UTILITY OF ROUTINE CHEST RADIOGRAPHS IN KENYA

A DISSERTATION SUBMITTED IN PART FULFILLMENT FOR

THE AWARD OF MASTERS DEGREE IN DIAGNOSTIC IMAGING AND RADIATION MEDICINE OF UNIVERSITY OF NAIROBI

BY;

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DECLARATION

I, Dr. Ndii K. Muriuki declare that this thesis is my original work and has not been submitted at another University or Institution of Higher Learning.

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Date_____

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This research dissertation has been submitted with my approval as a university supervisor.

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DEDICATION

I dedicate this work to my wife Ester and son Keni.

ACKNOWLEDGEMENTS

I wish to acknowledge the following persons who assisted me during the period I was working on this thesis.

My supervisor Dr. Kimani for his gentle and sustained pressure to ensure I completed this work on time.

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LIST OF ABBREVIATIONS

CXR	Chest Radiographs
PA	Postero-anterior
KNH	Kenyatta National Hospital
DIRM	Department of Imaging and Radiation Medicine
UoN	University of Nairobi
RME	Routine Medical Examination
AFBs	Acid-Fast Bacilli
PEE	Pre-employment Examination
PTB	Pulmonary Tuberculosis
USA	United States of America
HIV	Human Immunodeficiency Virus
ESAT	Early Secretory Antigen Target
ERC	Ethics Review Committee
mSv	Millisieverts
PACS	Picture Archiving and Communication System
IOM	International Organization for Migration

ABSTRACT

Background

Many otherwise healthy Kenyans are required to obtain chest radiographs as part of routine medical examination. The main reason is exclusion of Pulmonary TB, a condition of significant public health concern. Many of these people are required to have these radiographs taken yearly as part of routine check-up. All this is happening without any data locally to support this practice.

Though a quick procedure to perform and readily available throughout the country, a chest radiograph exposes the individual to a dose of ionizing radiation. Ionizing radiation is associated with increased risk of malignancy. The cost is also substantial.

Objective

The main objective of this study was to determine the prevalence of abnormal radiological findings among routine medical examination chest radiographs.

The specific objectives were:

1. To determine the spectrum of radiological findings in routine chest radiographs with special interest to those suggestive of PTB.

2. To find out if there is any difference in the prevalence of abnormal chest radiological findings between males and females.
3. To determine if any difference exists in the prevalence of abnormal chest findings between the various age groups.
4. To establish the reasons (indications) for routine chest radiographs in Kenya and their frequencies.

Methodology

A cross-sectional study performed from October 2011 to March 2012. Chest radiographs

performed and reported during this time were analyzed. Data was collected from the Nairobi Hospital and Plaza Imaging Solutions.

Results

A total of 402 radiographs were analyzed. The males accounted for 51.7% while the rest 48.3% were females. Out of the 402, 63 radiographs had abnormal findings (16%). Only one radiograph (0.25%) had radiological features of PTB. The rest were reported as normal (84%).

Migration and travel was the commonest reason for ordering the radiographs accounting for 94%. The other reasons were periodic medical exams at 3%, pre-school at 2% and others accounting for 1%.

The spectrum of pathological findings was diverse. It was divided into two for ease of analysis and taking into account that the main reason routine CXR are ordered is to rule out PTB or infection capable of human to human transmission; infective and non-infective process. As noted above, only one chest radiograph had features suggestive of an infective process.

Conclusion

Out of 63 abnormal CXRs, only one was suspected to be PTB. The diagnostic yield for the intended purpose (to include/exclude PTB) is therefore extremely low.

It is recommended that routine chest radiographs as a screening tools for active pulmonary tuberculosis need to be reconsidered due to poor diagnostic yield.

The author proposes a bigger national wide study before a policy decision can be proposed.

CHAPTER 1 INTRODUCTION

In Kenya, routine chest radiographs (CXR) are performed as part of routine Medical Examination for individuals intending to;

a) Join secondary schools, colleges and universities.
b) Travel or migrate abroad.
c) Join formal employment.
d) Join an insurance Scheme.
e) Undergo periodic medical examinations while in employment.

These are usually asymptomatic and young Kenyans. There is no medical indication for these radiographs. The only reason they are performed is because the client falls in any of the above categories. The CXR is performed mainly to exclude pulmonary tuberculosis, an infection of major public health concern.

A number of Western European and North American countries require that individuals travelling to their countries from areas with high prevalence of PTB undergo a CXR. Australia is another country with such requirement.

In this study, the author intended to find out whether there was justification for routine chest radiographs to continue being performed considering the financial and radiation exposure implications incurred in undergoing these examinations.

Medicine is a dynamic field. Periodic evaluation of current practices is vital. In literature review, there was scanty evidence of studies done to justify continued inclusion of chest radiograph as part of Routine Medical examination (RME). In Kenya, no such study has been carried out.

The procedure is usually carried out in the X-ray room by a radiographer. The procedure is explained to the individual undergoing the examination with only verbal consent being required. The individual is positioned as shown in the image below.

Figure 1 Procedure of chest radiography (image author's own)
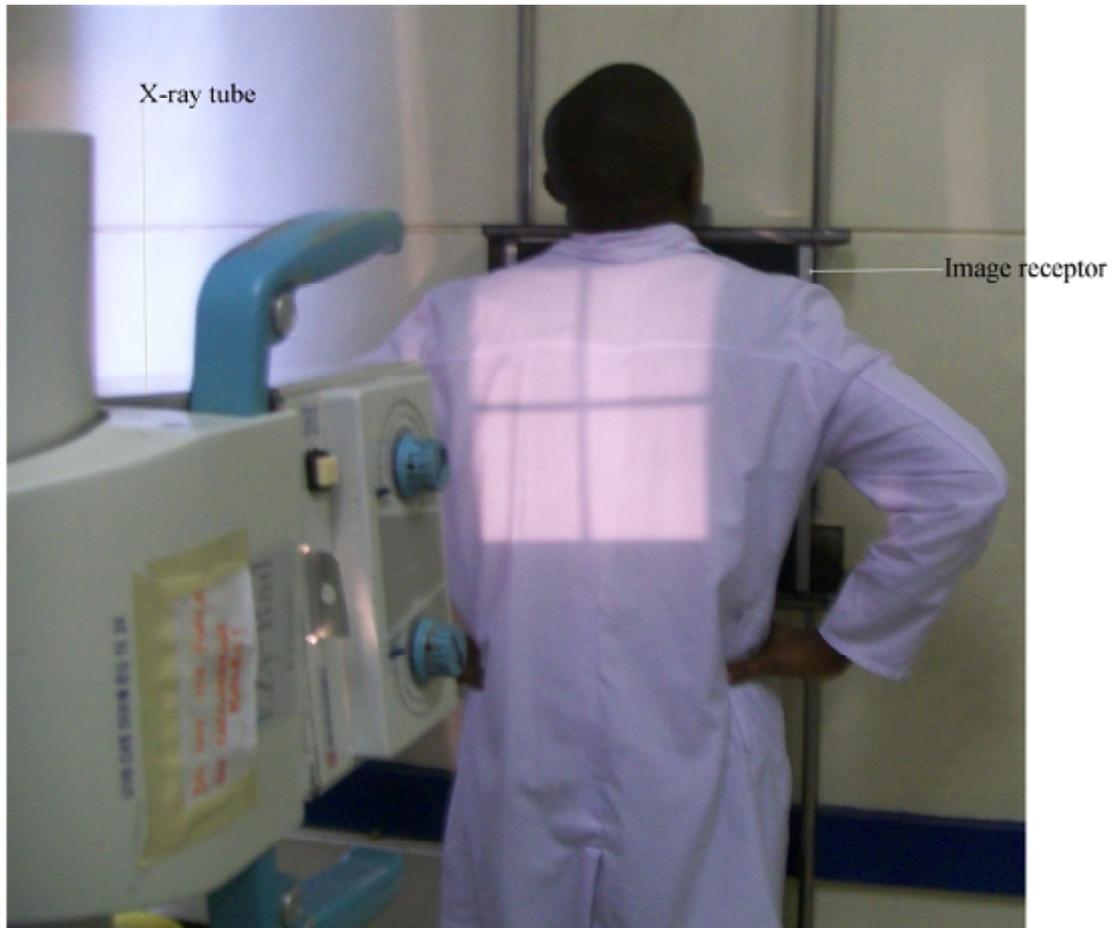
The person is positioned so that the anterior chest lies next to the image receptor. The x-rays are produced in the x-ray tube and pass through the subject from the posterior chest. The central ray is centered at the level of the fourth thoracic vertebrae.

It is not possible or practical to shield the radiosensitive tissues of the thyroid or breast as this would obscure the very areas a radiologist would want to check for pathology; these being the cervical spine area and the lungs. Inevitably therefore, these glands cannot be shielded from radiation. The final image of the chest obtained will appear as shown in figure 2.

Figure 2: A normal chest radiograph.
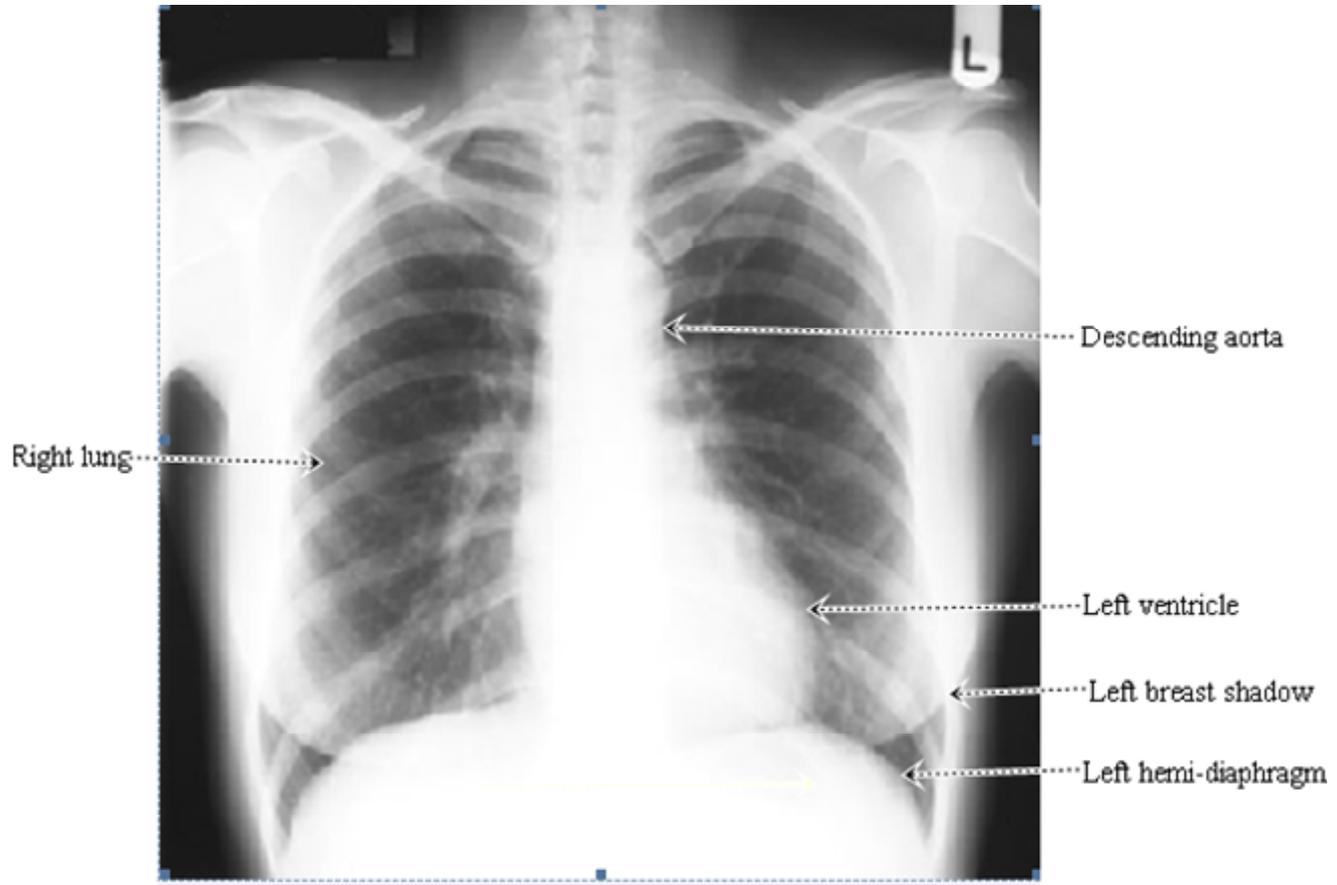
CHAPTER 2 LITERATURE REVIEW

A chest radiograph examination exposes the individual to ionizing radiation of about 0.1 millisieverts (mSv) (Staniszewska, 1999), (Aroua A et al, 2003). Other investigators have calculated similar figures (Diederich S, Lenzen H, 2000). Although other authors have found higher doses of more than 1mSv in some situations (Nohara T, Terao H, Tobe K, Musashi M, Nagao K, 2009), 0.1mSv is generally accepted as the average dose sustained in a routine radiograph. In contrast, the radiation dose associated with a typical CT scan ranges from 1-14 mSv depending on the body region being imaged and the type of examination (Bethesda, MD, 1987)

This should not give a false sense of security. The fact is radiation dose is cumulative. The younger one is therefore the higher the risk of a greater cumulative dose due to multiple radiographic exposures. No one should be exposed to the tiniest dose of radiation unless it is absolutely necessary.

There is an increased risk of malignancy following exposure to ionizing radiation. Several epidemiological studies have confirmed this relationship especially in areas that have experienced nuclear disasters. Tronko et al has described radiation induced thyroid cancer in Ukraine following the Chernobyl nuclear accident (Tronko M, 2010). Chadwick and Leenhouts have shown that 'radiation induced cancers arise from somatic mutations' (Chadwick KH, 2011).

One author has vividly described radiation from medical imaging as 'a silent harm' (Mercuri M, 2011). Despite these facts, many members of the public and even doctors do not fully appreciate the dangers posed by radiation. Bosanquet DC et al working in the United Kingdom showed that doctors of all grades have a very poor knowledge of radiation exposure even with the most common investigations (Bosanquet DC, 2011).

Further, many doctors are not even aware of the cost of a chest radiograph (Gervais N, 2011). The financial implication to the patient is therefore not in mind when ordering what they consider a simple and routine examination.

Although a chest radiograph can be useful in the diagnosis of pathologies other than

infections such as lung cancer and cardiac lesions, many studies have showed no reduction in mortality with screening for lung cancer using chest x-rays. The earliest study, the Northwest London Mass Radiography Service, randomly assigned 55,000 male workers to receive chest x-rays every six months for three years, or a baseline and end-of-study chest x-ray only. After three years, mortality from lung cancer remained the same in the two groups (Brett GZ, 1969).

In a study performed by at the University of Benin in Nigeria, there was no correlation between a positive Mantoux test and abnormal chest radiographs performed on newly employed/ admitted university staff/students (Adeyekun AA, 2010). This study aimed at establishing if any justification existed in requesting chest radiographs in asymptomatic subjects with a positive Mantoux skin test reaction. The study involved 174 adults comprising pulmonary tuberculosis (PTB) contacts and newly employed/admitted University staff/students. They were all subjected to an initial Mantoux test and those who were positive had a postero-anterior chest radiograph (PA-CXR). Of the 174 subjects, 102 (59.2%) had a positive Mantoux test. Of these, 27 (31.1%) had an abnormal CXR. There was no positive correlation between Mantoux readings and abnormal chest findings. The author therefore recommends that ancillary tests such as sputum for Acid Fast Bacilli (AFBs), interferon and ESAT tests should be carried out in clients with positive mantoux tests before being subjected to CXR.

Ladd SC et al working in Germany retrospectively reviewed 1760 Pre-Employment Examination (PEE) chest radiographs. Pathological findings were categorized as relevant or non- relevant. No positive finding in respect to Pulmonary Tuberculosis (PTB) or other infectious disease was found (Ladd SC, 2006). In fact, 94.8% of the chest radiographs were completely normal. Only 5 findings were regarded as relevant for the individual. No employment relevant diagnosis was made. She therefore concluded that routine CXR is not useful as part of PEE and that it can actually violate European law. She further concluded that it is both expensive and lacks medical justification.

Eisenberg RL et al in the United States of America reported a low yield of routine CXR in a large PTB screening program (Eisenberg RL, 2010). He undertook to assess the frequency and spectrum of abnormalities on routine screening chest radiographs in the pre-employment evaluation of healthcare workers with a positive tuberculin skin test (TST) results. 2586

asymptomatic participants were evaluated between January 2003 and December 2007. Only 159 (6.1%) CXRs yielded abnormal results with no finding consistent of active PTB. The investigators therefore concluded that that routine pre-employment chest radiographs were of low yield in detection of active PTB or latent TB infection reactivation risk.

Writing in the Journal of the National Medical Association, Lohiya GS et al concluded that pre-employment chest radiographs are not useful, gave the client unwarranted radiation and the employer a false sense of security (Lohiya GS, 2006). The study concluded by terming routine chest radiographs futile and recommending periodic review of long established procedures.

Sebro K et al performed a cross-sectional retrospective study of 12,662 chest x-ray reports collected over an eight year period (1989- 1997) from prospective University students. No active PTB was noted in this study at the University of West Indies. Three hundred and ninety nine findings which were classified as clinically insignificant were reported. These included calcified foci and mild scoliosis. The study recommended the discontinuation of such examinations noting that they posed unnecessary radiation to students joining university (Sebro K, 2001).

Krarup KC et al retrospectively reviewed 1994 CXRs of new employees of Leicestershire Health Authority to assess the use of this tool to detect and prevent PTB. No evidence suggestive of PTB was found in all the radiographs (Krarup KC, 1989).

CHAPTER 3 STATEMENT OF RESEARCH PROBLEM

3.1   Research Problem

Routine chest radiographs are commonly performed in Kenya. While this seems accepted by both physicians and the general public, there is no evidence to support this practice. Is it necessary to subject an asymptomatic individual to a chest radiograph? This is the question this study sought to answer.

The routine CXRs are performed to exclude mainly pulmonary tuberculosis. According to World Health Organization's Global TB report 2009, Kenya had approximately 132,000 new TB cases the previous year and an incidence rate of 142 new sputum smear- positive cases per 100,000 of the population.

Presently, the HIV sero-prevalence among the tuberculosis patients is 44% in 2009.

While acknowledging that PTB is a major health problem in the country, there is a need for an objective assessment of the need for continued routine chest radiographs.

Although routine chest radiographs are used to mainly diagnose infectious diseases, other pathologies can also be diagnosed. These include heart lesions, malignancies like bronchogenic carcinoma and metastases and interstitial lung diseases. However, routine CXRs are not ordered to exclude these conditions as it has been noted above.

3.2   Justification

Chest radiographs exposes the patient to ionizing radiation. The effective radiation dose from this procedure is about 0.1 mSv (Diederich S, Lenzen H, 2000)**.** This is the amount of radiation sustained by an individual in ten days from background radiation. Radiosensitive tissues of the breast and thyroid gland are involved.

A cursory survey in the major hospitals in Nairobi revealed that the cost of chest radiograph is between 700 and 1500 Kenya shillings. This is a significant amount of money considering that, according to Kenya Integrated Household and Budget Survey (KIHBS),

46% of Kenyans are absolutely poor i.e. they live below the poverty line defined as less than one United States of America (USA) dollar per day.

The financial aspects of acquiring a chest radiograph also involve travelling to a health institution with X-ray facility. Often, this facility will be far removed from the normal domicile of the individual therefore incurring him additional transport costs.

This study sought to find out whether indeed it is justified to include a chest radiograph as part of RME considering the radiation and financial implications involved.

3.3   Objectives

3.3.1   Broad Objective

To determine the prevalence of abnormal radiological findings among routine medical examination chest radiographs.

3.3.2   Specific Objectives

1. To determine the spectrum of radiological findings in Routine chest radiographs especially those suggestive of PTB.

2. To find out if there is any difference in the prevalence of abnormal chest radiological findings between males and females.

3. To determine if any difference exists in the prevalence of abnormal chest findings between the various age groups.

4. To establish the reasons for ordering of routine chest radiographs and their respective frequencies.

3.4   Hypothesis

A chest radiograph is not useful for individuals undergoing routine medical examination.

CHAPTER 4   RESEARCH METHODOLOGY

4.1   Study area

The study took place at the following institutions all within Nairobi County:

- Kenyatta National Hospital, Department of Radiology.
- Department of Imaging and Radiation Medicine, University of Nairobi.
- Plaza Imaging Solutions, a private radiology practice in Nairobi.
- Department of Radiology, the Nairobi Hospital after obtaining the necessary approval from the management of this institution.

Although the main catchment area is Nairobi, many of the individuals radiographed came from the surrounding counties.

4.2   Design of the study

This was a cross-sectional study. Routine chest radiographs reports signed by a qualified and experienced radiologist were reviewed. All the radiographs were reported by radiologists with more than ten years of experience. Chest radiograph reports from the time the study was approved by the Institutional Ethics Review Committee were analyzed.

4.3   Variables

The study had abnormal chest radiological findings as the variable outcome. The spectrum of the abnormal findings was determined. The study also sought to find the main reasons Kenyans are required to have routine chest radiographs.

4.4   Study Population

The study population consisted of all those individuals referred for routine chest radiographs in the radiology departments of Diagnostic Imaging Radiation Medicine, University of Nairobi and Kenyatta National Hospital between the months of May and November 2012. The study was also conducted at Plaza Imaging Solutions, a Private Radiology Practice in

Nairobi. After approval, data was also obtained from The Nairobi Hospital, a leading Private hospital within the city of Nairobi.

4.4.1 Inclusion criteria:

1. The CXRs performed in the year 2012 were included to reflect the current practice in the country.
2. Only reports signed by a qualified radiologist licensed by the Medical Practitioners and Dentist Board (MPDB) and the Radiation Protection Board were included. All reporting radiologists involved in this study had more than ten years of practice.

4.4.2 Exclusion Criteria:

1. Chest radiograph reports that do not include the age and sex of the client were excluded from the study.
2. Any radiograph whose requisition form indicated that the examining physician found an abnormal chest sign or the patient has chest symptoms was excluded. If a patient was symptomatic, then strictly speaking this cannot be classified as RME.

4.5 Sampling

Purposive sampling was undertaken. Only chest radiographs obtained for routine medical examination were reviewed. This was for clients meant to undertake pre-employment, pre-college, pre-travel and those clients undergoing periodic chest radiographs while in employment. Radiographs for individuals intending to migrate to other countries were also included in this study.

4.6 Sample Size determination

The error of estimation in the study was set at 0.05 and the prevalence of abnormal chest radiographs at 31% as per Adeyekun study in Nigeria.

$$N = \frac{(Z\alpha^{1/2})^2 (p(1-p))}{E^2}$$

Where,

Zα1/2 is the relative coefficient 1.96

P = 0.31

E is the error of estimation = 0.05

Therefore,

N= $(1.96^2 \times 0.31 \times 0.69)/0.05^2$

$= 328$

The estimated sample was therefore 328 chest radiographs. This was set as the minimum number of radiographs to be analyzed. The investigator however analyzed 402 radiographs.

4.7 Data collection techniques

This was a quantitative study. Data collection was primarily from secondary sources. This was through the review of Radiologists' reports for routine medical examination chest radiographs. Data was collected using a form attached at the appendix C.

4.8 Minimization of data errors

The data collected was reviewed, cleaned and saved daily in digital format to prevent data loss.

4.9 Data analysis

Data was entered into the Microsoft Access computer program database and analysis done on STATA.

Presentation of data findings has been done by use of description tables, pie charts and frequency histograms. Analysis was by chi square analysis, comparison of means by paired t-tests and medians by non-parametric tests.

After chi square analysis, the variables with an association were analyzed by regression technique to determine magnitude and direction of the association.

4.10 Ethical Issues

Ethical clearance was obtained from the Ethical Research Committee based at the Kenyatta National hospital upon submission of the proposal. As this study dealt with secondary sources of data, consent was obtained from the head of the radiology department from which the data was to be collected or his representative. The consent form is attached as appendix E.

4.11 Study procedure

Individuals were referred to the participating facilities with a request form. The form contained personal details of the individual such as age and sex and also the reason the CXR was ordered e.g. travel etc.

Most of the individuals underwent PA CXRs. In situations where the radiologist wanted more information, additional views were ordered; lordotic views in suspected apical lesions such as apical pleural thickening and lateral CXRs.

The Nairobi Hospital had a PACS system at the time of the study and therefore the images were viewed as soft copies. All the other centers had their images reported on film.

The author was present during the actual reporting by the radiologist and noted the radiologist's findings on the data collection form.

A single individual's image(s) was read by one radiologist.

4.12 Limitations of the study

Due to time and financial considerations, this study was performed only in Nairobi. The results however were generalized for the whole country. The results of this study can be generalized for the whole country as Nairobi is a fairly cosmopolitan city. Many individuals seeking medical services in Nairobi have actually travelled from upcountry counties. Many

students studying in Nairobi are from territories out of the city. The population of Nairobi can therefore be seen as fairly representative of the country.

CHAPTER 5 RESULTS

5.1   Introduction

The study data was collected mainly at the Nairobi Hospital and at Plaza Imaging in Nairobi. A total of 402 chest radiograph reports were examined. The males were 208 accounting for 51.7% of the total population. The females were 194 making 48.3% of the study population.

Table 1 Table showing population frequency by sex

Sex	Frequency	Percentage
Male	208	51.7
Female	194	48.3
Total	402	100

Figure 3 Pie chart showing population by sex

female   male
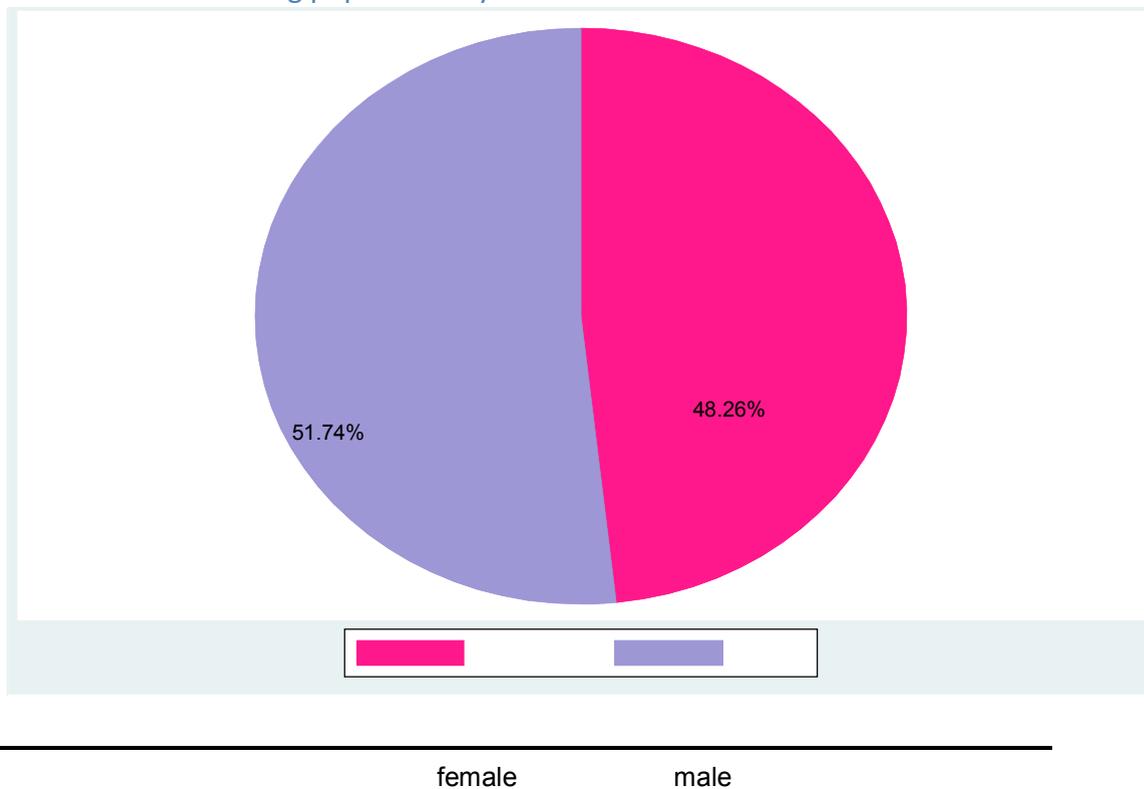
5.2   Socio-demographic characteristics

5.2.1   Age and sex

Overall mean age was 29.7 years. The 25th and 75th percentiles are 19 years and 38 years respectively, with a lower range of 4 years to an upper range of 63 years. The oldest participant was 86 years of age. A few outliers were noted.

Figure 4 Box Plot showing age of participants
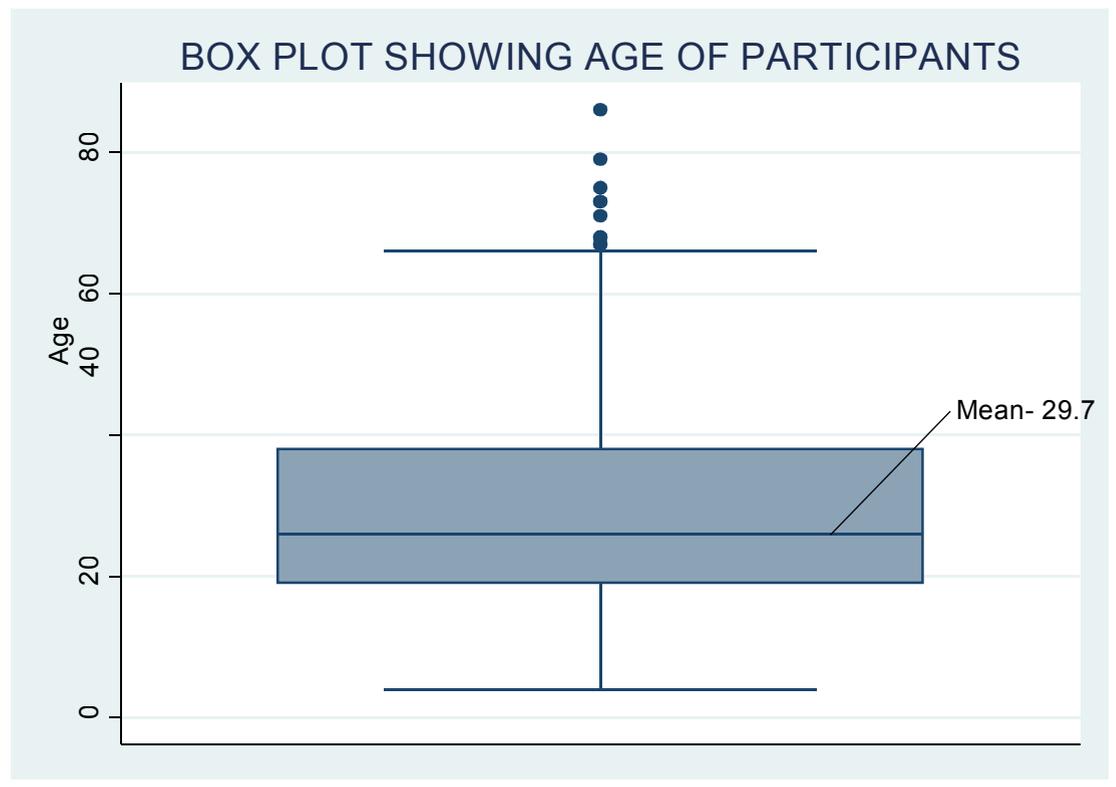
When stratified by sex, male participants had the youngest at 4 years and oldest at 61 years, with the 25th percentile and 75th percentile at 19 and 39 years respectively. Among the female participants, the 19 years fell on the 25th percentile, while the 75th percentile was 37 year. Age difference between male and female was not found to be significantly different (p=0.7)

Figure 5 Box plot showing age of participants by sex
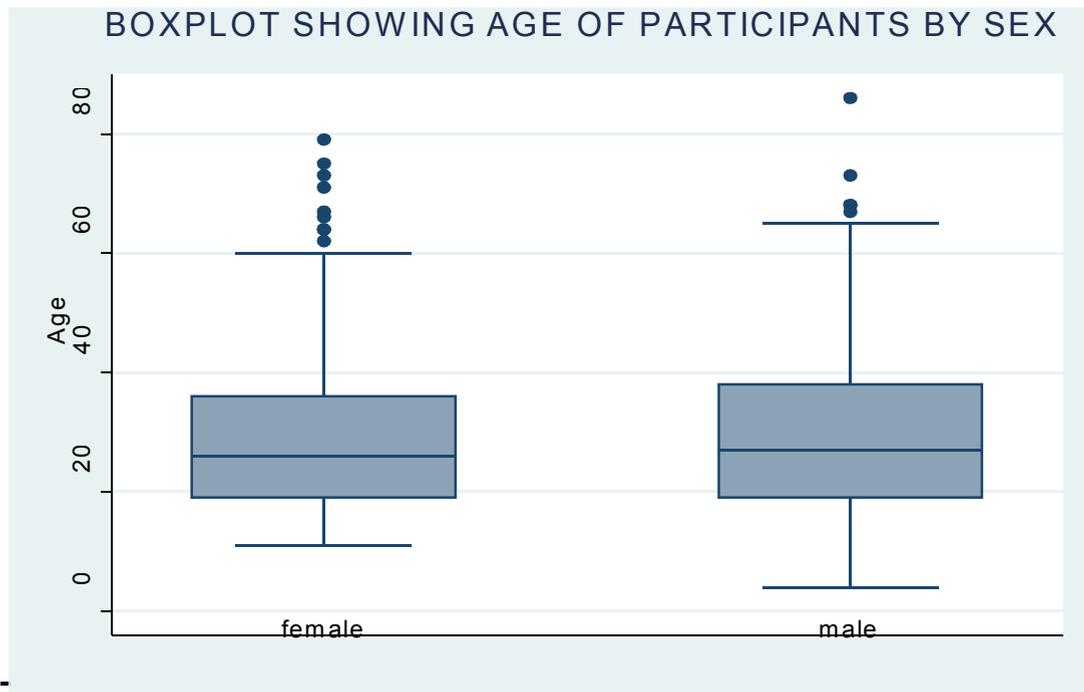
Table 2 Socio-demographic characteristics- Number of participants stratified by age groups

Age	Frequency	Percentage	Cumulative Percentage
<12	15	3.7	3.7
13-34	265	65.9	69.6
35-44	62	15.4	85.0
45-54	28	7.0	92
55-90	32	8.0	100

Figure 6 Population frequency stratified by age categories
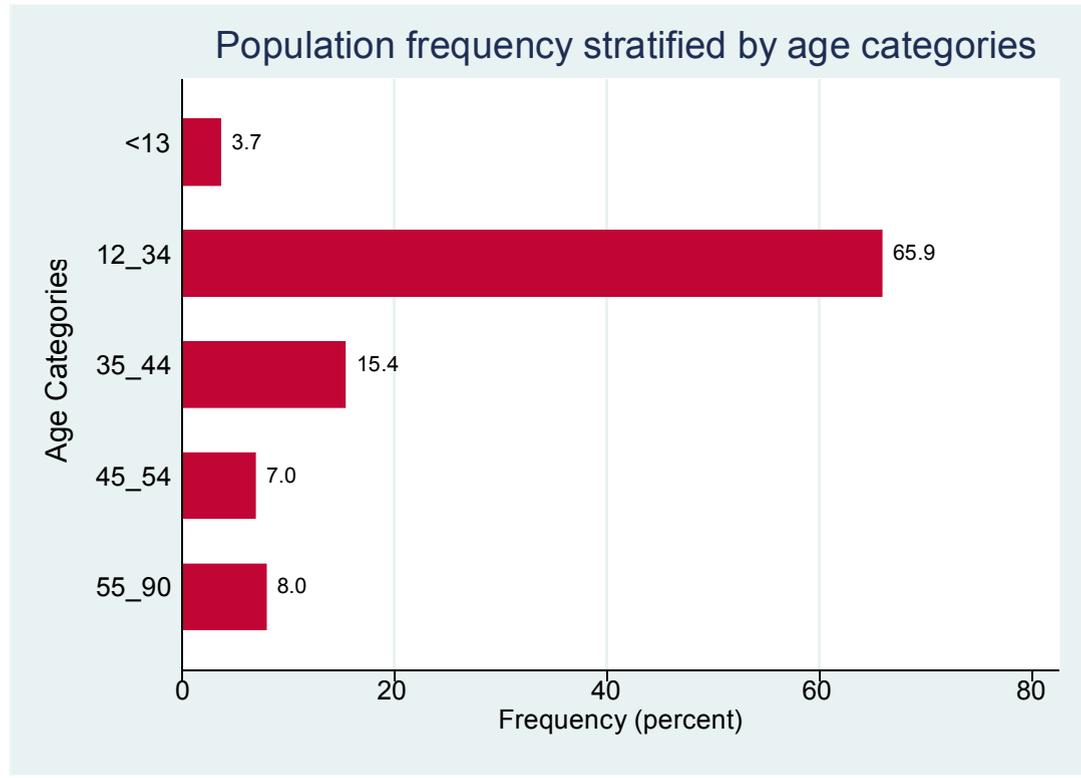
The 13-34 age-group had the most radiographs (265) accounting for 65.9%. This can be attributed to the fact that most of the Kenyan population is young and that most of the people migrating and travelling abroad for studies are young people in this age bracket.

5.3 Reasons for routine chest radiographs

Table 3 Reason for x-ray examination

Reason for X-ray	Frequency	Percentage	Cumulative Percentage
Migration and Travel	377	93.8	93.8
Periodic Medical Exam	14	1	94.8
Pre-employment	7	3.5	98.3
Other	4	1.7	100

Migration and travel accounted for most of the chest radiographs, a total of 377.This accounted for 93.8% reflecting the fact that the study centers received a lot of referrals for RME from International Organization for Migration (IOM). Periodic medical examination accounted for only 1% which may reflect the fact that in Kenya, the issue of healthy people visiting their doctors for routine medical check-up is still at a nascent stage.

Figure 7 Graph showing reasons for routine chest radiographs

GRAPH SHOWING REASON FOR ROUTINE CHEST RADIOGRAGPH
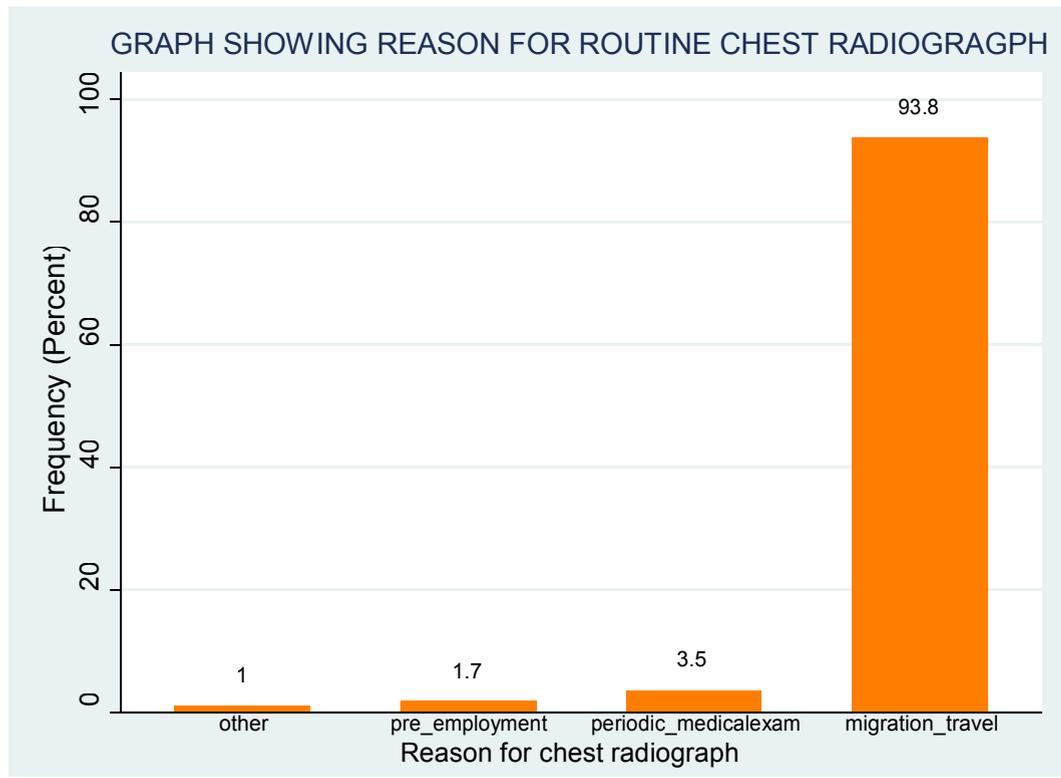
5.3.1 Prevalence of abnormal results by sex

More males than females had abnormal x-ray results (18% v 13%), with about 16% of the total population having abnormal results. This difference however is not statistically significant (p=0.13).

Table 4 Prevalence of abnormal results by sex

Sex	Abnormal report		Total
	No	Yes	
Female	169 87.1	25 12.9	194 100
Male	170 81.7	38 18.3	208 100
Total	339 84.3	63 15.7	402 100

5.3.2   Prevalence of abnormal results by age groups

A significantly higher population studied was aged between 12 and 34 years. Not surprisingly therefore, 48% of all abnormalities fell within this age group. The difference in prevalence of abnormal x-ray result was significantly different when stratification by age was done ($p<0.01$.)

Table 5 Table showing prevalence of abnormal results by age

Abnormal Report	Age					
	<13	13-34	35-44	45-54	55-90	Total
No	15 4.4	235 69.3	51 15.0	23 6.8	15 4.4	339 100
Yes	0 0	30 47.6	11 17.5	5 7.9	17 27	63 100
Total	15 3.7	265 65.9	62 15.4	28 7.0	32 8.0	402 100

Figure 8 Summary of pathological findings
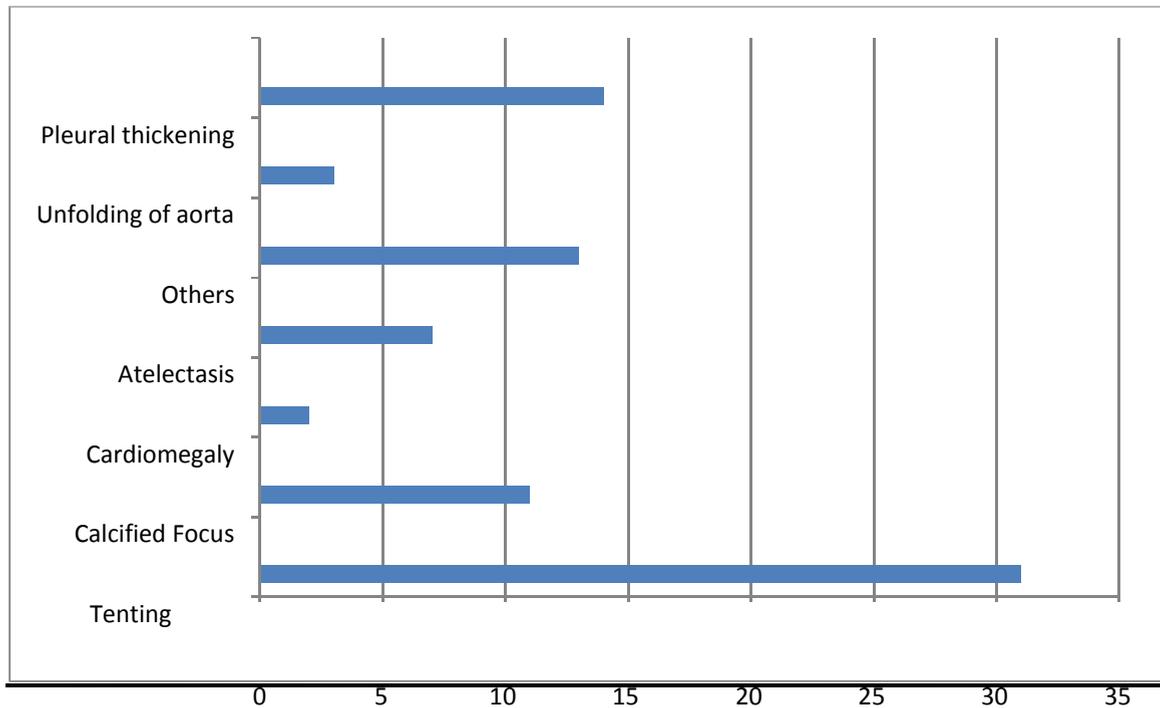
Sixty three chest radiographs had a total of eighty one abnormalities. This is because in some individuals a single radiograph had two or more abnormalities. For analysis, these abnormalities were grouped into six groups as showed in the figure 5.6 above. Focal lung fibrosis represented on the CXR by a focal fibrotic streak or tenting of the hemidiaphragm accounted for 38.3% of the pathological lesions. Only two cases of cardiomegaly were present (2.5%)

A calcified focus possibly representing a healed previous infection occurred in 11 radiographs which is 13.6% of the cases.

Only three radiographs had unfolded aorta as a pathological findings. The ages of the clients were 86, 61 and 59 years reflecting the possibility of age (senile unfolding) as a possible etiology.

5.4 Select Images of Pathological Chest Findings

Figure 9 Cardiomegaly

Figure 10 Image showing tenting of the right hemidiaphragm (arrow)
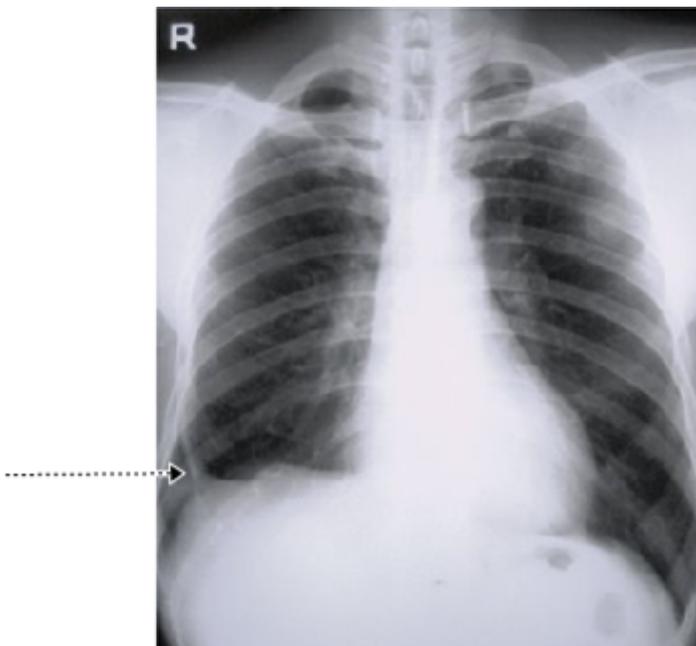
Figure 11 Image shows unfolded thoracic aorta (arrow)
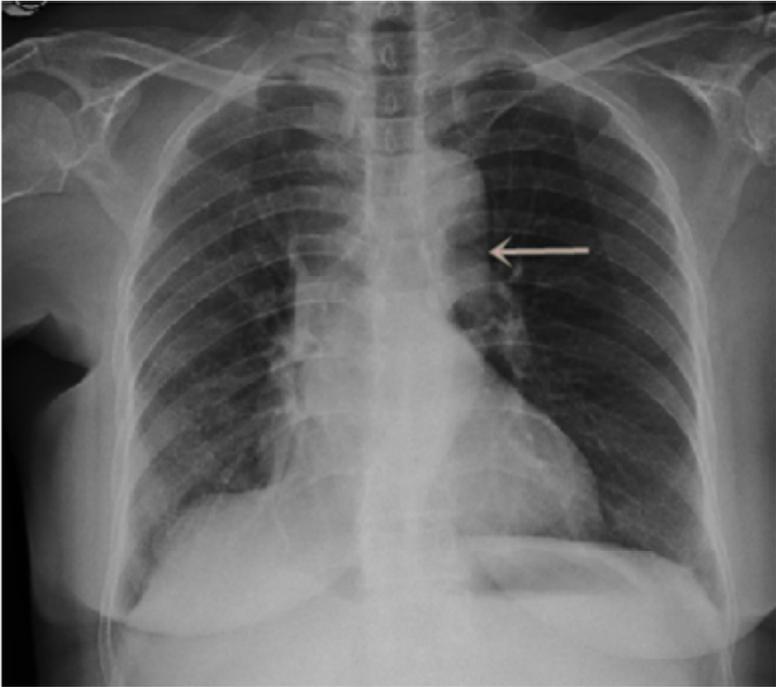
CHAPTER 6 DISCUSSION, CONCLUSION AND RECOMMENDATIONS

6.1 Discussion

6.1.1 Prevalence of abnormal chest findings

There were a total of 402 chest radiographs and reports analyzed. 16 percent of these showed abnormality. This means that of the 402 radiographs, 339 were normal. This is 84 percent of the study population.

Although 16% had abnormal findings, only one radiograph accounting for 1.6% of the abnormal radiographs had features suggestive of PTB. This is the only individual who required intervention in terms of treatment.

The prevalence of abnormal findings is higher in this study than in a study done in Germany for pre-employment chest radiographs which involved 1760 participants. Of these 94.8% were normal (Ladd SC, 2006).

The study findings also compare with a similar one by Krarup KC et al who retrospectively reviewed 1994 CXRs of new employees of Leicestershire Health Authority to assess the use of this tool to detect and prevent PTB. No evidence suggestive of PTB was found in all the radiographs (Krarup KC, 1989).

The males accounted for 51.7% of the radiographs (208 chest radiographs) while the females were 194 accounting for 48.3%.

More males than females had abnormal x-ray results (18% v 13%). This difference however is not statistically significant (p=0.13)

A significantly higher population studied was aged between 13 and 34 years. This is in keeping with the population structure of the Kenya. Not surprisingly therefore, 48% of all abnormalities fell within this age group. The difference in prevalence of abnormal x-ray result was significantly different when stratification by age was done (p<0.01.)

6.1.2   Indications for routine chest radiographs

Majority of the chest radiographs were done for migration/travel. This accounted for 93.8% of the 402 radiographs analyzed. As indicated above, this is due to the fact that the imaging centers where data was collected received most of patients for RME from IOM.   The rest were periodic medical exam at 3.5%, pre- employment at 1.7% and others took the rest (1%).

6.1.3   Spectrum of radiological findings

These were very varied. Of significance is that only one of the radiographs had a finding which could suggest PTB. This was a nodule and a cavity. The others had various findings as shown on the appendices.

6.2   Conclusion

The study found that only 16% of routine chest radiographs had an abnormal finding of any kind and that only one chest radiograph (0.25%) had a finding suggestive of active pulmonary tuberculosis.

Most of the radiographs analyzed were for individuals planning to travel or migrate out of the country.

6.3   Recommendations

1. The usefulness of routine chest radiographs in Kenya need to be reconsidered due to the poor yield of significant positive findings. The practice of carrying out routine chest radiographs should possibly be stopped. Only those patients who are symptomatic warrant a chest x-ray.
2. The concerned authorities should device a more sensitive screening method for pulmonary tuberculosis. A normal chest radiograph may give a false sense of security. A laboratory screening method may yield higher results.
3. The author proposes a larger study to include more parts the country and get a bigger sample size. This would increase the level of confidence before major policy changes are effected.

CHAPTER 7 APPENDICES

7.1   APPENDIX A- ORGANIZATION OF THE STUDY AND WORK PLAN

This study was scheduled to be completed within one year. The following time table was followed:

Table 6 Organization of the study and work plan

	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M
Proposal writing	x	x	x														
Submission to ERC			x	x	x												
Data collection					x	x	x	x	x	x	x	X					
Data analysis													x	x			
Report writing															x	x	
Final report submission																	x

7.2 APPENDIX B- BUDGET

Table 7 Budget

Description	Price per unit (Kshs.)	Quantity	Total (Kshs.)
1. Printing, 2. Photocopying 3. Paper 4. Writing material	10 per questionnaire	5000	50,000
Data analyst	50,000	1	40,000
Data entry	100 per questionnaire	402	40200
Data Collection Assistant	50,000	1	30,000
Ethics Review Committee fee	1000	1	1,000
Miscellaneous			26,000.
Transport			50,000
Spiral/ hard cover binding			10000
Total			**247,200.**

The study was financed by the researcher.

7.3 APPENDIX C- DATA COLLECTION FORM

Table 8 Data Collection Form

DATA COLLECTION FORM- UTILITY OF ROUTINE CHEST RADIOGRAPHS			
Date:		Facility:	
Age (Years)			
Sex (Tick)	Male		Female
Reason for CXR (Tick)	Pre-college		
	Pre-employment		
	Insurance		
	Travel		
	Migration		
	Periodic Medical Exam		
	Other(Explain)		
Diagnosis	Normal Report		
	Abnormal Finding(Explain)		

7.4 APPENDIX D- DUMMY TABLES FOR DATA ANALYSIS

Table 9 Table of normal versus abnormal radiographs

	Number	**Percentage (%)**
Total radiographs analyzed	**402**	**100**
Normal radiographs		
Abnormal radiographs		

Table 10 Reasons for ordering routine chest radiographs

Reason	Percentage
Pre-school	
Pre-employment	
Pre-Insurance	
Travel	
Periodic Medical Exams	
Others	

Table 11 Spectrum of disease pattern

Disease/ Radiological Finding	Frequency

7.6   APPENDIX E- CONSENT FORM

Part I: Information about the study

Name of Study: The Utility of Routine Chest Radiographs in Kenya.

Aim of the Study: The main objective of this study to determine the prevalence of abnormal radiological findings among routine medical examination chest radiographs.

Methods: Data will be obtained from secondary sources. No interviews shall be conducted with the patients. Consent shall therefore be obtained from the head of the radiology unit in which the study shall be performed. The period of data collection is expected to run from May to December 2011.

Confidentiality: Names of patients shall not be used during data collection.

Investigator: Dr. Ndii K.Muriuki, University of Nairobi. Email: drndii@yahoo.com. Any queries shall be directed to the investigator.

Sponsor: Dr. Ndii K. Muriuki.

Part II: Consent

Authority is hereby given to the researcher to collect data.

Name of Officer-in-Charge:--

Name of Institution---

Designation---

Signature--**Date**----------------------------

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