft Excel spreadsheets and transferred to SPSS
62 version 22 for statistical analysis. Descriptive statistics were used to explain the
63 demographic characteristics of the subjects according to availability of the records in the
64 picture archiving communicating system (PACS) of the Radiology Department. Frequencies
65 and percentages were also used to represent the information regarding the usefulness of
66 pre-operative chest X-rays, most common diseases affecting chest radiographs and the ratio
67 between the abnormal and normal radiological finding of the subjects. Appropriate statistical
68 tests were used based on the types of variables and the data.
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71 **3. RESULTS**
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73 In total, the data for 185 patients who underwent chest X-rays were analyzed. All of the
74 subjects (male and female) were aged over 14 years and seen as outpatients at the
75 Radiology Department of King Abdul–Aziz Medical City. Most of the patients were aged from
76 61 to 70 years (22.8%), followed by the group aged from 51 to 60 years (16.8%). In contrast,
77 patients in the 15 to 20 years and 91 to 100 years age groups comprised only 6.5% and
78 2.2% of the study sample as in the Table 1. Similarly in the Table 1 listed below most of the
79 patients were female (102 female and 83 male). Data were collected from 30 patients in the
80 Ambulatory Care Unit and 155 in the Emergency Care Unit 155 patients, representing 16.2%

81    and 83.8% of the total sample, respectively in the Table 2. As shown in the Table 3, the
82    highest proportion (30.3%) of the sample individuals had chest pain, followed by those who
83    had shortness of breath (25.4%). Cough, nasogastric tube, and palpitation were each
84    represented by 1.1% of the proportion of subjects, while infection, biliary inflammation, fever,
85    pneumothorax, pre-surgery, pain in the upper abdomen and swelling of neck were each
86    represented by 0.5%. According to the Table 4 it is reported that in total, 136 (73.5%) of the
87    patients had negative radiological findings, while 49 (26.5%) had positive radiological
88    findings. Furthermore, among the total number of patients (185), 135 (73%) had no related
89    diseases, 40 (21.6%) had lung disease, six (3.2%) had heart disease and four (2.2%) had
90    bone diseases. As shown in Table 5, plural effusion was identified as the most common
91    pathology (8.1%), followed by enlarged cardiac silhouette in five patients (2.7%),
92    bronchovascular and pulmonary edema each identified in four patients (2.2%).
93    Cardiomegaly, atelectasis, hyperinflation and infection were each identified in three patients
94    (1.6%). Two patients were affected by pneumonia (1.1%), while pneumothorax, unknown
95    lung disease, cancer, compression fracture, spinal degeneration and left para-tracheal soft
96    tissue density were each identified in one patient (0.5%).

## 4. DISCUSSION

100    In this study, we analyzed data from 185 randomly selected patients in King Abdul–Aziz
101    Medical City, Riyadh. This study is first of its kind in Riyadh city to the best of our knowledge
102    and very few similar studies were available for comparison worldwide. Most of the studies
103    were found to be related to routine chest x-rays in intensive care units and critically ill
104    patients. Based on our study the data were collected from the Emergency Care Unit (83.9%)
105    and Ambulatory Care Unit (16.1%). Most of the patients were female (55.1%, whereas male
106    patients were 44.9%.The main indication for chest X-ray was chest pain (56/185 patients;
107    30.3%), followed by shortness of breath, routine chest examinations, Pre-operation X-rays
108    pre-employment examination, trauma patients and patients with abdominal pain, atelectasis
109    and pneumonia. The eighth most common indications were palpitation (irregular rapid
110    heartbeat), cough, vital signs, fever, nasogastric tube, lymphadenopathy and pneumothorax.
111    The least frequent indications were neck swelling, upper abdominal pain, and admission,
112    cholangitis, infection, leg swelling, dysphagia, and pre-stent operation, post-operation,
113    follow-up and chronic obstructive pulmonary disease. According to the  consensus opinion of
114    the American College of Radiology-expert panel realized that  the daily-routine radiographs
115    are indicated for patients with acute cardiopulmonary problems and for patients receiving
116    mechanical ventilation [21] Furthermore in another study, consensus was reached that CXRs
117    should be considered routinely after certain procedures (for example, insertion of feeding
118    tube, endotracheal tube, central line catheter, and chest tube) [22].Our results also indicate
119    that negative findings (no disease found) in most of patients (73.5%), with positive findings in
120    only 26.5% of the patients. In relevant to previous study a total of 65 ICUs was received the
121    questionnaire and it was reported that chest radiographs are considered essential for
122    verification of the position of invasive devices (81%) and for diagnosing pneumothorax,
123    pneumonia or acute respiratory distress syndrome (82%, 74% and 69%, respectively) There
124    is notable lack of consensus on chest radiography practice in the Netherlands.[23]
125    In a study of the prevalence and characteristics of abnormal pre-operative chest X-rays
126    in 960 patients undergoing elective surgery, Dej-arkom et al. [7] reported positive findings in
127    50.5% of the sample. It can be speculated that the high incidence of abnormalities identified

128    in chest radiographs was because some of the patients underwent cardiothoracic and
129    cardiac catheterization. In another study it was stated that radiological finding was the
130    decrease in abnormalities presumed to be present on CXRs. Indeed, a 30% reduction in
131    expected predefined findings was observed.[24] Furthermore, in another study, the safety of
132    abandoning routine CXRs in critically ill patients remains uncertain and mandates further
133    investigation.[25] In view of the fact to similar study, there is lack of consensus on chest
134    Radiography and the value and effectiveness of quality in daily routine chest radiography
135    may doubt.[23]

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147    **Table1.Demographic characteristics amongst the patient visiting King Abdul-Aziz**
148    **Medical City (n=185), Riyadh, Saudi Arabia, 2017**
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| Demographic Characteristics | Number & percentage |
|---|---|
| Gender<br>Male<br>Female | 83 (44.9%)<br>102 (55.1%) |
| Age (y)<br>15-20 y<br>21-30 y<br>31-40 y<br>41-50 y<br>51-60 y<br>61-70 y<br>71-80 y<br>81-90 y<br>91-100 y | 12 (6.4%)<br>21 (11.4%)<br>20 (10.8%)<br>21 (11.4%)<br>31 (16.8%)<br>41 (22.8%)<br>22 (11.9%)<br>13 (7%)<br>4   (2.2%) |

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153    **Table 2. Distribution of the sample individuals according to the variable of X-rays Unit**
154    **visiting King Abdul-Aziz Medical City (n=185), Riyadh, Saudi Arabia, 2017**
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| Type of radiologic X-ray unit | Number & percentage |
|---|---|
| Emergency Care Unit | 155 (83.9% |
| Ambulatory Care Unit | 30 (16.1%) |

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158    **Table 3. Distribution of the sample according to the variable of complaint or indication**

| Chief complaints | Number & Percentage of subjects  N=185 | |
|---|---|---|
| | No. | % |
| Routine | 25 | 13.5 |
| Shortness of breath | 47 | 25.4 |
| Chest pain | 56 | 30.3 |
| Trauma | 7 | 3.8 |
| Atelectasis | 3 | 1.6 |
| Cough | 2 | 1.1 |
| Palpitations | 2 | 1.1 |
| Pneumonia | 3 | 1.6 |
| Neck swelling | 1 | 0.5 |
| Upper abdominal pain | 1 | 0.5 |
| Nasogastric tube | 2 | 1.1 |
| Pre-operation | 8 | 4.3 |
| Abdominal pain | 4 | 2.2 |
| Hospital Admission | 1 | 0.5 |
| Cholangitis | 1 | 0.5 |
| Infection | 1 | 0.5 |
| Vital Signs | 2 | 1.1 |
| Leg swelling | 1 | 0.5 |
| Lymphadenopathy | 2 | 1.1 |
| Dysphagia | 1 | 0.5 |
| Pre-employment | 7 | 3.8 |

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|---|---|---|
| Before stent anti-Tumor necrosis factor (TNF) | 1 | 0.5 |
| Chronic obstruction pulmonary disease | 1 | 0.5 |
| Fever | 2 | 1.1 |
| Follow-up | 1 | 0.5 |
| Pneumothorax | 2 | 1.1 |
| Post-operation | 1 | 0.5 |

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166 **Table 4. Distribution of the sample according to the variable of Results and their**
167 **related diseases**
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| Variable | Number & percentage of subjects N=185 |
|---|---|
| **Results** Positive Negative | 30 (16.1%) 155 (83.9%) |
| **Related Diseases** None Lungs Heart Bones | 135 (73%) 40 (21.6%) 6   (3.2%) 4   (2.2%) |

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173 **Table 5. Distribution of the sample according to the variable of radiological finding**
174 **with respect to Pathology**

| Radiological Pathology | Number & Percentage of subjects  N=185 | |
|---|---|---|
| | **No.** | **%** |
| None | 136 | 73.5% |
| Broncho vascular | 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% |

## 4. CONCLUSION

Our study revealed negative radiological findings in 73.5% of the chest X-rays performed at the King Abdulaziz Medical City. 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, whereas bone disease was rare, with pleural effusion as the most prevalent condition. 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. Subsequently, similar studies with large samples are required in order to get an empirical data and it will definitely impact towards the cost effective wise in the health care sector of Saudi Arabia.

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256                              **APPENDIX:**
257                              IRB Approval (I)
258                          Data collection form (II)
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Kingdom of Saudi Arabia
Ministry of National Guard - Health Affairs

المملكة العربية السعودية
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### King Abdullah International Medical Research Center (KAIMRC)

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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**
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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.

2 7 SEP 2017

Dr. Abdallah Adlan
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| S. No | Demographics | | | | Chief Indication | | | | | Finding | | Comorbidities | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 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 |
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2 7 SEP 2017

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