PATTERN OF REQUEST AND RADIOGRAPHIC FINDINGS IN PATIENT WITH PULMONARY TUBERCULOSIS IN UBTH, BENIN CITY, EDO STATE, NIGERIA.

A PROJECT WORK

BY

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OCTOBER, 2025

CERTIFICATION

This is to certify that this project work, **Pattern Of Request and radiographic findings in Patients with Pulmonary Tuberculosis in University Of Benin Teaching Hospital**, was carried out by **USIDEME DAVID OSAMOJE** with matriculation number **BMS2001270** under our guidance.

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APPROVAL PAGE

Project title: **Pattern Of Request and radiographic findings in Patients with Pulmonary Tuberculosis in University Of Benin Teaching Hospital**, This project work is hereby approved in partial fulfillment of the requirements for the award of Bachelor of Radiography (B.Rad) Degree in Radiography from the University of Benin.

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DEDICATION

To God Almighty who has been my foundation of strength, wisdom, knowledge and also my beloved family for their support towards the success of this project work.

ACKNOWLEDGEMENT

I wholeheartedly thank Almighty God for granting me the grace, wisdom, and strength to successfully carry out this project work. My heartfelt appreciation goes to my beloved parents and siblings for their consistent support. I also wish to express my sincere gratitude to my project supervisor, Dr. G. E. Okungbowa, for his valuable guidance and assistance.

My profound thanks also go to all my lecturers and to the non-academic staff for their as sistance and contributions in various capacities, and finally to the Head of Department, Mrs. Fanny Igbinedion for her leadership and support, which which was essential for the successful completion of this project.

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LIST OF ABBREVIATIONS

1. UBTH - University of Benin Teaching Hospital
2. PTB - Pulmonary Tuberculosis
3. LTBI - Latent Tuberculosis Infection
4. MDR-TB - Multi-drug resistant Tuberculosis
5. XDR-TB - Extensively Drug-Resistant TB
6. FMOH & SW - Federal ministry of Health & Social welfare
7. HIV - Human Immunodeficiency Vírus
8. WHO - World Health Organization
9. SPSS - Statistical Package for the Social Sciences

ABSTRACT

Pulmonary Tuberculosis typically more common in low economic communities has shown a resurgence in non-endemic populations in recent years, a phenomenon that has been attributed to factors such as increased migration and the HIV epidemic. Pulmonary tuberculosis is a disseminated disease (likely to progress and spread from the lungs to involve other organs and systems, e.g the cardiac and the CNS), hence timely diagnosis of the disease is paramount. So it is important that radiologists and clinicians understand the typical distribution, patterns, and clinical manifestations of Pulmonary Tuberculosis.

A retrospective study of clinical and chest radiographic features of all 331 Pulmonary Tuberculosis (PTB) patients diagnosed within june, 2024 and june, 2025 was carried out. at the end of the study analysis indicated a male predominance (63%) with a mean age of 48 years. Clinical symptoms like cough were most common (52%) but had low specificity for TB diagnosis. Radiographic findings revealed advanced disease, with fibro-cavitary changes in 31.4% and upper lobe involvement in 90.6% of cases. Clinical suspicion had a sensitivity of 78.6% but a specificity of only 36.1%, limiting its diagnostic accuracy. The study shows both the benefits and limitations associated with reliance on clinical manifestations of Pulmonary Tuberculosis (PTB) alone before further diagnosis and encourages combining clinical assessment with routine chest X-rays and improved diagnostic protocols for early and more accurate Tuberculosis detection

ABSTRACT

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CHAPTER ONE

INTRODUCTION

1.1 Background Of The Study

Tuberculosis (TB) is a significant global health concern, with more severe implications on low and middle-income countries where healthcare systems are not usually well equipped and resourced (WHO, 2017). Pulmonary tuberculosis (PTB), caused by *Mycobacterium tuberculosis*, primarily affects the lungs and is transmitted through airborne droplets released by individuals with active disease (WHO, 2019). Despite decades of global control efforts, TB continues to pose serious challenges to modern healthcare, due to evolving epidemiological patterns, and still existing gaps in detection and reporting systems.

Various studies carried out around the world indicate a gradual decline in TB incidence and mortality over the years. however, this progress has been uneven across different regions. Many countries located in Sub-Saharan Africa, including Nigeria, still experience one of the highest burdens of PTB, reflecting inadequacy in disease control, socioeconomic development, and access to healthcare which is fueled by poverty, overcrowding, inadequate ventilation systems, and limited environmental sanitation. factors that encourage rapid airborne disease spread. Despite best efforts by national TB programs and awareness campaigns, misdiagnosis and delayed case detection are still persistent problems in the Nigerian public healthcare system.(FMOH & SW, 2017).

A critical information gap still exists in understanding the true magnitude of PTB in many regions due to diagnostic limitations. Many healthcare facilities lack the tools and trained personnel required for timely diagnosis and follow-up (Tamirat et al., 2022). Chest radiography is the standard diagnostic tool used for detecting pulmonary abnormalities, it is essential for early case identification and treatment monitoring. However, the limited access to radiographic interpretation experts and inadequate integration with confirmatory tests such as sputum microscopy or GeneXpert further

contribute to diagnostic challenges (Te Riele et al., 2019). These limitations highlight the need for improved diagnostic capacity and standardized reporting systems to close existing data gaps.

Only a few contemporary studies have systematically assessed the radiographic features of PTB within Nigerian healthcare contexts, Despite its diagnostic value, indicating a deficiency in localized data and evidence-based practice. This study aims to address part of this by evaluating radiographic findings among patients diagnosed with pulmonary tuberculosis at the University of Benin Teaching Hospital, Benin City. By examining current imaging patterns and correlating them with clinical presentation, this research contributes to the broader understanding of TB trends and diagnostic challenges in Nigeria.

1.2 Statement Of The Problem

Nigeria being one of the countries with the highest tuberculosis burden globally, so it contributes substantially to Nigeria's annual morbidity and mortality rates, we face considerable obstacles in combating this disease. In 2016, the estimated number of new and relapse TB cases was 158 per 100,000 people, with a total of 39,933 deaths attributed to TB in that year alone. These figures highlights the urgent need for comprehensive strategies to address the TB epidemic in the country (FMOH & SW, 2017).

Urban and suburban areas, characterized by high population densities and often limited healthcare infrastructure, are particularly vulnerable to the spread of PTB. Overcrowded living conditions and inadequate access to healthcare services exacerbate the situation, facilitating the transmission of the disease. Addressing these challenges requires a multifaceted approach, including improved healthcare delivery, enhanced public awareness, and targeted interventions to reduce transmission rates.(FMOH & SW, 2017)

The University of Benin Teaching Hospital (UBTH), as a tertiary healthcare facility in Benin City, plays a crucial role in the diagnosis, treatment, and management of TB cases within Benin city and the surroundings.

Chest radiography continues to serve as an essential, cost-effective, and accessible tool in the initial assessment and follow-up of patients with suspected or confirmed pulmonary tuberculosis. Radiographic imaging not only aids in early detection but also helps in monitoring treatment response and detecting complications such as cavitation, fibrosis, and pleura involvement .However, there is a noticeable gap in the systematic documentation and evaluation of the pattern of radiographic requests and the typical imaging findings in PTB patients at UBTH. It is unclear whether imaging is being requested appropriately in alignment with clinical guidelines, or if there are trends in misuse of radiography in TB care. Additionally, there is limited data on the common chest X-ray findings in PTB patients in this specific hospital setting, which could help in building a reference database for diagnosis and clinical decision-making.

1.3 Research question

1. Which subset of the Population is most at risk of PTB Infection in Benin city and its environs
2. What are the common clinical indications documented for requesting chest X-rays in PTB patients at UBTH?
3. What are the typical radiographic findings observed in patients with confirmed pulmonary tuberculosis at UBTH?

1.4 Hypothesis

i. **Null Hypothesis (H_0):** There is no significant association between Clinical Suspicion and Radiographic Findings in patients diagnosed with pulmonary tuberculosis in UBTH **.**

ii. **Alternative Hypothesis (H_1):** There is a significant association between Clinical Suspicion and Radiographic Findings in patients diagnosed with pulmonary tuberculosis in UBTH .

1.5 Aim Of This Study

The aim of this study is to evaluate the patterns of request and radiographic findings in patient diagnosed with pulmonary tuberculosis in University of Benin teaching Hospital (UBTH), Benin city.

Specific Objectives

i. To identify and describe the common radiographic findings in patients diagnosed with pulmonary tuberculosis

ii. To identify the most common clinical indications documented for requesting chest X-rays in PTB patients at UBTH?

1.6 Significance of the Study

This study aims to provide new insights into the trends or patterns of occurrence of tuberculosis among patients at UBTH, which is essential for effective health service planning and resource allocation to improve the pulmonary tuberculosis victims healthcare. By correlating clinical symptoms with radiological findings, the research will greatly improve diagnostic accuracy, Additionally, the study will evaluate key demographic and clinical risk factors particularly age and gender, helping to facilitate early detection and timely treatment of tuberculosis patients at the university of Benin teaching hospital. UBTH

1.7 Scope of the Study

This study will be conducted in UBTH using patient records and information and radiologist report of patients diagnosed of pulmonary tuberculosis using a chest x-ray examinations recorded within a 1-year period, June 2024 and June 2025

1.8 Operational Definition of Terms

1. **Pulmonary Tuberculosis:** PTB is a bacterial infection caused by the *mycobacterium tuberculosis,* it primarily affects the lungs but can also affect other parts of the body. It's a contagious disease spread through airborne transmission when an infected person coughs sneezes or coughs
2. **Multidrug-Resistant TB (MDR-TB):** TB that is resistant to atleast isoniazid and rifampicin, the two most effective first-line anti-TB drugs.

3. **Extensively Drug-Resistant TB (XDR-TB):** A more severe type of drug-resistant TB that is resistant to isoniazid, rifampicin, and fluoroquinolones plus at least one second-line injectable drug.
4. **Cross sectional study (Prevalence study)**: A cross-sectional study is a type of observational research design in which data is collected at a single point in time (or over a short period) from a population or more commonly a representative subset to assess the prevalence of an outcome or characteristics

CHAPTER TWO

LITERATURE REVIEW

2.1 Conceptual Review

2.1.1 Definition, History and Pathophysiology of Pulmonary Tuberculosis

Pulmonary tuberculosis (PTB) is a contagious bacterial disease which mostly affects the lungs but may spread to other organs in the body. TB is caused by the bacteria called tubercle bacillus or *Mycobacterium tuberculosis*. (Iseman, 2000) The disease spread either by droplet infection from an individual with active TB, or in dust contaminated by infected sputum. Pulmoary Tuberculosis is characterized by high mortality and morbidity rates, mostly in developing countries (WHO, 2017)

The World Health Organization referred TB as the single most important deadly infectious disease, with an incidence rate of about 10 million and an annual mortality rate of 1.7 million (WHO, 2019). TB is a major public health problem in Nigeria ranking 7th among the 30 high TB burden countries worldwide and 2nd in Africa, accounting for 4% of the estimated incidence cases globally It has been estimated that about 460,000 cases of TB occur in Nigeria every year with incidence and mortality rates of 219/100,000 and 39/100,000 population, respectively. (FMOH & SW, 2017)

Tuberculosis (TB) has afflicted humanity for millennia and remains a significant global health issue, particularly in low- and middle-income countries. The history of tuberculosis is deeply intertwined with the development of human civilization, medical science, and public health policy. Archaeological evidence, including signs of spinal tuberculosis (Pott's disease) in Egyptian mummies dating back to 3000 BCE, indicates that TB has existed in human populations for thousands of years. Hippocrates, in ancient Greece, described a condition called "*phthisis*," likely tuberculosis, which he considered the most common cause of death in his era. During the 17th and 18th centuries, tuberculosis, then known as consumption, ravaged Europe and was often romanticized in literature and art due to its slow, wasting effects. Despite its prevalence, the

infectious nature of tuberculosis was not recognized until the 19th century. In 1882, German physician Robert Koch made a pivotal contribution by identifying the tubercle bacillus as the causative agent, for which he received the Nobel Prize in Physiology or Medicine in 1905. This discovery paved the way for future research and public health interventions. The development of the Bacillus Calmette-Guérin (BCG) vaccine in the 1920s marked another milestone in TB control, although its efficacy varies depending on the population and region. In the mid-20th century, the introduction of antibiotics such as streptomycin, isoniazid, and rifampin revolutionized the treatment of tuberculosis and led to significant declines in incidence in industrialized countries. However, the emergence of multidrug-resistant (MDR) and extensively drug-resistant (XDR) strains of TB, along with the HIV/AIDS pandemic, has complicated control efforts in recent decades.(Thomas, 1999)

The Pathophysiology of tuberculosis is characterized by a complex interaction between the host immune system and *Mycobacterium tuberculosis*. The bacterium is a slow-growing, aerobic, acid-fast bacillus with a waxy cell wall rich in mycolic acid, which contributes to its resistance to desiccation and many antibiotics. Transmission occurs primarily through inhalation of aerosolized droplets expelled by an infected individual with active pulmonary TB. Once inhaled, the bacilli reach the alveoli, where they are destroyed by alveolar macrophages. However, *M. tuberculosis* has evolved mechanisms to resist intra-cellular killing, such as inhibiting phagosome-lysosome fusion, allowing it to survive and replicate within macrophages. (Iseman, 2000)

PTB can be symptomatic or asymptomatic (latent) form, Latent TB infection (LTBI) is defined as a state of persistent infection without clinical features of active disease. When the clinical feature of the disease is present, the term TB is used without a further prerequisite is used to designate the disease.(Iseman, 2000) Based on this description, both TB and LTBI may be considered different phases in a continual pathological process, and both conditions are usually distinguished on the basis of the presence (TB) or absence (LTBI) of clinical, microbiological (direct microscopy or culture), and radiographic findings.(Mack et. al., 2009)

Chest radiography is a common radiographic investigation tool for screening, diagnosis and management of patients on anti-TB treatment. Despite its low sensitivity and a high inter-rater variability,and other imaging modalities like Computed Tomography (Chest CT) may provide better resolution and diagnostic quality, It still currently remains the most widely available and commonly employed PTB Diagnosis tool, particularly in low resource setting. (Te Riele et. al., 2019)

The radiographic feature of PTB varies with the stage of the infection, radiographic technique used and other associated conditions. However, the typical indicating features found on chest X-ray include:

i. Nodular Opacities: Nodular opacities are small, well-defined, rounded spots that appear on chest imaging, such as X-rays or CT scans. These nodules represent localized areas within the lung where inflammation, infection, or granuloma formation has occurred. Their size can range from a few millimeters to larger nodules, and their distribution may be scattered or clustered throughout the lung fields. These findings are often associated with a variety of conditions, including infectious diseases like tuberculosis, inflammatory disorders such as sarcoidosis, and even malignancies where metastases form small tumor nodules within the lung parenchyma (Khalid et al., 2023).

ii. Consolidations: Consolidations refer to regions within the lung where the normally air-filled alveoli become densely packed with substances such as fluid, pus, blood, or cellular debris. This causes the affected lung tissue to become firm and solidified, losing its typical spongy appearance. On imaging studies, consolidations show up as dense, white or opaque areas and are frequently seen in infectious processes like bacterial pneumonia. The presence of consolidation indicates an acute inflammatory process and can sometimes be associated with symptoms such as cough, fever, and difficulty breathing.

iii. Cavitation: Cavitation involves the development of hollow, air-filled spaces within lung tissue, often due to the necrosis (death) of lung parenchyma. These cavities form when lung tissue breaks down and creates a space that appears radiolucent (dark) on imaging studies amidst otherwise solid

areas of consolidation. Cavitation is typically a sign of aggressive or severe infections such as tuberculosis, lung abscesses, or certain fungal infections. The presence of cavitary lesions often suggests ongoing tissue destruction and can sometimes be associated with the release of infectious material into the airways.(Khalid et al., 2023).

iv. Fibro-cavitary Changes: Fibro-cavitary changes describe a complex lung pattern where both fibrosis (the development of scar tissue) and cavitation coexist. This combination is indicative of chronic, long-standing lung disease, most commonly seen in advanced cases of tuberculosis. The fibrosis reflects the body's attempt to heal and contain damage, while cavitation shows ongoing tissue necrosis and destruction. These changes often lead to structural distortion of the lung architecture, contributing to significant functional impairment and respiratory symptoms.(Khalid et al., 2023).

v. Lymphadenopathy: Lymphadenopathy in the chest refers to the enlargement of lymph nodes, particularly in the mediastinal or hilar regions, as observed on chest X-rays or CT scans. Enlarged lymph nodes may result from infections, inflammatory conditions, or malignancies. For instance, infections like tuberculosis or sarcoidosis often cause granulomatous inflammation leading to swollen lymph nodes. Similarly, malignancies such as lymphoma or metastatic cancers can cause lymph node enlargement. The presence of lymphadenopathy can be an indication in evaluating underlying pulmonary or systemic diseases.

vi. Fibrosis: Fibrosis is characterized by the thickening and scarring of lung tissue resulting from chronic inflammation or repeated injury. This process leads to stiffening of the lung parenchyma, reducing its elasticity and impairing effective gas exchange. On imaging, fibrosis appears as a network of reticular (net-like) or linear opacities, often associated with volume loss and architectural distortion of the lungs. Fibrotic changes can develop secondary to various chronic lung diseases, including idiopathic pulmonary fibrosis, post-infectious scarring, or exposure-related lung damage.

vii. Unilateral Pleural Effusion: Unilateral pleural effusion refers to the abnormal accumulation of fluid within the pleural space on one side of the chest cavity. This fluid collection can result from several causes, including infections such as pneumonia or tuberculosis, malignancies, congestive heart failure, or inflammatory conditions like rheumatoid pleuritis. On chest imaging, pleural effusions manifest as homogeneous opacities that obscure the underlying lung and demonstrate a characteristic meniscus-shaped curve at the fluid's upper edge. Patients with pleural effusions may experience symptoms such as chest pain, shortness of breath, or cough.

viii. Miliary Patterns: Miliary patterns describe the presence of numerous tiny nodules, each typically 1-3 millimeters in diameter, scattered diffusely and evenly throughout both lungs. These nodules resemble millet seeds in size and distribution, hence the name. The pattern indicates a hematogenous (blood-borne) dissemination of infection or disease and is classically seen in disseminated tuberculosis. Other conditions such as fungal infections or metastatic cancers can also produce a miliary pattern. This diffuse involvement usually reflects widespread disease and often presents with systemic symptoms like fever, weight loss, and malaise.(Khalid et al., 2023).

Figure 2.1: (a) : A PA chest radiograph showing fibro- cavitatory changes **(b) An AP chest radiograph showing widespread nodular cystic changes involving both lungs**

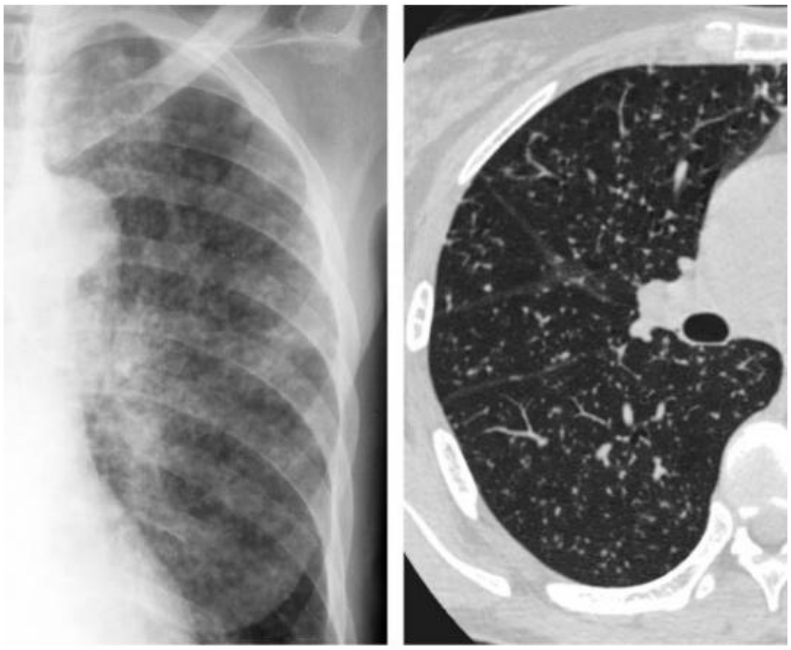

Figure 2.2: (a) Radiograph of the left lung shows diffuse 2–3-mm nodules, findings that are typically seen in miliary tuberculosis (b) high resolution CT scan demonstrating similar nodules in a random distribution

Source: (Grainger & Allison's Diagnostic Radiology: A Textbook of Medical Imaging. 7th ed. Vol 2)

2.1.2 Risk Factors and Causes of Pulmonary Tuberculosis

Pulmonary Tuberculosis is medical condition influenced by both intrinsic and extrinsic factors. These factors, which range from genetic predisposition to lifestyle choices, prior infection to other disease conditions and occupational exposures Understanding the key risk factors and causes of Pulmonary Tuberculosis is crucial for carrying out this study some of these risk factors include.

1. **HIV Infection:** HIV is the strongest known risk factor for developing active TB. The virus weakens the immune system by depleting CD4+ T cells, which play a central role in controlling *Mycobacterium tuberculosis* (M. tuberculosis). With a compromised immune system, latent TB can reactivate more easily, and new infections are less likely to be contained. Studies show that people living with HIV are 18–20 times more likely to develop active TB than HIV-negative individuals (Desalu, 2009)

2. **Malnutrition:** Poor nutrition weakens immune defenses, particularly cell-mediated immunity, which is crucial for containing *M. tuberculosis*. Individuals with low body mass index (BMI < 18.5 kg/m²) are at greater risk for TB progression. Nutritional deficiencies (e.g., vitamin D, iron, and zinc) may impair macrophage and T-cell function, allowing latent TB to become active

3. **Prior Diabetes Mellitus infection:** Diabetes is an important comorbidity that triples the risk of developing active TB. Hyperglycemia impairs immune cell functions, including phagocytosis and cytokine production. TB patients with diabetes also tend to have worse treatment outcomes and higher relapse rates.(FMOH & SW, 2017)

4. **Smoking:** Tobacco smoke impairs mucociliary clearance and macrophage activity in the lungs, increasing susceptibility to TB infection and disease. Smokers are about twice as likely to develop TB compared to non-smokers. Smoking also increases the risk of TB-related complications and mortality. (Iseman, 2000)

5. **Alcohol Abuse :** Chronic alcohol consumption is linked to immune dysfunction and increased risk of both acquiring TB and experiencing poor treatment outcomes. Alcohol abuse often coexists with other risk factors such as poor nutrition, homelessness, and liver disease, which further increase TB risk

6. **Age :** Children (<5 years) and elderly people (>65 years) are more susceptible to TB due to underdeveloped or declining immune function. (Iseman, 2000)

7. **Socioeconomic Factors:** Poverty, homelessness, and overcrowded living conditions increase exposure and lower resistance to TB. People in low-income settings often lack access to healthcare, leading to delayed diagnosis and higher transmission rates(WHO, 2023)

8. **Previous TB Infection:** A history of TB, especially if inadequately treated, significantly increases the risk of reactivation. Scarred or damaged lung tissue from a past infection provides a conducive environment for re-colonization or progression.

2.1.3 Diagnosis, and common clinical indicators of Pulmonary Tuberculosis

Pulmonary Tuberculosis (PTB) is a contagious bacterial infection caused by *Mycobacterium tuberculosis*, primarily affecting the lungs but capable of spreading to other organs. Despite being a preventable and curable disease, tuberculosis (TB) remains a global health concern, particularly in low- and middle-income countries. Timely diagnosis is critical to reducing transmission, initiating appropriate treatment, and improving outcomes.There are several objective and subjective symptoms and clinical indicators of PTB and the used to identify it.

Clinical Indicators of Pulmonary Tuberculosis: The clinical presentation of pulmonary tuberculosis can vary based on the stage of the disease, immune status of the patient, and coexisting conditions. However, certain symptoms and signs are considered classic indicators:

i. **Persistent Cough**: A chronic cough lasting more than two to three weeks is one of the most common symptoms. It may start dry but often progresses to a productive cough, sometimes with blood-streaked sputum (Hemoptysis). (WHO, 2019)
ii. **Constitutional Symptoms**: These include fever, night sweats, fatigue, and weight loss. These symptoms reflect the systemic nature of the disease and the body's inflammatory response.(Job J. R, 1986- 1996)
iii. **Chest Pain**: Patients may complain of chest discomfort or pain due to inflammation of the pleura or lung parenchyma.
iv. **Shortness of Breath**: In advanced cases, or when complications such as pleural effusion or extensive lung damage occur, dyspnea may be present. (Tamirat et. al., 2022)
v. **Physical Examination Findings**: These can be non-specific but may include decreased breath sounds or signs of lung consolidation. In some cases, clubbing of the fingers may be noted in chronic disease.

2.1.4 Treatment And Management Of Pulmonary Tuberculosis

Treatment is based on a combination of multiple antibiotics over an extended period because *M. tuberculosis* has a slow growth rate and can exist in latent forms that are resistant to single-drug therapies. The main goals of tuberculosis treatment are:

i. To eliminate the TB bacilli from the body.

ii. To prevent relapse after cure

iii. To reduce transmission of the disease.

iv. To prevent the development of drug-resistant strains. (WHO, 2023)

First-Line Anti-Tuberculosis Drugs

The standard treatment for drug-sensitive pulmonary TB consists of two phases:

A. Intensive Phase (First 2 Months)

i. Isoniazid (H)

ii. Rifampicin (R)

iii. Pyrazinamide (Z)

iv. Ethambutol (E) (Syeda, 2024)

This phase aims to rapidly kill actively dividing bacilli and reduce infectiousness.

B. Continuation Phase (Next 4 Months)

i. Isoniazid (H)

ii. Rifampicin (R)

This phase targets dormant bacilli to prevent relapse, the total duration of treatment is 6 months for most drug-sensitive cases. (Syeda, 2024)

3. Treatment of Drug-Resistant TB

Drug-resistant TB, particularly multidrug-resistant TB (MDR-TB), which is resistant to at least isoniazid and rifampicin, requires longer and more complex treatment. Options include:

Second-line drugs: fluoroquinolones (e.g., levofloxacin, moxifloxacin), injectable agents (e.g., amikacin, capreomycin), and newer drugs like bedaquiline and linezolid. Treatment duration: 9 to 24 months depending on the regimen and resistance pattern. (Te Riele et. al., 2019)

4. Directly Observed Therapy (DOT)

To ensure adherence, the Directly Observed Therapy, Short-course (DOTS) strategy involves a healthcare worker or trained individual observing the patient taking each dose. DOT improves treatment success and reduces default and resistance rates. (Syeda, 2024)

5. Monitoring and Follow-Up

Monitoring during treatment includes:

i. Monthly sputum smear or culture tests to assess response.
ii. Liver function tests, especially when hepatotoxic drugs like isoniazid and pyrazinamide are used.
iii. Adherence checks and counseling to manage side effects and barriers to compliance.
v. Chest X-rays at baseline and as needed for clinical monitoring. (WHO, 2023)

6. TB and Special Populations

i. **HIV-positive patients**: TB treatment is similar, but anti-retroviral therapy (ART) must be coordinated with TB medications to avoid drug interactions. (Syeda, 2024)
ii. **Pregnant women**: Most first-line TB drugs are safe, but pyrazinamide use may depend on national guidelines. (Syeda, 2024)
iii. **Children**: Dosing is weight-based, and diagnosis and adherence may be more challenging

7. Public Health Measures

Effective TB management extends beyond individual treatment:

i. **Contact tracing**: Testing and treating people who have been in close contact with a TB patient
ii. **Vaccination**: Bacillus Calmette-Guérin (BCG) vaccine offers partial protection, especially in children (WHO, 2019)

iii. **Infection control**: Isolating infectious patients, improving ventilation, and using masks in healthcare settings.

iv. **Health education**: Raising awareness about TB transmission, symptoms, and the importance of completing treatment.

2.2 Empirical Review

The empirical review concentrates on earlier studies based on the accuracy of diagnosis of pulmonary tuberculosis from radiographic patterns found on the chest x-ray investigations alone. Although a lot of studies has been done on the accuracy of the various medical laboratory investigations techniques, relatively much less studies has been done on the accuracy of radiographic investigations knowledge and comprehension of radiation safety. A few of this studies would be highlighted in this review.

Burrill and Williams (2009) provided a comprehensive radiological review of pulmonary tuberculosis , the specific objectives of this study was to improve understanding of the clinical and radiological indications and pattern related to active and latent PTB, In order to improve and assist early diagnosis, staging, management, and differentiation of pulmonary tuberculosis,

van Cleeff , Kivihya- Ndugga and Klatser, (2005). studied The role and performance of chest X- ray for the diagnosis of tuberculosis, this was a cost- effectiveness analysis carried out in Nairobi, Kenya. With specific objectives to evaluate the diagnostic tool in terms of accuracy, specificity, feasibility, acceptability, and impact on patient outcome. At the end of the study it was found that the chest x-ray detected 85%-95% of all lung related diseases (sensitivity of 85% - 95%), while its specificity or ability to distinguish Pulmonary tuberculosis from other overlapping lung related disease dropped to about 50 - 60% of cases. (Klaster et al 2005) concluded that the use of chest x-ray remains a vital, accurate, and widely accepted diagnostic tool for PTB diagnosis especially in resource limited setting but it does have its own limitations like lower ability to differentiate PTB

from other overlapping lung disease, the benefits of this study is to highlight the performance and limitations of chest x-ray as diagnostic tool for Pulmonary Tuberculosis.

Akhigbe, Ugwu, and Maduka (2019) investigated the Abnormal chest radiographic patterns in patients with pulmonary tuberculosis in Lagos State, Nigeria, the purpose of this study was to identify and characterize the type and frequency of abnormal chest radiographic patterns seen in patients attending medical facilities in lagos state, Nigeria. the study found that Tuberculosis related patterns were the most frequently found abnormalities, and a significant amount of patients showed radiographic evidence consistent with chronic respiratory conditions. (Akhigbe et.al., 2019) concluded that while radiographic signs of PTB are mostly accurate signs of a normal chest x-ray does not entirely exclude the possibility of tuberculosis highlighting the importance of corroborating radiographic result with clinical and laboratory findings .

The prospective observational cohort study by (Ralph, et al., 2010), attempted to develop A simple, valid, numerical score for grading chest x-ray severity in adult smear-positive pulmonary tuberculosis in order to have a standardized system for predicting treatment outcomes, particularly 2 months sputum smear status and radiological track treatment and disease progression over time, it was a two phase study. The first phase focused on identifying and selecting key clinical and laboratory variables that were associated with then severity and prognosis of smear-positive TB. This factors includes body mass index (BMI), respiratory rate, hemoglobin levels, the researchers analyzed data from a cohort study of tuberculosis patients to determine which of this indicators had the most predictive value for patient outcome. In the second phase this data from the first phase was used to develop a unique scoring system by assigning a simple point value to each selected variable based on their statistical strength and each patient total score was calculated by summing the points associated with their clinical measurements, this study was crucial in helping clinical decision making by providing a quick and simple assessment method while improving consistency and standardization in patient evaluation rather than relying on subjective judgment.

Besen and Staub et. al., (2011) carried out an extensive review on Clinical, radiological, and laboratory characteristics in pulmonary tuberculosis patients a Comparative study of HIV-positive and HIV- negative patients at a referral hospital. J Bras Pneumol. This study sought to deepen understanding of how HIV status influences TB manifestations, addressing a critical gap in managing co-infected patients. To explore this, the research employed a cross-sectional design in which 50 inpatients diagnosed with pulmonary tuberculosis were enrolled 25 with confirmed HIV infection and 25 without. All participants underwent a structured clinical assessment including symptom review and physical examination. Radiological data were extracted from chest X-ray reports, while laboratory variables encompassed sputum smear and culture results, hemoglobin concentration, and CD4+ T- cell counts, all sourced from medical records Despite similar demographic characteristics average age around 38 years and a predominance of males the study demonstrated clear differences between the two groups. HIV-positive patients were significantly less likely to produce sputum (52% vs. 84%, p = 0.016), exhibited lower hemoglobin levels (mean 9.3 g/dL vs. 11.1 g/dL, p = 0.015), and showed less frequent cavitary lesions on chest X-ray (10% vs. 43%, p = 0.016). Notably, interstitial radiographic patterns were also reduced among HIV-positive individuals (40% vs. 78%, p = 0.012). (Besen et. Al., 2011) concluded that HIV co-infection is associated with a subtle yet distinct TB phenotype: fewer respiratory symptoms (especially productive cough), greater degree of anemia, and less typical radiological features such as cavitation and diffuse infiltration sought to deepen understanding of how HIV status influences manifestations of Pulmonary tuberculosis, addressing a critical gap in managing co-infected patients.

Te Riele JB, Buser V,(2019) investigated on the correlation between chest radiographic characteristics, sputum bacterial load, and treatment outcomes in patients with extensively drug- resistant tuberculosis, specific objectives of this study was to investigate the relationship between chest radiographic characteristics and sputum bacterial load in extensively drug resistant tuberculosis an determine their association with treatment outcome of this patients. This was

conducted using data from 120 patients confirmed to have MDR-TB through drug susceptibility tests at the Ghurki trust teaching hospital Lahore , at the end of the study it was determined that patients mostly showed extensive lung damage, with 62.5% being male and 70% aged 16-45. Rural residents made up 65% of the cohort, and 60% were married. The median age was 35 years. Extensive lung involvement was seen in 67.5%, and 53% had high sputum bacterial loads. Sputum culture converters were slightly older (median age 36), mostly male (72.2%), and had a higher median weight (55.25 kg). Non-converters had a higher prevalence of diabetes (14.2%), and previous DR-TB significantly lowered conversion chances ($p = 0.05$). Unfavorable outcomes were more common in non-converters ($p < 0.0001$). Te Riele and Buser (2019) concluded that Chest radiographic characteristics and sputum bacterial load are crucial factors influencing treatment outcomes in MDR-TB. Extensive lung damage and high bacterial load are linked to poorer prognoses and prolonged treatment times. These findings highlight the importance of incorporating radiographic and microbiological assessments into treatment planning to enhance patient outcomes in MDR-TB

2.3 Summary Of The Review

Regardless of this breakthroughs and findings, significant gaps still remain in the literature. Most recent studies focus on only radiographic patterns for Pulmonary tuberculosis without addressing the objective and subjective symptoms and clinical manifestations that may suggest this specific disease. This study will capture information on doctors examination request and radiologist remark on patients suspected and confirmed to have PTB in University of Benin Teaching Hospital (UBTH).

2.4 Theoretical Review

This study draws inspiration from three theoretical models the first is the Decision theory which have had many relevant contributions over the years, the second is the Dual Process Diagnostic Theory (DPDT) proposed by peter wason (1974) and extensively revisited and discussed in Eva's (2005) work giving us a more immersive review of the study, and the third is the Wheel Of

Causation Model proposed by Mausner and Kramer (1985)

2.4.1 Decision Theory (Patrícia, 2008)

Decision theory is a multidisciplinary field that offers a framework for making rational choices under conditions of uncertainty. It is grounded in both mathematics and psychology, providing a systematic approach to analyze decision-making processes in various contexts, from business to medicine. The theory itself spans various branches, including normative decision theory, which focuses on how decisions should be made, and descriptive decision theory, which aims to explain how decisions are actually made. In its essence, decision theory provides tools to help individuals and organizations make the most informed and optimal choices by analyzing alternatives, evaluating outcomes, and managing risk. It is particularly useful when outcomes are uncertain and when there are multiple factors or stakeholders involved. At its core, decision theory revolves around the idea that decisions can be quantified, and by considering probabilities, costs, and benefits, a decision-maker can systematically choose the most beneficial course of action. Central to this is the concept of expected utility, which posits that individuals make decisions by comparing the expected benefits of each alternative, weighing these against their associated risks. A decision-maker, according to this framework, will always opt for the alternative that maximizes their expected utility, defined as the weighted average of the possible outcomes, adjusted for the probability of each outcome.

Relevance of Decision Theory to Radiological Diagnosis of PTB

The traditional radiological approach to diagnosing PTB primarily involves chest X-rays and, more recently, computed tomography (CT) scans. These imaging techniques can reveal a range of signs indicative of PTB, such as cavitary lesions, infiltrates, and lymphadenopathy. However, these signs are not exclusive to tuberculosis and may overlap with other conditions, such as lung cancer, pneumonia, and sarcoidosis. As a result, radiologists often face the challenge of interpreting these findings in the context of other clinical data. Here, decision theory comes into play by offering a

structured approach to evaluating the likelihood of PTB, given the available radiological findings and patient history. One of the key aspects of decision theory is the use of Bayesian reasoning to update the probability of a disease as new information becomes available. For instance, if a radiologist observes a potential TB lesion on a chest X-ray, Bayesian decision theory allows the radiologist to calculate the updated probability of PTB based on factors such as the patient's clinical history (e.g., known exposure to TB, symptoms like cough and weight loss) and risk factors (e.g., immuno-compromised state). This dynamic approach helps refine the diagnosis, making it more accurate than relying on radiological findings alone.

. 2.4.2 Dual Process Diagnostic Theory (Eva, 2005).

Dual Process Diagnostic Theory (DPDT) is a cognitive framework that explains clinical decision-making through the interaction of two mental processes commonly referred to as System 1 and System 2 thinking. In the context of radiological diagnosis, particularly for Pulmonary Tuberculosis (PTB), the application of DPDT provides a valuable lens through which diagnostic accuracy, errors, and training methods can be understood and improved. The Dual Process Theory delineates two types of cognitive processing:

System 1: Fast, automatic, intuitive, and reliant on pattern recognition.

System 2: Slow, effortful, analytical, and reliant on rule-based logic.

2.4.3 Wheel of Disease Causation (Mausner and Kramer (1985))

The Wheel of Disease Causation is a conceptual model that illustrates the multi-factorial nature of disease development. Unlike earlier models, such as the Germ Theory, which emphasized a single causative agent (e.g., a specific bacterium or virus), the wheel model eliminates the idea of an agent being the sole cause of disease. Instead, it underscores the complex interplay between multiple contributing factors, highlighting how disease emerges from an intricate web of influences rather than a single origin. In this model, the core of the wheel represents the genetic makeup of an individual. Genetics is recognized as a fundamental, internal factor that predisposes a person to

certain diseases or health conditions. However, genetic predisposition alone is rarely sufficient to cause disease. It is the interaction between genetic susceptibility and external environmental factors that ultimately influences whether a disease develops.

Surrounding the genetic core is the outer rim of the wheel, which is divided into three primary segments representing the major categories of environmental influences: biological, physical, and social factors. As seen in figure 2.3

i. **Biological factors** include elements such as infectious agents (bacteria, viruses, parasites), the presence of allergens, and interactions with other organisms that may either protect or predispose an individual to illness.
ii. **Physical factors** encompass a wide range of non-living environmental conditions such as climate, pollution, radiation, noise, and housing conditions. These can play a direct or indirect role in disease causation
iii. **Social factors** refer to elements like socioeconomic status, education, access to healthcare, cultural practices, occupational risks, stress, and social support systems. These are often considered social determinants of health, as they significantly influence individual and population health outcomes.

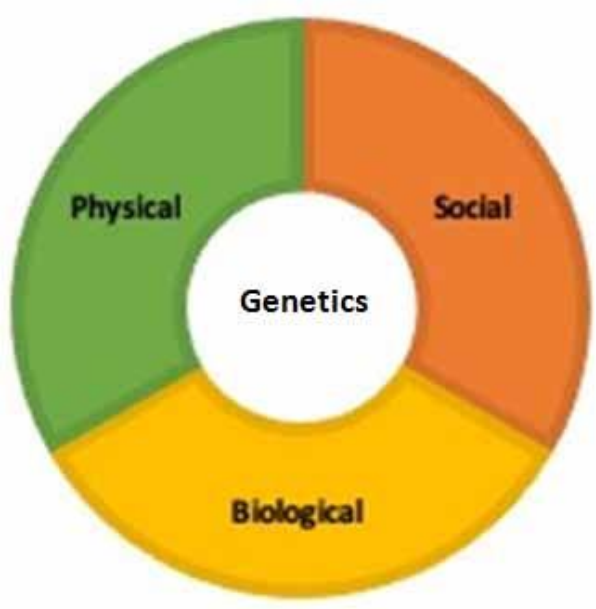

Figure 2.3 Epidemiological Wheel

CHAPTER THREE

RESEARCH METHODOLOGY

The purpose of this study was to analyze the pattern of request and radiographic findings in patients diagnosed with pulmonary Tuberculosis at the University of Benin Teaching Hospital (UBTH), Benin city. this chapter provides a detailed review of my research work, Including research materials, population of interest, and methodology that was employed to during the course of this investigation

3.1 Research setting

This research was conducted at radiology department of the University of Benin Teaching Hospital (UBTH). UBTH is a multi-specialty healthcare centre founded on 12th of may, 1973, located along Ugbowo Lagos Road, Benin City, Nigeria. It is a well-equipped, comprising of several departments including the radiological department, which is equipped with a wide range of radiographic equipment including conventional x-ray and computed tomography (CT) systems required for many kinds of radiographic investigations that provides diagnosis for a diverse populations of patients across different age groups, gender and clinical manifestations in Benin city and its surrounding area, making it an appropriate setting for assessing clinical and radiological patterns present in pulmonary Tuberculosis patients in this region.

3.2 Study design

This study was a retrospective Cross sectional descriptive study of the records of patients who were diagnosed with pulmonary tuberculosis including Their age, gender, clinical presentation, radiographic findings, nature and location of the lung changes as stated in their radiological reports at the University of Benin teaching hospital between within the proposed one year period (June 2024 (and June 2025)

3.3 Target population

The target population consisted of patients diagnosed with pulmonary tuberculosis after undergoing a chest x-ray examination at University of Benin teaching hospital between June 2024 and June 2025

3.4 Sample size determination

All inclusive sample from the population with documented information(in hospital records) relevant for this study which includes Age, clinical indication, radiological findings and location of lesions were selected for this study

Sample size = 331 Patients

3.5 Instrument for data collection

All data was collected using data capture sheet with age, sex, most recurring clinical indications documented for request, nature, and location of the lungs changes as variables.

3.6 Reliability of the instrument

To ensure reliability, data collection was designed based on standardized criteria for diagnosing pulmonary tuberculosis and patients without complete relevant information (see 3.4) documented in the hospital records were excluded from this research work. Trained research assistants and data analysts were needed to use the structured data extraction sheet to record patient information consistently.

3.7 Method of Data collection

After obtaining ethical approval, eligible patient records will be retrieved from the radiology department's archives. Patients Data will be extracted manually using the data capture sheet, including the information documented in the radiologist reports of all selected patients within the time period of interest. (see Appendix I)

3.8 Method of Data analysis

The data was analyzed using the Statistical Package for the Social Sciences (SPSS) version 29.0. Frequencies and percentages will be calculated for different findings. Chi square test will be used to examine associations between demographic variables and findings. A p-value < 0.05 will be considered statistically significant.

3.9 Ethical considerations

Before carrying out this study, ethical approval form was collected from the Health Research Ethics Committee of University of Benin Teaching Hospital (UBTH). No patient consent is required due to the retrospective nature of the study. All data will be anonymized, and also strict adherence to patients confidentiality guidelines was observe. (see Appendix II)

CHAPTER FOUR

RESULTS AND DATA ANALYSIS

The primary aim of the study was to determine the analyse the pattern of request and radiographic findings in patients diagnosed with pulmonary Tuberculosis at the university of Benin teaching hospital.

Presentation of Results

4.1 Demographic Characteristics of Study Participants

Table 4.1 Demographic Characteristics of Study Participants

Characteristic	N = 331[1]
Age(years)	48.0(22.1)
Sex	
F	120(36)
M	208(63)
Sex	3(0.9)

A total of 331 patients diagnosed with pulmonary tuberculosis (PTB) were included in this study at the University of Benin Teaching Hospital (UBTH). The mean age of participants was 48.0 ± 22.1 years. The study population comprised 208 males (63.0%) and 120 females (36.0%), with 3 participants (0.9%) having unspecified sex documentation. The male-to-female ratio was approximately 1.7:1, indicating a male predominance in PTB cases at UBTH during the study period (Table 4.1)

4.2 Clinical Indications for Requesting Chest X-rays

Table 4.2: Frequency of Clinical Indications for Chest X-ray Requests(N = 331 patients)

Clinical Indication	Frequency(%)
Cough	172(52)
Suspected PTB	112(33.8)
Fever	84(25.4)
Weight Loss	40(12.1)

Hemoptysis	28(8.5)
RVD	20(6)
Chest Infection	16(4.8)
ARI	12(3.6)
COPD	12(3.6)
Pre-operative	12(3.6)
Pneumonia	4(1.2)
Pleural Effusion	4(1.2)

Table 4.2 presents the frequency of clinical indications that prompted chest X-ray requests among the 331 PTB patients. The most common clinical indication was cough, present in 172 patients (52.0%), followed by suspected PTB in 112 patients (33.8%). Fever was documented in 84 patients (25.4%), while weight loss and hemoptysis were less frequent, occurring in 40 (12.1%) and 28 (8.5%) patients respectively.

Other clinical indications included right ventricular disease (RVD) in 20 patients (6.0%), chest infection in 16 patients (4.8%), and acute respiratory infection (ARI), chronic obstructive pulmonary disease (COPD), and pre-operative assessment, each accounting for 12 patients (3.6%). The least common indications were pneumonia and pleural effusion, each present in only 4 patients (1.2%).

Notably, cough was the predominant presenting symptom, appearing in more than half of all cases, while classic TB symptoms such as weight loss and hemoptysis were present in a minority of patients.

4.3.1 Frequency Specific Radiographic Patterns

Table 4.3.1 Frequency Specific Radiographic Patterns

Radiographic Finding	Frequency(%)
Fibro-cavitory changes	104(31.4)
Cavitations	56(16.9)
Fibro-nodular Opacities	56(16.9)

Inhomgenous Opacities	52(15.7)
Homogeneous consolidation	16(4.8)
Patchy consolidations	16(4.8)
Recticulo-nodular Opacities	12(3.6)
Cavitations, fibrotic scarring	8(2.4)
Cavitations, fibrotic scarring	4(1.2)
Fibro- nodular Opacities	4(1.2)
Radiological Findings	3(0.9)

The radiographic findings observed in the chest X-rays of PTB patients showed considerable variability (Table 4.3). The most frequent finding was fibro-cavitary changes, identified in 104 patients (31.4%). Cavitations were observed in 56 patients (16.9%), while fibro-nodular opacities were equally prevalent, also occurring in 56 patients (16.9%). Inhomogeneous opacities were found in 52 patients (15.7%).

Less common radiographic patterns included homogeneous consolidation and patchy consolidations, each present in 16 patients (4.8%), and reticulo-nodular opacities in 12 patients (3.6%). Some cases showed combinations of findings, such as cavitations with fibrotic scarring, documented in 8 patients (2.4%) and 4 patients (1.2%). Other fibro-nodular opacities variants were observed in 4 patients (1.2%), while 3 patients (0.9%) had radiological findings documented without specific categorization.

4.3.2 Categorized Radiographic Findings

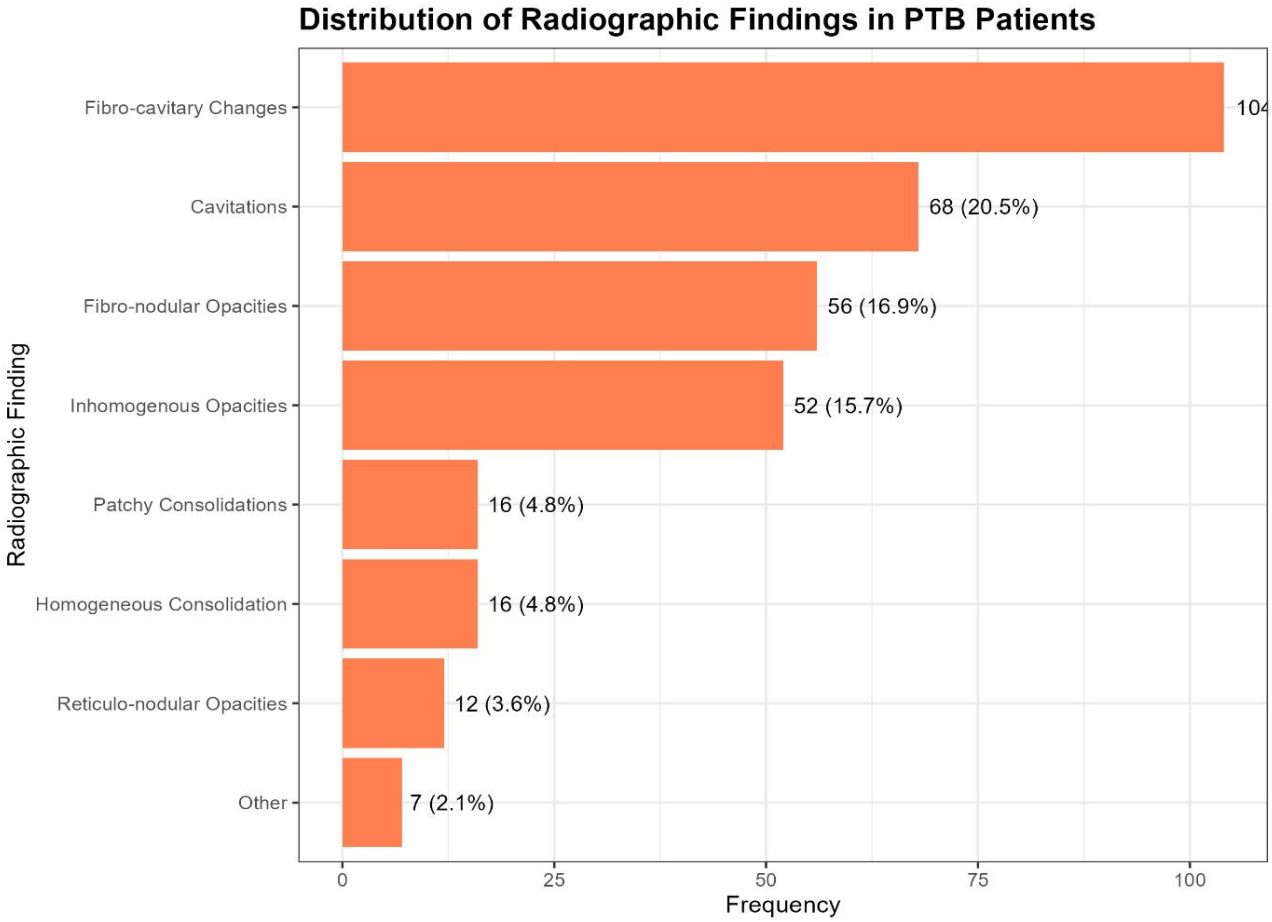

Figure 4.1: Distribution of Radiographic Finding Categories

When radiographic findings were categorized into major patterns (Figure 4.1), fibro-cavitary changes remained the most prevalent category at 31.4% (n=104). Cavitations, when grouped with related findings including those with fibrotic scarring, accounted for 68 cases (20.5%). Fibro-nodular opacities represented 16.9% (n=56) of cases, while inhomogeneous opacities comprised 15.7% (n=52).

Consolidative patterns included homogeneous consolidation (4.8%, n=16) and patchy consolidations (4.8%, n=16), together accounting for 9.6% of cases. Reticulo-nodular opacities were present in 12 patients (3.6%). Cases that did not fit into these major categories were classified as "Other" and represented 2.1% (n=7) of the study population.

The predominance of fibro-cavitary changes and cavitations (collectively 51.9%) indicates that a significant proportion of patients had advanced disease at the time of radiographic examination.

4.4 Anatomical Distribution of Pulmonary Lesions

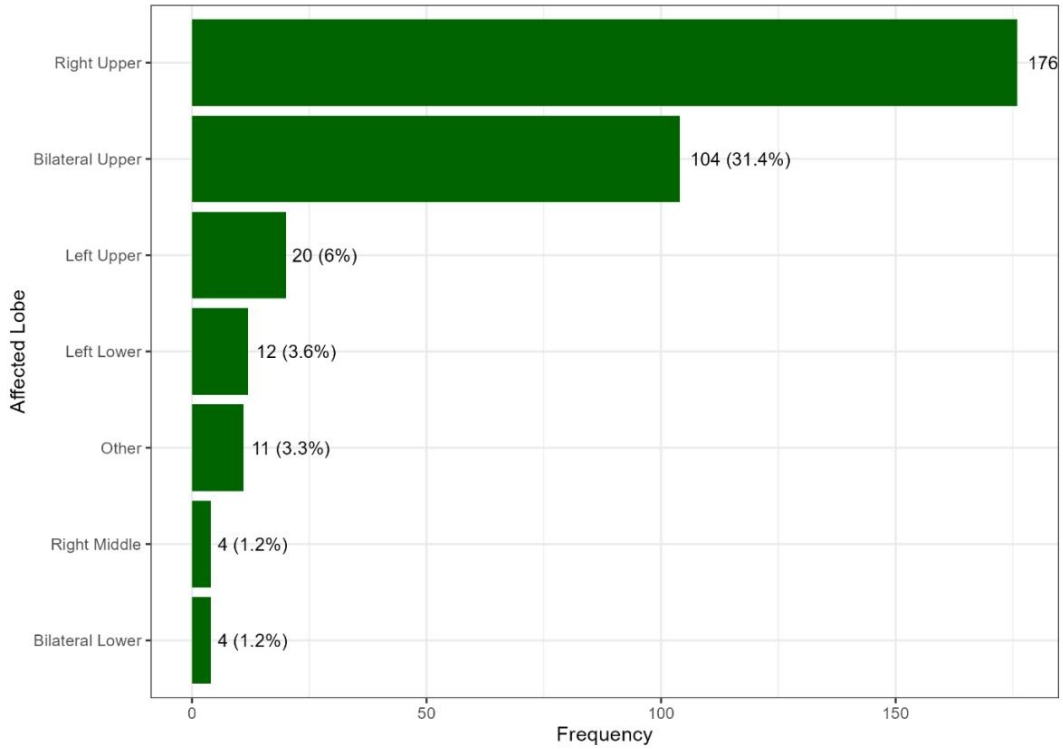

Figure 4.2: Distribution of Affected Lung Lobes Anatomical distribution of PTB lesion

Analysis of the affected lung lobes revealed a clear predilection for upper lobe involvement (Figure 4.2). The right upper lobe was the most commonly affected site, involved in 176 patients (53.2%). Bilateral upper lobe involvement was observed in 104 patients (31.4%), while isolated left upper lobe disease was relatively uncommon at 6.0% (n=20).

Lower lobe involvement was rare, with left lower lobe disease present in only 12 patients (3.6%) and bilateral lower lobe involvement in 4 patients (1.2%). Right middle lobe disease was also infrequent, occurring in 4 patients (1.2%). Other patterns of involvement that did not fit into standard lobar classifications accounted for 11 cases (3.3%).

Combined, upper lobe disease (unilateral or bilateral) accounted for approximately 90.6% of all cases, consistent with the typical distribution pattern of pulmonary tuberculosis, which preferentially affects the apical and posterior segments of the upper lobes due to favorable oxygen tension for mycobacterial growth.

4.5 Radiographic Findings in Clinically Suspected PTB Cases

Table 4.4. Radiographic Findings in Suspected PTB Cases.

Radiographic Finding	Frequency(%)
Fibro-cavitary Changes	52(46.4)
Fibro-nodular Opacities	20(17.9)
Cavitations	16(14.3)
Inhomogenous Opacities	16(14.3)
Patchy Consolidations	4(3.6)
Reticulo-nodular Opacities	4(3.6)

Among the 112 patients in whom PTB was clinically suspected prior to radiographic examination, specific radiographic patterns were identified (Table 4.4). Fibro-cavitary changes were the common finding in this subset, present in 52 patients (46.4%). Fibro-nodular opacities were found in 20 patients (17.9%), while cavitations and inhomogeneous opacities were each observed in 16 patients (14.3%). Patchy consolidations and reticulo-nodular opacities were less frequent, each present in 4 patients (3.6%).

The distribution of radiographic findings in clinically suspected cases showed a notably higher proportion of fibro-cavitary changes (46.4%) compared to the overall study population (31.4%), suggesting that more advanced disease with cavitation may be more readily suspected clinically. This finding implies that clinicians may be more likely to suspect PTB when patients present with more severe or characteristic symptoms associated with advanced disease

4.6.1 Overall Performance of Clinical Suspicion

Table 4.5. Diagnostic Performance of Clinical Suspicion for PTB

Metric	Value
Sensitivity	78.6
Specificity	36.1
Positive Predictive Value(PPV)	38.6
Negative Predictive Value(NPV)	76.7

Accuracy	50.5
Positive Likelihood Ratio(LR+)	1.23
Negative Likelihood Ratio(LR-)	0.59

The diagnostic performance of clinical suspicion for PTB was evaluated using radiographic findings as the reference standard (Table 4.5). Clinical suspicion demonstrated a sensitivity of 78.6%, indicating that approximately four out of five patients with radiographic evidence of PTB were correctly suspected clinically. However, the specificity was relatively low at 36.1%, suggesting that clinical suspicion frequently occurred in patients without characteristic PTB features on chest X-ray. The positive predictive value (PPV) was 38.6%, meaning that less than two out of five patients clinically suspected of having PTB actually showed radiographic confirmation. Conversely, the negative predictive value (NPV) was considerably higher at 76.7%, indicating that when PTB was not clinically suspected, there was approximately a 77% probability that radiographic features would also be absent.

The overall accuracy of clinical suspicion was 50.5%, reflecting moderate agreement between clinical assessment and radiographic findings. The positive likelihood ratio (LR+) was 1.23, suggesting minimal increase in post-test probability of disease when PTB is suspected. The negative likelihood ratio (LR-) was 0.59, indicating modest value in ruling out disease when clinical suspicion is absent.

These findings indicate that while clinical suspicion had reasonable sensitivity in identifying patients with radiographic evidence of PTB, its low specificity and PPV suggest that clinical features alone are insufficient for definitive diagnosis, and many patients without PTB may be suspected of having the disease based on non-specific respiratory symptoms.

4.6.2 Diagnostic Value of Individual Clinical Symptoms

Table 4.6. Diagnostic Value of Individual Clinical Symptoms

Symptom	Sensitivity	Specificity	PPV	NPV
Cough	60.5	22	45.6	34
Fever	61.9	28.7	22.8	68.9
Weight Loss	80	32.6	14	92.2
Hemoptysis	71.4	31.4	8.8	92.2

The diagnostic value of individual clinical symptoms varied considerably (Table 4.6). Weight loss demonstrated the highest sensitivity at 80.0%, meaning it was present in four out of five patients with radiographic PTB features. However, it had low specificity (32.6%) and a very low PPV (14.0%), indicating that weight loss was also common in patients without characteristic PTB findings. The NPV was relatively high at 92.2%, suggesting that absence of weight loss was strongly associated with absence of typical radiographic PTB features.

Hemoptysis showed a sensitivity of 71.4% and specificity of 31.4%. While relatively sensitive, its extremely low PPV of only 8.8% indicates that hemoptysis was rarely predictive of radiographic PTB features in this population. However, its high NPV of 92.2% suggests good negative predictive utility.

Fever demonstrated a sensitivity of 61.9% and specificity of 28.7%, with a PPV of 22.8% and NPV of 68.9%. These moderate values indicate that fever alone is neither sensitive nor specific enough to reliably identify PTB.

Cough, despite being the most common presenting symptom (52.0% of cases), had a sensitivity of 60.5% and the lowest specificity at 22.0%. Its PPV was 45.6%, the highest among all individual symptoms, while its NPV was the lowest at 34.0%. These findings suggest that while cough is common in PTB, it lacks discriminatory power as many patients without characteristic radiographic PTB also present with cough.

Overall, individual symptoms demonstrated high sensitivity but poor specificity and low positive predictive values, suggesting that while these symptoms are common in PTB, they are not specific enough to reliably distinguish PTB from other respiratory conditions based solely on clinical presentation.

4.7 Hypothesis testing

Association Between Clinical Suspicion and Radiographic Findings

Table 4.7. Cross-tabulation of Clinical Suspicion vs Radiographic Findings

	Radiographic Status		Total	p-value[1]
	No PTB	PTB Present		
Clinical Status				0.006
Other Indications	79(36)	140(64)	219(100)	
Suspected PTB	24(21)	88(79)	112(100)	
Total	103(31)	228(69)	331(100)	

[1]Pearson's Chi-squared test

Cross-tabulation analysis (Table 4.7) revealed a statistically significant association between clinical suspicion of PTB and the presence of radiographic PTB features ($p = 0.006$, Pearson's Chi-squared test). Among the 112 patients with clinically suspected PTB, 88 (79%) had radiographic features consistent with PTB, while 24 (21%) did not show characteristic PTB findings on chest X-ray.

In contrast, among the 219 patients with other clinical indications, 140 (64%) had radiographic PTB features, while 79 (36%) did not. Overall, of the 331 patients in the study, 228 (69%) had radiographic evidence of PTB, while 103 (31%) did not show typical PTB features despite having confirmed PTB diagnosis.

This analysis demonstrates that while clinical suspicion of PTB was significantly associated with positive radiographic findings, a substantial proportion of patients (64%) presented with non-specific clinical indications yet still had radiographic evidence of PTB. This finding underscores the importance of maintaining a high index of suspicion for PTB even when patients present with

atypical or non-specific respiratory symptoms, and highlights the limitation of relying solely on classical PTB symptoms for case detection.

The statistically significant association ($p = 0.006$) confirms that clinical assessment does provide valuable diagnostic information, although its moderate predictive value suggests it should be used in conjunction with radiographic and laboratory investigations rather than as a standalone diagnostic criterion

CHAPTER FIVE

CONCLUSION, RECOMMENDATIONS AND LIMITATIONS

5.1 Conclusion

At the end of the study findings indicated the PTB predominance in adults in their productive years, with a higher prevalence among males. This pattern has significant socioeconomic implications, as tuberculosis often impacts individuals in their most active and economically productive stage of life.

Clinically, cough was the most common presenting symptom, followed by general signs such as fever and weight loss. However, the diversity and nonspecific nature of symptoms highlight the difficulty of relying solely on clinical presentation for accurate diagnosis. Many symptoms overlap with those of other respiratory conditions, reinforcing the need for supportive diagnostic tools such as chest radiography. Radiographic findings revealed that fibro-cavitary changes and cavitations were the most common abnormalities, suggesting that many patients presented with advanced disease. The predominance of upper lobe involvement further supports existing evidence that the apical and posterior lung segments are more susceptible to *Mycobacterium tuberculosis* infection.

While clinical suspicion showed moderate diagnostic accuracy and a strong association with radiographic evidence, it also demonstrated limited specificity. The observation that a substantial proportion of patients without initial clinical suspicion still had radiographic evidence of PTB further underscores the need for broader screening practices and heightened awareness among healthcare providers. Overall, the study highlights the ongoing diagnostic challenges associated with PTB in resource-limited settings and underscores the importance of integrating clinical assessment, radiologic evaluation, and laboratory testing for more effective disease detection. Strengthening diagnostic protocols, expanding access to radiographic services, and promoting early case identification are essential steps toward improving patient outcomes and controlling tuberculosis transmission in the community.

5.2 Recommendations

1. **Promote routine chest radiography:** for patients with respiratory symptoms, especially in high TB burden settings. This should include not only those with clinical suspicion of PTB but also patients with non-specific or less typical symptoms to avoid missed cases.
2. **Strengthen early case detection strategies**: Public health campaigns should emphasize early health-seeking behavior for persistent respiratory symptoms, even if they are mild or non-specific. Community outreach and education should target high-risk populations, particularly middle-aged men.
3. **Enhance clinician training**: Medical practitioners should be trained to recognize both classical and atypical presentations of PTB. Emphasis should be placed on the limitations of symptom-based diagnosis and the need for thorough clinical-radiologic correlation.
4. **Invest in radiographic infrastructure**: Given the crucial role of chest X-rays in PTB diagnosis, healthcare facilities especially in low-resource settings should prioritize functional radiology units and trained radiographers. Mobile radiography units could also be used in rural areas.
5. **Incorporate diagnostic algorithms** that combine clinical signs, radiographic findings, and when possible, microbiological testing such as GeneXpert or sputum microscopy. These algorithms should be standardized and adapted for local resource settings.
6. **Encourage further research**: Larger, multicenter studies incorporating microbiological confirmation and follow-up outcomes are needed to further refine diagnostic criteria and understand the clinical trajectory of patients with atypical presentations.
7. **Integrate TB screening with other chronic disease programs**: Since PTB can mimic or co-exist with conditions like COPD, pneumonia, or heart disease, integrated screening programs may help identify hidden TB cases during routine care for other illnesses.

5.3 Limitations

1. **Retrospective design:** The study relied solely on patient records, which limited control over data quality, completeness, and consistency of documentation.
2. **Absence of microbiological confirmation:** Diagnosis was based on recorded clinical and radiographic findings without laboratory confirmation (e.g., GeneXpert, culture), increasing the potential for diagnostic error.
3. **Single-center data source:** Findings were derived from one healthcare facility, which may limit its accuracy in other regions or healthcare settings.
4. **Observer and reporting bias:** Variability in radiographic interpretation by different radiologists or clinicians may have introduced bias in pattern classification.
5. **Lack of longitudinal follow-up:** The study design did not track patient treatment outcomes, limiting understanding of how initial radiographic or clinical patterns relate to disease progression or response to therapy,

5.4 Suggestions for Further Studies

1. Combining radiographic assessment with GeneXpert, culture, and other advanced diagnostic methods would strengthen diagnostic validity.
2. Further work should evaluate standardized chest X-ray scoring models to objectively grade disease severity and correlate it with treatment outcomes.Future research should involve multiple healthcare facilities and adopt a prospective design to improve data accuracy.
3. Future investigations should include post-treatment follow-up to understand radiographic resolution, relapse patterns, and prognostic indicators.
4. Research assessing the impact of radiologist and clinician training on diagnostic accuracy could provide insights into improving TB detection practices.

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APPENDIX I

Procedure checklist used for the Pattern Of Request and radiographic findings in Patients with Pulmonary Tuberculosis in University Of Benin Teaching Hospital.

S/N	Patient id	age	sex	Clincal indication	Radiological findings	affected lobe

APPENDIX II

HEALTH RESEARCH ETHICS COMMITTEE (HREC)

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Registration Number:
NHREC-UBTH-HREC/24/12/2022B

PROTOCOL NUMBER: ADM/E 22/A/VOL.VII/2025/151

PROPOSAL TITLE: "PATTERN OF REQUEST AND RADIOGRAPHIC FINDINGS IN PATIENT WITH PULMONARY TUBERCULOSIS IN UBTH, BENIN CITY, EDO STATE, NIGERIA"

PRINCIPAL INVESTIGATOR(S): USIDEME DAVID OSAMOJE

DEPARTMENT/INSTITUTION: DEPARTMENT OF RADIOGRAPHY, SCHOOL OF BASIC MEDICAL SCIENCES UNIVERSITY OF BENIN, BENIN CITY, EDO STATE

DATE CONSIDERED: AUGUST 6TH, 2025

DECISION OF THE COMMITTEE: APPROVED

THIS APPROVAL DATES 6/8/2025 TO 5/8/2026. IF THERE IS DELAY IN STARTING THE RESEARCH, PLEASE INFORM THE HREC SO THAT THE DATES OF APPROVAL CAN BE ADJUSTED ACCORDINGLY

REMARK:

CHAIRMAN: PROF. (MRS) A.N. OFILI **SIGNATURE & DATE** A.N.O. 6/8/2025

SUPERVISOR (S): DR. G.E. OKUNGBOWA

DECLARATION BY INVESTIGATOR(S):
PROTOCOL NUMBER (please quote in all enquiries)
Note that no participant accrual or activity related to this research may be conducted outside of these dates. All informed consent forms used in this study must carry the HREC assigned number and duration of HREC approval of the study. In multiyear research, endeavor to submit your annual re-port to the HREC early in order to obtain renewal of your approval and avoid disruption of your research. No changes are permitted in the research without prior approval by the HREC except in circumstances outlined in the Code. The HREC reserves the right to conduct compliance visit your research site without previous notification

Signature & Date 14/8/25

ubthresearchethics@gmail.com Registration Number: NHREC/24/01/202