KNOWLEDGE, ATTITUDE AND PRACTICES OF RADIOGRAPHERS TOWARDS TUBERCULOSIS CASES IN SELECTED HOSPITALS IN BENIN CITY, EDO STATE, NIGERIA.

BY

TIAMIYU AYOBAMI OMOWALE

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CERTIFICATION

This is to certify the project on **KNOWLEDGE, ATTITUDE AND PRACTICES OF RADIOGRAPHERS TOWARDS TUBERCULOSIS CASES IN SELECTED HOSPITALS IN BENIN CITY, EDO STATE, NIGERIA.** written by **TIAMIYU AYOBAMI OMOWALE** with Matriculation number **BMS2009066** in partial fulfillment of the Bachelor of Radiography (B.Rad.) degree in the Department Of Radiography, School Of Basic Medical Science, College Of Medical Sciences, University Of Benin.

DR OKUNGBOWA, G. E. **DATE**
Project Supervisor

MRS F. O. IGBINEDION **DATE**
Head of Department

EXTERNAL EXAMINER **DATE**

APPROVAL

Project title; KNOWLEDGE, ATTITUDE AND PRACTICES OF RADIOGRAPHERS TOWARDS TUBERCULOSIS CASES IN SELECTED HOSPITALS IN BENIN CITY, EDO STATE, NIGERIA.

DR OKUNGBOWA, G. E.	**DATE**
Project Supervisor	

MRS F. O. IGBINEDION	**DATE**
Head of Department	

DEDICATION

This work is dedicated to God Almighty, the one who made me firm, and strong throughout my journey in school.

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ABSTRACT

Tuberculosis (TB) remains a significant public health challenge in Nigeria, with radiographers playing a crucial role in TB diagnosis through chest radiography. However, gaps in knowledge, attitudes, and practices (KAP) regarding TB among radiographers may compromise both diagnostic quality and infection control. This study assessed the knowledge, attitudes, and practices of radiographers towards TB cases in selected hospitals in Benin City, Edo State, Nigeria. A descriptive cross-sectional survey was conducted among 43 radiographers from University of Benin Teaching Hospital, Lily Hospital, and Raytouch Diagnostic Center. Data were collected using structured questionnaires and analyzed using descriptive statistics and chi-square tests ($p<0.05$). The majority of respondents (88.4%) demonstrated good knowledge of TB transmission, symptoms, causation, diagnosis, and prevention. Most participants (83.7%) exhibited positive attitudes toward TB patients, with 83.7% acknowledging professional duty to care for TB cases and 93% agreeing TB patients deserve equal care. However, practice levels were lower, with only 48.8% demonstrating good adherence to universal precautions, while 32.6% showed fair practice and 18.6% poor practice. No statistically significant associations were found between demographic characteristics and KAP levels ($p>0.05$). While radiographers in Benin City possess adequate knowledge and positive attitudes toward TB, practice gaps exist in implementing universal precautions. Findings emphasize the need for continuous professional training, improved access to personal protective equipment, and strengthened infection control policies to enhance TB management and reduce occupational exposure risks.

Keywords: Tuberculosis, radiographers, knowledge, attitude, practice, infection control, Benin City.

CHAPTER ONE

INTRODUCTION

1.1 Background of Study

Tuberculosis (TB) is an infectious disease caused by *Mycobacterium tuberculosis,* primarily affecting the lungs and transmitted through airborne droplets released when people with active TB cough, sneeze or speak. (WHO, 2025).

Despite being preventable and treatable, TB remains a major global health challenge, particularly in low- and middle-income countries. Nigeria is listed among the 30 high TB-burden countries and currently ranks first in Africa and among the top six globally (WHO, 2023). The high burden is worsened by weak health systems, inadequate diagnostic facilities, and late case detection.

Following the declaration of TB as a global emergency by the World Health Organization in 1993 (WHO, 1994), early diagnosis and infection control became central strategies for reducing transmission. In clinical settings, radiographers are essential frontline professionals since chest radiography remains one of the most widely used tools for TB screening and diagnosis in Nigeria. Their level of knowledge about TB transmission, symptoms, diagnostic protocols, and infection prevention measures directly influences both the accuracy of diagnosis and their own occupational safety.

A radiographer's attitude toward TB patients also plays a significant role in clinical outcomes. Positive attitudes—characterized by empathy, professionalism, and adherence to ethical

practice—reduce patient stigmatization and diagnostic errors, while negative attitudes may result in poor imaging quality, repeated exposures, and delays in diagnosis.

Similarly, preventive practices such as proper use of personal protective equipment (PPE), hand hygiene, adequate ventilation, and adherence to infection control guidelines are fundamental in preventing nosocomial spread among healthcare workers and patients. These constitute the Practice component of the Knowledge, Attitude, and Practice (KAP) framework, which forms the basis of the present study's methodological approach.

Given the central role of radiographers in TB diagnosis, a KAP survey provides a suitable methodological approach for assessing their preparedness and behavior because it enables measurement of what radiographers know, how they feel, and what they actually do in relation to TB. However, such studies may be limited by self-reported responses that could introduce bias, and findings may not be fully generalizable beyond the selected hospitals. Despite these limitations, a KAP design offers valuable insight for targeted interventions in local healthcare settings.

Therefore, this study assesses the knowledge, attitudes, and practices of radiographers toward TB in selected hospitals in Benin City, contributing evidence for improved infection control and early detection strategies within radiology departments.

1.2 Statement of the Problem

Tuberculosis (TB) remains a major public health threat in Nigeria, which is among the 14 countries with the highest TB burden worldwide (KNCV Nigeria, 2019). In 2023, the country

recorded 371,019 TB cases—the highest notification since the establishment of the National Tuberculosis and Leprosy Control Programme (NTBLCP) in 1989 (NTBLCP, 2025). Despite ongoing national control efforts, TB still claims about 71,000 lives annually in Nigeria (Akor, 2025), indicating gaps in early diagnosis and infection control.

Radiographers play a crucial role in TB detection because chest radiography continues to be one of the primary diagnostic tools used for screening and case identification in Nigeria (Olaleye, Balogun & Adusei-Mensah, 2023). Their knowledge, attitudes, and infection-prevention practices directly influence diagnostic accuracy and the likelihood of TB transmission within radiology departments. However, previous studies have shown persistent gaps in infection control adherence among healthcare workers, including radiographers, which may increase both occupational risk and nosocomial spread (Olaleye et al., 2023).

In Benin City, there is limited empirical data on the KAP of radiographers toward TB, making it difficult to evaluate their readiness to manage TB cases effectively. This lack of data justifies the use of a hospital-based cross-sectional KAP study, which allows systematic assessment of radiographers' understanding, perceptions, and safety practices. Nonetheless, such a methodology has limitations, including reliance on self-reported information and restriction to selected facilities, which may affect generalizability. Despite these limitations, the study is essential because identifying gaps in KAP will provide evidence for designing targeted training, strengthening safety protocols, and improving TB diagnosis and infection control in radiology units.

1.3 Research Question

What are the levels of knowledge, attitudes, and practices among radiographers regarding tuberculosis cases in selected hospitals in Benin City, Edo State, Nigeria?

1.4 Hypotheses

Null Hypotheses (H_0)

1. Radiographers working in selected hospitals in Benin City **do not possess** adequate knowledge regarding tuberculosis transmission, symptoms, and prevention.
2. Radiographers **do not demonstrate** a positive attitude towards patients with tuberculosis during patient preparation and investigations.
3. Radiographers **do not consistently adhere** to Universal Precautions when handling tuberculosis cases.
4. Radiographers **do not employ** appropriate protective measures to safeguard themselves from tuberculosis infection.

Alternate Hypotheses (H_1)

1. Radiographers working in selected hospitals in Benin City **possess** adequate knowledge regarding tuberculosis transmission, symptoms, and prevention.
2. Radiographers **demonstrate** a positive attitude towards patients with tuberculosis during patient preparation and investigations.
3. Radiographers **consistently adhere** to Universal Precautions when handling tuberculosis cases.

4. Radiographers **employ** appropriate protective measures to safeguard themselves from tuberculosis infection.

1.5 Aim of the Study

The aim of this study is to assess the knowledge, attitudes, and practices of radiographers toward tuberculosis cases in selected hospitals in Benin City, Edo State, Nigeria.

1.6 Objectives of the Study

1. To assess radiographers' knowledge of tuberculosis and its mode of transmission.
2. To assess the attitude of radiographers towards patients with tuberculosis cases during patient preparation and investigations.
3. To determine the extent to which Radiographers adhere to Universal Precautions and Infection-prevention practices when handling tuberculosis cases.

1.7 **Significance of Study**

This study is important because it provides evidence on the preparedness of radiographers to safely and effectively manage TB cases. The findings will help hospital administrators, professional bodies, and policymakers identify gaps in knowledge, attitude, and infection-control practices, enabling targeted interventions such as training, seminars, and policy strengthening. Furthermore, the study adds to existing literature on KAP towards tuberculosis and will serve as a useful reference for future researchers and TB-control stakeholders.

1.8 Scope of the Study

This study will cover all Radiographers in selected hospitals in Benin City, including Intern Radiographer and Radiographers presently undergoing their NYSC in these Hospitals on their knowledge, attitudes and practices towards TB cases.

The areas of study are limited to - University of Benin Teaching Hospital, Benin City; Lily Hospital Limited Benin City; and Raytouch Diagnostic Center Benin City.

1.9 Operational definition of terms

Tuberculosis: Tuberculosis (TB) is an infectious disease caused by bacteria (*Mycobacterium tuberculosis)* that most often affects the lungs. It spreads through the air when people with TB cough, sneeze or spit.

Universal Precautions: Universal precautions are a standard set of guidelines to prevent the transmission of bloodborne pathogens from exposure to blood and other potentially infectious materials.

PPE: Personal Protective Equipment (PPE) is a specialized clothing or equipment designed to protect healthcare workers from exposure to infectious agents. PPE typically includes disposable gloves (latex or vinyl), gowns, masks or respirators, and eye protection such as goggles or face shields. These items are generally intended for single use to prevent cross-contamination and should be donned and doffed following established protocols to ensure safety.

BCG: BCG means Bacillus Calmette-Guėrin, a vaccine which confers inconsistent protection against pulmonary tuberculosis.

Knowledge: is the awareness, understanding, or familiarity gained through experience, education, or reasoning. It encompasses facts, information, skills, and concepts acquired by perceiving, discovering, or learning.

Practice: the actual application or use of an idea, belief, or method, as opposed to theories relating to it.

Attitude: a psychological tendency that is expressed by evaluating a particular entity with some degree of favor or disfavor.

Radiographer: A radiographer is a healthcare professional trained to perform diagnostic imaging procedures using ionizing radiation (such as X-rays) or non-ionizing radiation (such as ultrasound). They operate imaging equipment to produce images of the human body, which assist physicians in diagnosing and treating medical conditions. They may also be involved in administering radiation treatments and monitoring patients' conditions under the supervision of a radiologist or other health professionals.

CHAPTER TWO

LITERATURE REVIEW

2.1 CONCEPTUAL REVIEW

This section provides a conceptual overview of tuberculosis, highlighting its historical development, causative organism, modes of transmission, clinical features, diagnosis, prevention, and treatment. Understanding these foundational concepts is essential for assessing the knowledge, attitudes, and practices of radiographers regarding tuberculosis.

2.1.1 HISTORY OF TUBERCULOSIS

Tuberculosis (TB) is an ancient disease that has affected humans for thousands of years. Evidence suggests that Mycobacterium tuberculosis, the causative agent, originated in East Africa nearly 3 million years ago, with all modern strains evolving around 20,000–15,000 years ago (Daniel, 2006). Archaeological findings in Egypt, including skeletal deformities and DNA from mummies, confirm TB's presence over 5,000 years ago.

References to TB are found in ancient Hebrew texts, and it was known as phthisis in classical Greece, where Hippocrates described its symptoms and prevalence among young adults (Daniel, 2006). During the Middle Ages, TB remained widespread though less documented. In the 19th century, Laennec advanced understanding of TB pathology, and in 1882, Robert Koch identified the tubercle bacillus, proving the disease was infectious (Daniel, 2006).

Clemens von Pirquet's introduction of the tuberculin skin test in 1907 allowed for detection of latent TB. Sanatoria became common treatment centers, though their effectiveness was debated. Public health efforts expanded, and the BCG vaccine was introduced in 1921 (Daniel, 2006).

The discovery of streptomycin in 1944 and isoniazid in 1952 marked the start of effective TB chemotherapy, significantly improving treatment outcomes. Despite this progress, TB remains a public health challenge in many parts of the world, particularly where HIV is prevalent (Daniel, 2006).

2.1.2 CAUSES AND TRANSMISSION OF TUBERCULOSIS

Tuberculosis (TB) is caused by the bacterium *Mycobacterium tuberculosis*, which primarily targets the lungs but has the potential to spread to other organs, including the brain, kidneys, and spine. The bacterium thrives in environments with limited oxygen, making the lungs an ideal site for colonization and infection. It can be transmitted through airborne particles that are expelled when an individual with active pulmonary TB coughs, sneezes, speaks, or even laughs. These tiny droplets, known as droplet nuclei, can remain suspended in the air for several hours, especially in enclosed or poorly ventilated spaces (WHO, 2025).

Infection risk is higher in crowded conditions, such as prisons, shelters, or densely populated areas, where ventilation may be inadequate. Close contact with an infected individual, particularly someone with untreated or poorly managed TB, significantly increases exposure risk. Factors such as a weakened immune system, malnutrition, and chronic diseases (e.g., diabetes or HIV) further elevate the likelihood of developing TB after exposure (WHO, 2023). It's important to note that TB is not spread through physical contact, such as shaking hands, sharing food, or using the same utensils (CDC, 2024).

2.1.3 PATHOGENESIS OF MYCOBACTERIUM TUBERCULOSIS

TB infection initiates when mycobacteria reach the pulmonary alveoli, invading and replicating within endosomes of alveolar macrophages (Ernst & Cornelius, 2022). The primary lung infection site, known as the Ghon focus, typically localizes in the upper lower lobe. Dendritic cells transport bacilli to mediastinal lymph nodes without supporting replication. Hematogenous dissemination enables secondary lesions in lung apices, lymph nodes, kidneys, brain, and bone. While many organs may be affected, cardiac, pancreatic, thyroid, and skeletal muscle involvement is rare (Heemskerk et al., 2015).

Active pulmonary TB transmits via infectious aerosol droplets (0.5–5.0 μm diameter) expelled during coughing, sneezing, speaking, or spitting. A single sneeze releases thousands of droplets, with fewer than 10 bacilli potentially causing infection due to TB's low infectious dose (CDC, 2023).

2.1.4 SIGNS AND SYMPTOMS

The clinical manifestations of TB vary depending on whether the infection is active or latent:

I. **Active TB Disease:** This is characterized by symptomatic illness, with respiratory symptoms like a persistent cough lasting three weeks or more, chest pain, and hemoptysis (coughing up blood or sputum). Systemic symptoms often accompany respiratory signs, including fatigue, unexplained weight loss, decreased appetite, fever, chills, and night sweats. These systemic effects reflect the body’s immune response to the infection and can severely impact an individual’s overall health (American Lung Association, 2025).

II. **Latent TB Infection (LTBI):** the individuals harbor the bacteria but remain asymptomatic and non-contagious. While they may appear healthy, about 5-10% of these individuals may progress to active TB at some point in their lifetime, particularly if their

immune system becomes compromised. Reactivation can occur due to aging, stress, malnutrition, or medical conditions like HIV/AIDS (CDC, 2023).

Children, older adults, and immunocompromised individuals may exhibit atypical symptoms, such as less pronounced fever or weight loss. Recognizing these subtle signs in high-risk populations is vital for timely intervention.

2.1.5 DIAGNOSIS

A complete medical evaluation for tuberculosis (TB) must include a medical history, a physical examination, a chest X-ray and microbiological examination (of sputum or some other appropriate sample). It may also include a tuberculin skin test and surgical biopsy (Lewinsohn et al., 2017).

Medical History:

The medical history includes obtaining the symptoms of pulmonary TB: productive, prolonged cough of three or more weeks, chest pain, and hemoptysis. Systemic symptoms include low-grade intermittent fever, chills, night sweats, appetite loss, weight loss, easy fatiguability and production of sputum that starts out mucoid but changes to purulent. Tuberculosis should be suspected when a pneumonia-like illness has persisted longer than three weeks, or in a respiratory illness has persisted longer than three weeks, or in a respiratory illness in which an otherwise healthy individual does not respond to regular antibiotics. (Nahid et al., 2017).

Physical examination:

A physical examination is done to assess the patient's general health and find other factors which may affect the TB treatment plan. It cannot be used to confirm or rule out TB. (Lewinsohn et al., 2017).

Microbiological studies:

Using histological stains on expectorate samples from phlegm (also called sputum), scientists can identify MTB under a regular microscope. Since MTB retains certain stains after being treated with acidic solution, it is classified as an acid-fast bacillus (AFB). The most common acid-fast staining technique, the Ziehl-Neelsen stain, dyes AFBs a bright red that stands out clearly against a blue background. Other ways to visualize AFBs include an auramine-rhodamine stain and fluorescent microscopy. (Pfyffer, 2015; CDC, 2023b).

Alternative sampling:

In patients incapable of producing a sputum sample,common alternative sample sources for diagnosing pulmonary tuberculosis include gastric washing, laryngeal swab, bronchoscopy (with bronchoalveolar lavage, bronchial washings, and/or transbronchial biopsy), and fine needle aspiration (transtracheal or transbronchial). In some cases, a more invasive technique is necessary, including tissue biopsy during mediastinoscopy or thoracoscopy. (Denkinger et al., 2014).

Chest X-ray:

Active pulmonary TB typically shows upper-lobe infiltrates, consolidations, or cavitation, with possible hilar lymphadenopathy or pleural effusion. Lesions may occur anywhere in the lungs.

Miliary TB presents with diffuse micronodules. In immunocompromised patients (e.g., HIV+), radiographs may appear normal despite active infection (Nachiappan et al., 2016).

Tuberculin Skin Test

Mantoux Test: The mantoux test for TB involves intradermally injecting PPD (Purified Protein Derivative) tuberculin and measuring the size of induration 48-73 hours later. An induration (palpable raised hardened area of skin) of more than 5-15 mm (depending upon the person's risk factors) to 10 Mantoux units is considered a positive result, indicating TB infection. Mantoux tuberculin skin tests are often used for routine screening of high risk individuals. (Lewinsohn et al., 2017).

2.1.6 PREVENTION AND CONTROL

Vaccination

Bacillus Calmette-Guérin (BCG) vaccination remains the primary preventive measure against tuberculosis, particularly for infants in high-burden regions. The World Health Organization (WHO) recommends neonatal BCG administration due to its efficacy against severe pediatric TB manifestations (meningitis and miliary TB). Globally, BCG is the most widely administered vaccine, with Nigeria incorporating it into the National Programme on Immunization (NPI) schedule at birth. However, BCG demonstrates variable protection (0–80%) against adult pulmonary TB, which represents the majority of global disease burden (WHO, 2022; Colditz et al., 2022).

Early Detection and Treatment

Systematic screening for latent TB infection (LTBI) is essential for TB control. Asymptomatic individuals with positive tuberculin skin tests (Mantoux) and normal chest radiographs should receive chemoprophylaxis to prevent progression to active disease. First-line regimens include:

I. Isoniazid monotherapy for 6–9 months
II. Isoniazid + rifampicin for 3 months
III. Isoniazid + rifapentine weekly for 3 months (CDC, 2023a; WHO, 2022).

Combating Drug Resistance

Secondary drug resistance arises from inadequate treatment adherence, suboptimal dosing, or poor-quality medications. The WHO-endorsed DOTS (Directly Observed Treatment, Short-course) strategy mitigates resistance by ensuring:

1. Standardized drug combinations
2. Direct observation of therapy
3. Continuous drug supply
4. Systematic monitoring

This approach achieves >85% treatment success rates in compliant populations and reduces multidrug-resistant TB (MDR-TB) emergence by 40–60% (WHO, 2022).

2.1.7 TREATMENT

TB treatment employs antibiotics to eliminate *Mycobacterium tuberculosis*, though efficacy is challenged by the bacterium's complex cell wall structure that limits drug penetration (Ernst, 2018). Standard therapy combines isoniazid and rifampicin as core agents, with treatment duration extending to 6–24 months due to mycobacterial persistence (Nahid et al., 2019). While

latent TB typically requires monotherapy (e.g., isoniazid), active TB necessitates multi-drug regimens to prevent resistance development (WHO, 2022).

Nigeria's Treatment Protocol

The National Tuberculosis and Leprosy Control Programme (NTBLCP) implements an 8-month regimen:

1. Intensive Phase (2 months):
    a. Directly Observed Treatment, Short-course (DOTS) with four drugs: rifampicin, isoniazid, pyrazinamide, and ethambutol
    b. Ensures adherence and minimizes early resistance
2. Continuation Phase (6 months):
    a. Rifampicin and isoniazid maintenance therapy
    b. Pyrazinamide and ethambutol discontinued after initial phase.

This strategy yields 85–90% treatment success rates for drug-susceptible TB when fully adhered to. (NTBLCP, 2022).

2.2 EMPIRICAL REVIEW

In assessing tuberculosis (TB) infection control practices across healthcare settings in Nigeria, Ogbonnaya, Chukwu, Uwakwe, Oyibo, and Ndukwe (2011) conducted a comprehensive descriptive study involving 12 health facilities in the southern region of Nigeria. The study utilized a triangulated methodology incorporating self-administered questionnaires to infection control officers and health workers, as well as facility observations and review of clinic records. The findings revealed significant lapses in the implementation of WHO-recommended TB infection control measures. For instance, only 8.3% of facilities had a documented TB infection

control policy, while just 16.7% had functional infection control committees. Alarmingly, no facility employed respiratory protection control measures, and over half (58.3%) of the facilities managed sputum-positive TB patients alongside HIV-positive and other immunocompromised individuals. Despite the well-ventilated environments, issues such as overcrowding and lack of patient screening protocols persisted. These findings expose a critical vulnerability in healthcare systems, where poor administrative and environmental control practices could facilitate nosocomial transmission of TB. While the study did not focus exclusively on radiographers, it underscores the heightened occupational risk faced by frontline healthcare workers, including diagnostic imaging professionals who often operate in close proximity to potentially infectious patients. Therefore, the study serves as a foundational reference for evaluating contemporary TB control practices and reaffirms the urgent need for targeted training, protective policy frameworks, and routine infection control assessments among healthcare personnel in Nigeria (Ogbonnaya et al., 2011).

Similarly, Ekuma and Oridota (2016) conducted a cross-sectional study assessing the knowledge, attitude, and practice (KAP) of TB infection control among healthcare workers (HCWs) in Directly Observed Treatment, Short-course (DOTS) centres in Lagos State, Nigeria. The study involved 182 HCWs across nine centres and employed structured questionnaires along with facility assessments. Despite generally positive attitudes and self-reported compliance with infection control activities, the results revealed notable gaps in practical knowledge and implementation. Only 42.3% of HCWs had received training on TB infection control, and just 64.3% could accurately differentiate between an N95 respirator and a surgical mask. Alarmingly, only one centre had a supply of N95 respirators, and most facilities lacked separate waiting areas for TB and non-TB patients. While 83% of respondents reported knowing their HIV status,

stigma and confidentiality concerns remained significant issues. The study concluded that TB infection control practices in Lagos DOTS centres were not fully compliant with national guidelines, primarily due to training gaps, inadequate resources, and infrastructural limitations. These findings underscore the need for continued professional development and stronger policy enforcement. For radiographers and other diagnostic staff who frequently interact with TB patients during imaging procedures, such systemic gaps further highlight occupational exposure risks, making institutional infection control frameworks crucial to their safety (Ekuma & Oridota, 2016).

Focusing more specifically on a national TB care institution, Ajayi and Isiyaku (2018) carried out a study at the National Tuberculosis and Leprosy Training Centre in Zaria, Nigeria, to assess healthcare workers' knowledge and practice of tuberculosis infection control (TBIC). Using a cross-sectional design, the researchers surveyed 78 healthcare professionals across various cadres through structured, self-administered questionnaires. The study revealed that 78.2% of respondents had received prior training on TBIC, and among these, 90.2% demonstrated good knowledge while 85.3% exhibited good practice. Additionally, health workers with more than five years of experience showed significantly better infection control behavior (AOR = 8.3, 95% CI = 1.44–20.14), and those trained in TBIC were markedly more likely to apply appropriate measures in clinical settings (AOR = 13.8, 95% CI = 2.10–32.36). The findings emphasized that both training and years of service were strong predictors of effective infection control practices. While radiographers were not isolated as a subgroup in the analysis, the results remain applicable due to their direct exposure to TB patients in diagnostic settings. The study further highlights the necessity of institutionalizing continuous professional training and integrating TBIC protocols

into the routine operations of radiology departments and similar high-risk units (Ajayi & Isiyaku, 2018).

Expanding the lens beyond tuberculosis-specific contexts, Ezeama et al. (2023) conducted a national cross-sectional study assessing radiographers' knowledge, attitude, and adherence to standard COVID-19 precautions across Nigeria. The study surveyed 255 radiographers using an online questionnaire and found that participants exhibited high levels of knowledge regarding COVID-19 pathology (82.5%) and prevention (93.4%), as well as a generally positive attitude (74.1%). However, adherence to safety precautions was relatively low, with an average compliance score of 56.1%. Notably, radiographers with lower educational qualifications and fewer years of professional experience demonstrated significantly lower compliance with safety protocols. Systemic barriers such as lack of personal protective equipment (PPE), inadequate hygiene infrastructure, and the absence of clear institutional guidelines were identified as major contributors to poor compliance. Although the study focused on the COVID-19 context, its findings reflect similar infection control challenges faced by radiographers in the management of other airborne diseases such as tuberculosis. The study underscores the critical need for consistent training, upgraded facilities, and structured infection control policies to protect radiographers and improve patient safety in Nigeria's healthcare system (Ezeama et al., 2023).

In summary, the reviewed empirical studies reveal a consistent pattern of gaps in infection control knowledge and practice among healthcare workers, including radiographers, across various Nigerian healthcare settings. While training and professional experience were repeatedly shown to enhance both knowledge and compliance with infection control measures, systemic challenges such as limited access to personal protective equipment, infrastructural deficiencies, and lack of institutional policies continue to hinder effective implementation. Even in contexts

outside tuberculosis, such as the COVID-19 pandemic, radiographers demonstrated commendable awareness but struggled with adherence due to inadequate resources and unclear operational frameworks. These findings underscore the critical need for sustained, targeted training programs, policy enforcement, and facility upgrades to ensure that radiographers and other frontline professionals are adequately protected and equipped. Strengthening infection control at all levels is not only essential for curbing occupational exposure but also for safeguarding public health and sustaining quality diagnostic services in high-burden settings like Nigeria.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 RESEARCH SETTING

This study was conducted in selected hospitals in Benin City, Edo State, Nigeria. They include; University of Benin Teaching Hospital (UBTH), Lily Hospital and Raytouch Diagnostic Center. These were selected due to their regular handling of pulmonary cases, including tuberculosis, and having active radiology departments staffed with qualified radiographers.

3.1.1 HISTORY OF THE SELECTED HOSPITALS

The University of Benin Teaching Hospital (UBTH) was established in 1973 by the Federal Government of Nigeria. It began as the Midwest Medical Centre before being renamed and affiliated with the University of Benin. Today, it is a leading tertiary hospital serving Edo State

and neighboring regions, providing specialized healthcare, professional training, and medical research.

Lily Hospital was founded in 1984 in Warri, Delta State, and later expanded to Benin City to meet rising healthcare needs. It has since grown into one of Nigeria's foremost private hospital groups, recognized for modern facilities, specialized care, and international quality accreditation.

Raytouch Diagnostic Center was established in 2017 in Benin City by Prof. Igbinedion and partners to provide affordable, technology-driven diagnostic services. With advanced imaging such as CT, MRI, ultrasound, and X-ray, alongside comprehensive laboratory services, it has become a key diagnostic hub in Edo State. Known for its community-friendly approach, including subsidized CT scans and free ambulance services, Raytouch is one of the most sought-after diagnostic facilities in Benin City.

3.2 STUDY DESIGN

This research adopted a descriptive cross-sectional survey design to evaluate the current level of knowledge, Attitude, and Practices (KAP) among radiographers regarding tuberculosis (TB) in selected hospitals in Benin City.

3.3 TARGET POPULATION

The target populations for this study were radiographers, intern radiographers and NYSC radiographers employed and are practicing at the selected hospitals within Benin City. This includes- University Of Benin Teaching Hospital (UBTH); Lily Hospital Limited Benin City; and Raytouch Diagnostic Center Benin City.

Table 3.1: Target Population

S/N	Center	Number of Radiographer
1	UBTH	31
2	Lily Hospital limited	4
3	Raytouch Diagnostic Center	8

3.4 SAMPLING TECHNIQUES/SAMPLING SIZE

A purposive sampling approach was used to recruit radiographers actively involved in chest imaging at the selected hospitals in Benin City. This ensures participants directly relevant to TB imaging are included. The target population was about 43 radiographers. The study aims for a near-complete census, and 40 responses were reached which aligns with response rates in similar Nigeria KAP studies.

3.5 INSTRUMENT FOR DATA COLLECTION

The instrument for data collection was questionnaire, which is a primary source. The questionnaire was designed by the researcher according to the objective of the study.

The questionnaire was developed based on information on the literatures of Knowledge, attitudes and practices of radiographer towards tuberculosis cases. The questionnaire was reviewed by my project supervisor.

The questionnaire consists of four sections. Section A has items of demographic and professional information; section B has questions on radiographers' knowledge about tuberculosis; section C contained questions on the attitude of radiographers towards patient with tuberculosis; section D consist of questions aimed at finding out if radiographers follow universal precaution in their

practices and the protective measures they adopt. The format for the questionnaire includes yes or no, multiple choice and open-ended to enable respondents express their view.

3.6 VALIDITY OF THE INSTRUMENT

The validity of the questionnaire was ensured through a combination of expert review and pilot testing. To establish face and content validity, the draft instrument was reviewed by my supervisor, an expert in radiography and research methodology. The review focused on clarity of language, relevance of items to the study objectives, logical sequencing of questions, and the adequacy of the content in measuring knowledge, attitude, and practice components. Feedback from the review guided the restructuring and refinement of several items to improve precision and comprehensiveness.

In addition to expert review, a pilot test was conducted using a small sample of radiographers from a hospital not included in the main study. This pilot group was selected to evaluate the practicality of the questionnaire, the time required for completion, and the respondents' understanding of each item. The pilot testing also helped determine whether any questions were ambiguous, repetitive, misleading, or difficult to interpret.

Responses and observations from the pilot test were analyzed to identify problematic items. Necessary adjustments were made, including rephrasing unclear statements, eliminating redundant questions, and ensuring that the response options were appropriate and exhaustive. This process strengthened the reliability and usability of the questionnaire, ensuring it was suitable for the main study population.

3.7 RELIABILITY OF INSTRUMENT

The questionnaire's reliability was evaluated through internal consistency and temporal stability. Internal consistency was assessed using Cronbach's alpha for each domain, knowledge, attitudes, and practices, with a minimum acceptable value of 0.70, in line with psychometric standards (Fan et al., 2018; Elbahloul et al., 2023).

3.8 METHOD OF DATA COLLECTION

The questionnaire was distributed electronically via Google Forms to radiographers currently on duty in the radiology departments of the selected hospitals during the morning and afternoon shifts.

3.9 METHOD OF DATA ANALYSIS

Data collected was subjected to simple descriptive analysis involving frequencies and percentages, which are appropriate for summarizing categorical variables in survey research. The results were presented in tables for clarity and ease of interpretation, as recommended by Mugenda and Mugenda (2003). The structure of the tables was guided by the objectives of the study, with categories including respondents' demographic data, knowledge of radiographers about tuberculosis, attitudes towards tuberculosis cases, and protective practices adopted when handling such cases. CHi-square test of association was used to test the research hypotheses. Level of significance is set at $p<0.05$. Data was analyzed using IBM Statistical Package for Social Sciences (SPSS) version 29.0 for windows.

3.10 ETHICAL CONSIDERATION

Ethical approval for this study was obtained from the health research and ethics committee from the selected hospitals in Benin City (UBTH, Lilly hospital and Raytouch Diagnostic Center), ensuring compliance with national and international ethical standards. Participation was entirely voluntary, and informed consent was sought from each radiographer after explaining the study's purpose, procedures, potential risks and benefits, and their right to withdraw at any point without penalty.

To protect confidentiality, data was anonymized using unique participant codes and securely stored in password-protected files, with access limited only to the research team. Special attention was paid to preventing stigma or discomfort associated with TB-related questions by clearly communicating that responses are confidential and only used for research purposes.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Introduction

This chapter presents the analysis and interpretation of data collected from 43 radiographers working in selected hospitals in Benin City, Edo State, Nigeria. The chapter is divided into two main sections: the results section, which presents the raw findings from the data analysis, and the discussion section, which interprets these findings in relation to existing literature and the study objectives. The results are organized according to the study objectives: to assess radiographers' knowledge of tuberculosis, evaluate their attitudes toward TB patients, and determine their adherence to universal precautions when handling TB cases.

SECTION A: RESULTS

4.2 Sociodemographic Characteristics of Respondents

Table 4.1: Sociodemographic Characteristics of Respondents (N=43)

Variable	Frequency (n)	Percentage
Age Group (years)		
20-24	18	41.9
25-29	17	39.5
30-34	8	18.6
Sex		
Female	28	65.1
Male	15	34.9
Educational Level		
B.Sc.	36	83.7
M.Sc.	5	11.6
Pgd.	1	2.3
PhD	1	2.3
Place of Work		
LILY	4	9.3
RAYTOUCH	8	18.6
UBTH	31	72.1
Years of Practice		
1-5yrs	25	58.1
6-10yrs	8	18.6
Less than 1yr	10	23.3

Table 4.1 presents the sociodemographic profile of the 43 radiographers who participated in the study. The age distribution shows that the majority were young professionals, with 41.9% (n=18) aged 20-24 years and 39.5% (n=17) aged 25-29 years, while only 18.6% (n=8) were aged 30-34 years. This age pattern reflects the relatively recent expansion of radiography training programs in Nigeria and the growing workforce of early-career professionals.

Regarding sex distribution, females constituted the majority at 65.1% (n=28) compared to males at 34.9% (n=15). This finding contrasts with traditional gender patterns in medical imaging but aligns with recent trends showing increased female participation in allied health professions in Nigeria.

Educational qualifications revealed that the vast majority held Bachelor of Science degrees (83.7%, n=36), while 11.6% (n=5) had Master's degrees, and 2.3% each held Postgraduate Certificates and Doctorate degrees. This educational profile demonstrates a well-qualified workforce, though opportunities for advanced training remain limited.

In terms of workplace distribution, the majority of respondents (72.1%, n=31) worked at the University of Benin Teaching Hospital (UBTH), while 18.6% (n=8) were from Raytouch Diagnostic Center and 9.3% (n=4) from Lily Hospital. The dominance of UBTH reflects its status as the largest public tertiary health institution in the region with the highest staff capacity.

Years of practice showed that 58.1% (n=25) had 1-5 years of experience, 23.3% (n=10) had less than one year, and 18.6% (n=8) had 6-10 years of experience. This distribution indicates a predominantly early-career workforce, which has implications for experience-based competencies in TB management.

Table 4.2a: Knowledge of Tuberculosis among Respondents (N=43)

Knowledge Item	**Correct (n)**	**Correct**	**Incorrect (n)**	**Incorrect**
How can TB be transmitted?	30	69.8	13	30.2
What are the symptoms of TB?	42	97.7	1	2.3
TB is caused by...?	36	83.7	7	16.3
Diagnosis of TB can be made through?	40	93	3	7
How can TB be prevented?	38	88.4	5	11.6

Table 4.2 presents responses to five knowledge-based questions about tuberculosis. The results demonstrate generally high levels of knowledge across all domains. Regarding TB transmission, 69.8% (n=30) provided correct responses, while 30.2% (n=13) gave incorrect answers. This suggests that while most radiographers understand TB transmission mechanisms, nearly one-third harbor misconceptions that could compromise infection control practices.

Knowledge of TB symptoms was exceptionally high, with 97.7% (n=42) correctly identifying the clinical manifestations of TB. Only 2.3% (n=1) provided incorrect responses. This high level of awareness is encouraging, as it enables radiographers to recognize potentially infectious patients and implement appropriate precautions.

Understanding of TB causation showed that 83.7% (n=36) correctly identified bacteria as the causative agent, while 16.3% (n=7) provided incorrect answers. Knowledge of diagnostic methods was also strong, with 93% (n=40) correctly identifying appropriate diagnostic approaches, compared to 7% (n=3) with incorrect responses. Finally, 88.4% (n=38) demonstrated correct knowledge of TB prevention methods, while 11.6% (n=5) provided incorrect answers.

Table 4.2b: Level of Knowledge about Tuberculosis (N=43)

Knowledge Level	Frequency (n)	Percentage
Poor	2	4.7
Fair	3	7
Good	38	88.4

When knowledge was categorized into overall levels (Table 4.2b), 88.4% (n=38) demonstrated good knowledge, 7% (n=3) had fair knowledge, and only 4.7% (n=2) showed poor knowledge.

4.3 Attitude Towards Tuberculosis Patients

Table 4.3a: Attitude towards Tuberculosis Patients (N=43)

Variables	Frequency (n)	Percentage
Professional duty to care for TB patients		
Maybe	1	2.3
No	6	14
Yes	36	83.7
Feelings about TB patients		
Dispassionate	1	2.3
Empathy	33	76.7
Indifferent	2	4.7
Sympathy	7	16.3
TB patients entitled to same care		
Maybe	2	4.7
No	1	2.3
Yes	40	93
Reaction to regular TB care		
Attend to them professionally	1	2.3
Attend to them with maximum caret	1	2.3
Attend with utmost care to avoid infection, by ysing the approved and provided PPE	1	2.3
Being careful	1	2.3
Do it grudgingly	1	2.3
Do with it while taking precautionary measures	1	2.3
Gladly accept	29	67.4
It's like risking one's life	1	2.3
No complaints	1	2.3
Resign and leave the profession	3	7
Self protect myself	1	2.3
That will be hard cuz my life will also be at risk	1	2.3
Wear a face mask	1	2.3

Table 4.3 presents data on radiographers' attitudes toward TB patients across four dimensions. When asked about professional duty to care for TB patients, 83.7% (n=36) affirmed their obligation, while 14% (n=6) said no, and 2.3% (n=1) were unsure. This indicates that the vast

majority recognize their ethical and professional responsibilities, though a notable minority do not share this view.

Regarding emotional responses to TB patients, 76.7% (n=33) reported empathy, 16.3% (n=7) expressed sympathy, 4.7% (n=2) were indifferent, and 2.3% (n=1) were dispassionate. The high empathy rate suggests that most radiographers can emotionally connect with TB patients' experiences, which is crucial for providing compassionate care.

When asked whether TB patients are entitled to the same care as other patients, 93% (n=40) agreed, 4.7% (n=2) were unsure, and 2.3% (n=1) disagreed. This overwhelming consensus reflects adherence to ethical principles of non-discrimination in healthcare.

Responses to regular TB care revealed diverse reactions: 67.4% (n=29) would gladly accept, 7% (n=3) would resign and leave the profession, and 2.3% (n=1) would do it grudgingly. The remaining respondents provided various conditional acceptances emphasizing precautionary measures and self-protection. The 7% resignation rate is concerning, as it indicates that some radiographers perceive occupational TB risk as unacceptable despite available protective measures.

Table 4.3b: Level of Attitude towards Tuberculosis Patients (N=43)

Attitude Level	Frequency (n)	Percentage
Poor	1	2.3
Fair	6	14
Good	36	83.7

Overall attitude levels (Table 4.3b) showed that 83.7% (n=36) had good attitudes, 14% (n=6) had fair attitudes, and 2.3% (n=1) had poor attitudes.

4.4 Practice Towards Tuberculosis Cases

Table 4.4a: Practice towards Tuberculosis Cases (N=43)

Response	Frequency (n)	Percentage
Knowledge of Universal Precautions		
It is a means of instructing TB infected patients	4	9.3
Means of aseptic procedure	2	4.7
No idea	3	7
Ways of protection against infection in the workplace	34	79.1
Follow Universal Precautions in daily care		
Maybe	2	4.7
No	2	4.7
Yes	2	90.7

Table 4.4 presents data on practice-related behaviors, specifically knowledge and adherence to universal precautions. When asked about their understanding of universal precautions, 79.1% (n=34) correctly identified them as "ways of protection against infection in the workplace," while 9.3% (n=4) incorrectly believed they were means of instructing TB-infected patients, 4.7% (n=2) thought they were aseptic procedures, and 7% (n=3) had no idea. This indicates that while most radiographers understand universal precautions conceptually, approximately one-fifth harbor misconceptions or lack awareness.

Regarding adherence to universal precautions in daily patient care, 90.7% (n=39) reported compliance, 4.7% (n=2) said no, and 4.7% (n=2) were unsure. The high self-reported compliance rate appears encouraging but must be interpreted cautiously, as self-reported behavior often overestimates actual practice due to social desirability bias.

Table 4.4b: Level of Practice towards Tuberculosis Cases (N=43)

Practice Level	Frequency (n)	Percentage
Poor	8	18.6
Fair	14	32.6
Good	21	48.8

When practice was categorized into overall levels (Table 4.4b), only 48.8% (n=21) demonstrated good practice, 32.6% (n=14) showed fair practice, and 18.6% (n=8) had poor practice. This distribution reveals a significant gap between knowledge/attitude and actual practice—a pattern consistently observed in healthcare KAP studies. While 88.4% possessed good knowledge and 83.7% had good attitudes, only 48.8% demonstrated good practice.

4.5 Association Between Demographic Characteristics and Knowledge Level

Table 4.5: Association Between Demographic Characteristics and Knowledge Level (N=43)

Category	Knowledge Level, n (%)			χ^2	*p*-value†
	Fair	**Good**	**Poor**		
Age Group				0.892	1.000
20-24 years	1 (5.6)	16 (88.9)	1 (5.6)		
25-29 years	1 (5.9)	15 (88.2)	1 (5.9)		
30-34 years	1 (12.5)	7 (87.5)	0 (0.0)		
Sex				1.718	0.594
Male	2 (13.3)	12 (80.0)	1 (6.7)		
Female	1 (3.6)	26 (92.9)	1 (3.6)		
Education				14.291	0.232
Bachelor	2 (5.6)	32 (88.9)	2 (5.6)		
Postgraduate Cert	0 (0.0)	1 (100.0)	0 (0.0)		
Masters	0 (0.0)	5 (100.0)	0 (0.0)		
Doctorate	1 (100.0)	0 (0.0)	0 (0.0)		
Place of Work				3.416	0.484
Lily	1 (25.0)	3 (75.0)	0 (0.0)		
Raytouch	0 (0.0)	8 (100.0)	0 (0.0)		
UBTH	2 (6.5)	27 (87.1)	2 (6.5)		
Years of Practice				1.926	1.000
< 1 year	1 (10.0)	8 (80.0)	1 (10.0)		
1-5 years	1 (4.0)	23 (92.0)	1 (4.0)		
6-10 years	1 (12.5)	7 (87.5)	0 (0.0)		
	3 (7.0)	**38 (88.4)**	**2 (4.7)**		

Fisher's Exact Test (2-sided); $p < 0.05$ considered statistically significant

Table 4.5 presents the association between demographic variables and knowledge levels. Fisher's Exact Test revealed no statistically significant associations between knowledge level and age group (p=1.000), sex (p=0.594), educational level (p=0.232), place of work (p=0.484), or years of practice (p=1.000).

4.6 Association Between Demographic Characteristics and Attitude Level

Table 4.6: Association Between Demographic Characteristics and Attitude Level (N=43)

Category	Attitude Level, n (%)			χ^2	*p*-value†
	Fair	**Good**	**Poor**		
Age Group				4.528	0.339
20-24 years	2 (11.1)	16 (88.9)	0 (0.0)		
25-29 years	4 (23.5)	12 (70.6)	1 (5.9)		
30-34 years	0 (0.0)	8 (100.0)	0 (0.0)		
Sex				1.911	0.456
Male	2 (13.3)	12 (80.0)	1 (6.7)		
Female	4 (14.3)	24 (85.7)	0 (0.0)		
Education				1.626	0.741
Bachelor	6 (16.7)	29 (80.6)	1 (2.8)		
Postgraduate Cert	0 (0.0)	1 (100.0)	0 (0.0)		
Masters	0 (0.0)	5 (100.0)	0 (0.0)		
Doctorate	0 (0.0)	1 (100.0)	0 (0.0)		
Place of Work				1.869	0.723
LILY	0 (0.0)	4 (100.0)	0 (0.0)		
RAYTOUCH	2 (25.0)	6 (75.0)	0 (0.0)		
UBTH	4 (12.9)	26 (83.9)	1 (3.2)		
Years of Practice				3.936	0.483
< 1 year	2 (20.0)	7 (70.0)	1 (10.0)		
1-5 years	3 (12.0)	22 (88.0)	0 (0.0)		
6-10 years	1 (12.5)	7 (87.5)	0 (0.0)		
	6 (14.0)	**36 (83.7)**	**1 (2.3)**		

†Fisher's Exact Test (2-sided); $p < 0.05$ considered statistically significant

Table 4.6 shows that no statistically significant associations were found between attitude level and age group (p=0.339), sex (p=0.456), educational level (p=0.741), place of work (p=0.723),

or years of practice (p=0.483). This indicates that positive attitudes toward TB patients are relatively consistent across demographic categories.

4.7 Association Between Demographic Characteristics and Practice Level

Table 4.7: Association Between Demographic Characteristics and Practice Level (N=43)

Category	Practice Level, n (%)			χ^2	*p*-value†
	Fair	**Good**	**Poor**		
Age Group				3.416	0.504
20-24 years	6 (33.3)	8 (44.4)	4 (22.2)		
25-29 years	6 (35.3)	7 (41.2)	4 (23.5)		
30-34 years	2 (25.0)	6 (75.0)	0 (0.0)		
Sex				1.177	0.585
Male	4 (26.7)	9 (60.0)	2 (13.3)		
Female	10 (35.7)	12 (42.9)	6 (21.4)		
Education				9.982	0.075
Bachelor	12 (33.3)	18 (50.0)	6 (16.7)		
Postgraduate Cert	0 (0.0)	0 (0.0)	1 (100.0)		
Masters	2 (40.0)	3 (60.0)	0 (0.0)		
Doctorate	0 (0.0)	0 (0.0)	1 (100.0)		
Place of Work				2.075	0.750
LILY	2 (50.0)	2 (50.0)	0 (0.0)		
RAYTOUCH	2 (25.0)	5 (62.5)	1 (12.5)		
UBTH	10 (32.3)	14 (45.2)	7 (22.6)		
Years of Practice				5.037	0.305
< 1 year	5 (50.0)	2 (20.0)	3 (30.0)		
1-5 years	7 (28.0)	15 (60.0)	3 (12.0)		
6-10 years	2 (25.0)	4 (50.0)	2 (25.0)		
	14 (32.6)	21 (48.8)	8 (18.6)		

†Fisher's Exact Test (2-sided); $p < 0.05$ considered statistically significant

Table 4.7 presents associations between demographic variables and practice levels. Fisher's Exact Test revealed no statistically significant associations between practice level and age group ($p=0.504$), sex ($p=0.585$), educational level ($p=0.075$), place of work ($p=0.750$), or years of practice ($p=0.305$). Although the association between educational level and practice level approached statistical significance ($p=0.075$), it did not reach the conventional threshold of $p<0.05$.

4.8 Discussion of Findings

4.8.1 Respondents' Sociodemographic Profile

The study population's sociodemographic traits highlight significant trends in Benin City's radiography workforce. The majority of young professionals (81.4%) are between the ages of 20 and 29, which is indicative of a workforce in its early career stages and the relatively recent growth of radiography training programs in Nigeria. Given that younger professionals tend to have more recent education and may have been exposed to more contemporary TB care methods during their training, this age distribution has implications for both professional development and knowledge acquisition.

In contrast to traditional gender patterns in medical imaging, the higher percentage of female radiographers (65.1%) is consistent with global trends in allied health professions, where female participation has grown dramatically over the past 20 years. This gender distribution may be a reflection of evolving educational and employment options for women and differs from previous studies of Nigeria's healthcare workforce.

A well-qualified workforce that satisfies basic professional standards is shown by the educational profile, which is dominated by those with a bachelor's degree (83.7%). Nonetheless, the low percentage of people with advanced degrees (11.6% holding Master's degrees) points to restricted chances for specialized education in fields like infection control and TB imaging procedures.

The fact that UBTH is the biggest tertiary healthcare facility in the area and a significant training site is reflected in the concentration of responders there (72.1%). However, because UBTH's institutional practices and regulations might not be entirely representative of those at smaller private clinics, this concentration also raises the possibility of sample bias.

Senior radiographers who may have greater practical experience with TB cases are underrepresented, as seen by the preponderance of early-career professionals (58.1% with 1–5 years of experience, 23.3% with less than a year). The practice gaps found in the study might be a result of this distribution of experiences.

4.8.2 Tuberculosis Knowledge

It is quite heartening to see that 88.4% of radiographers had good general knowledge of tuberculosis, which is higher than the percentages found in some similar research. Ajayi and Isiyaku (2018) found that 90.2% of healthcare workers who received training in TB infection control at the National Tuberculosis and Leprosy Training Centre in Zaria showed good understanding, which is consistent with this robust knowledge base. A number of factors may have contributed to the high level of knowledge found in this study, including the workforce's preponderance of educated individuals (83.7% holding Bachelor's degrees), exposure to TB cases in clinical settings, and the effects of national TB awareness campaigns run by the National Tuberculosis and Leprosy Control Programme (NTBLCP).

Item-level analysis, however, identifies significant knowledge gaps that demand addressing. Given that TB transmission is the most important knowledge domain for infection control practice, the fact that 30.2% of respondents gave inaccurate answers is quite alarming. Radiographers' capacity to put the proper safety precautions in place is directly jeopardized by misconceptions regarding transmission pathways. Given that radiographers may underestimate their professional risk if they lack a thorough understanding of airborne transmission, this gap could help to explain why some respondents said they did not consistently apply universal measures.

In order to initiate infection control procedures, radiographers must be able to identify potentially infected patients, as seen by the remarkably high correct response rate for TB symptoms (97.7%). Early detection of suspected TB patients and the use of suitable safety measures during radiography operations are made possible by this knowledge.

Strong knowledge of TB pathogenesis (83.7% correct) and diagnostic techniques (93% correct) demonstrated a sufficient comprehension of TB as a bacterial infection and the diagnostic use of chest radiography. Good knowledge of BCG vaccination, environmental controls, and nutritional aspects in TB prevention is indicated by the 88.4% correct response rate for prevention approaches.

These results are somewhat at odds with those of Ekuma and Oridota (2016), who discovered that only 64.3% of medical staff at Lagos DOTS centers were able to distinguish between surgical masks and N95 respirators—a particular technical knowledge area that was not specifically evaluated in the current study. This implies that specialized knowledge of infection control tools and practices may be less developed, even while basic TB knowledge may be sufficient.

It appears that TB knowledge is comparatively consistent across age groups, educational levels, and experience categories because there are no discernible correlations between knowledge level and demographic characteristics. Standardized training in radiography programs and the extensive dissemination of TB information through national health campaigns may be the cause of this homogeneity. Nevertheless, it also suggests that TB knowledge is not always improved by further education or experience beyond what is learned during initial professional training, suggesting possible shortcomings in ongoing professional development.

4.8.3 Attitude towards Patients with Tuberculosis

It is encouraging to learn that 83.7% of radiologists had positive attitudes toward TB patients, which demonstrates their professional dedication to patient care values. Strong ethical awareness and adherence to professional radiography norms that prioritize non-discriminatory care are demonstrated by the large percentage (83.7%) that acknowledges the professional duty to care for TB patients.

It is also noteworthy that when it comes to emotional reactions to TB patients, empathy (76.7%) outweighs compassion (16.3%). Compared to sympathy, which keeps a wider emotional distance, empathy, which entails comprehending and experiencing patients' experiences, is linked to stronger therapeutic partnerships and patient outcomes. The high empathy rate indicates that the majority of radiographers are able to empathize with the experiences of TB patients, which helps to provide compassionate care.

The nearly unanimous (93%) opinion that TB patients should receive the same treatment as other patients indicates low levels of overt stigmatization and demonstrates commitment to basic healthcare ethics. Given the historical links between TB and societal stigma, poverty, and blame that have fueled discrimination in healthcare settings around the world, this discovery is heartening.

A worrying minority, however, is represented by the 7% of respondents who said they would quit rather than continue to provide routine treatment for TB patients. This severe negativity implies that, in spite of the protective measures that are available, these people believe that occupational TB risk is unacceptable. This conclusion can be the result of prior bad experiences, a lack of trust in institutional infection control procedures, or basic misconceptions about how tuberculosis is spread and prevented.

Although many radiographers accept their responsibility to care for TB patients, there is still a great deal of anxiety around occupational exposure, as evidenced by the range of conditional acceptance responses (23.3% expressing concerns about preventative measures, self-protection, and life risk). Real or perceived deficiencies in ventilation systems, PPE availability, or institutional support for infection control may be the cause of this concern.

These attitude findings are consistent with a larger body of research on healthcare workers' attitudes toward infectious diseases, which consistently demonstrates that positive attitudes are not solely dependent on knowledge but also on perceived institutional support, access to protective gear, and confidence in safety precautions. Better TB awareness and treatment availability may have lessened stigma and fear among healthcare personnel, as seen by the more favorable attitudes seen in this study compared to those reported in previous Nigerian studies carried out prior to increased TB control efforts.

Age, sex, education, occupation, and experience categories all show comparatively consistent positive attitudes toward TB patients, as seen by the lack of significant demographic relationships with attitude levels. Regardless of the institutional setting, this consistency indicates that patient-centered care ideas have been successfully incorporated into radiography training and professional socialization.

4.8.4 Practice for Tuberculosis Cases

The significant discrepancy between knowledge/attitudes and actual practice is the study's most alarming finding. Only 48.8% showed good practice levels, despite 88.4% demonstrating good knowledge and 83.7% demonstrating good attitudes. This knowledge-practice gap is the biggest obstacle to efficient TB infection management in the research settings and is a well-established phenomena in healthcare KAP studies.

The discovery that universal precautions are accurately understood by 79.1% of radiographers as "ways of protection against infection in the workplace" suggests that they possess sufficient conceptual knowledge. Nonetheless, a sizable risk category for occupational TB exposure and nosocomial transmission is represented by the 21% of people who misinterpret or are ignorant of universal precautions.

The low overall excellent practice rating (48.8%) seems to be at odds with the strong self-reported adherence to universal precautions (90.7%). This disparity most likely stems from a number of factors: Disparities between radiographers' perceived and actual actions, social desirability bias in self-reported behaviors, and the potential that the practice grading included other factors outside of self-reported adherence that exposed implementation gaps.

The findings of Ezeama et al. (2023), who found that Nigerian radiographers had high COVID-19 knowledge (82.5%) and favorable attitudes (74.1%) but relatively low adherence to safety procedures (56.1%), are substantially paralleled by this knowledge-practice discrepancy. The practical implementation of TB infection control measures remained inadequate due to training gaps, resource limitations, and infrastructural deficiencies, according to Ekuma and Oridota (2016), despite positive attitudes and self-reported compliance among healthcare workers in Lagos DOTS centers.

The knowledge-practice gap seen in this study is probably explained by a number of interrelated factors. First, regardless of awareness or motivation, structural obstacles like insufficient PPE supplies immediately hinder the regular application of universal measures. Widespread infrastructure deficiencies in Nigerian health facilities were documented by Ogbonnaya et al. (2011). Specifically, no facility used respiratory protection control measures, and more than half of them managed sputum-positive TB patients alongside immunocompromised individuals without proper separation—conditions that still exist in many settings today.

Second, a high patient volume results in time pressures that lead to shortcuts that compromise infection control, especially in public hospitals with limited resources like UBTH. Time-consuming tasks like washing their hands properly after each patient or putting on and taking off the correct PPE may be shortened or skipped when radiographers are dealing with long patient lines.

Third, many radiography departments have inadequate ventilation systems, which raise the risk of TB transmission but are infrastructure issues outside the control of individual radiographers. Even full devotion to personal protective equipment can not give total protection in the absence of engineering controls like negative pressure rooms or sufficient air exchange rates.

Fourth, non-compliance might continue unchecked since there is no institutional oversight, accountability, or monitoring of infection control procedures. Practice standards steadily decline when non-adherence is not handled with remedial actions and adherence is not routinely monitored, recorded, or rewarded.

Although the short sample size and small number of advanced degree holders hindered statistical power to detect this impact definitively, the near-significant trend ($p=0.075$) between educational level and practice level implies that advanced education may influence practicing behaviors. This pattern is consistent with research by Ajayi and Isiyaku (2018), who found that healthcare professionals who received training on TB infection prevention were much more likely to use the right precautions (AOR=13.8, 95% CI=2.10-32.36).

The results of Ajayi and Isiyaku (2018), who found that health workers with more than five years of experience demonstrated considerably superior infection control behavior (AOR=8.3, 95% CI=1.44-20.14), are in conflict with the lack of significant relationships between practice level and years of experience. This disparity can be the result of variations in study places' work environments, supervision standards, or institutional training programs. It also implies that expertise does not always translate into better practical infection control skills in the study settings, possibly as a result of insufficient infrastructure and resources that hinder even seasoned radiographers from applying best practices.

It is significant that there is no correlation between practice level and workplace, suggesting that radiographers in both public and commercial healthcare environments are impacted by practice deficits. This consistency shows that rather than being limited to public facilities with limited resources, systemic obstacles to implementing universal precautions—such as a lack of personal protective equipment (PPE), infrastructure constraints, and insufficient institutional policies—are widespread throughout Benin City's healthcare system.

CHAPTER FIVE

CONCLUSION, RECOMMENDATIONS, LIMITATIONS OF THE STUDY, AND SUGGESTIONS FOR FURTHER STUDIES

5.1 Introduction

This chapter presents the conclusions drawn from the study findings, provides practical recommendations for improving TB management practices among radiographers, acknowledges the study's limitations, and suggests directions for future research.

5.2 Conclusion

This study assessed the knowledge, attitudes, and practices of radiographers toward tuberculosis cases in selected hospitals in Benin City, Edo State, Nigeria. The study confirms that radiographers working in selected hospitals in Benin City possess adequate knowledge regarding tuberculosis transmission, symptoms, and prevention, with 88.4% demonstrating good knowledge levels. Radiographers demonstrated positive attitudes toward patients with tuberculosis during patient preparation and investigations, with 83.7% exhibiting good attitudes. The majority (83.7%) acknowledged their professional duty to care for TB patients, 93% agreed that TB patients deserve equal care, and 76.7% expressed empathy toward TB patients. The absence of statistically significant associations between demographic characteristics and KAP levels indicates that knowledge deficits, attitude problems, and practice gaps are distributed across all demographic subgroups rather than being concentrated in specific categories defined by age, sex, education, workplace, or experience.

5.3 Recommendations

Based on the study findings, the following recommendations are proposed:

1. **Ensure enough PPE Supply and Accessibility:** Healthcare facilities should create dependable procurement methods for personal protective equipment (N95 respirators, masks, gloves, gowns) and maintain enough stock levels in all radiology departments.
2. **Implement Written TB Infection Control Policies:** Each hospital should design and enforce TB-specific policies for radiology departments, combining WHO and NTBLCP principles, encompassing patient handling procedures, PPE requirements, and post-exposure management.
3. **Give Mandatory Infection Control Training:** Integrate practical TB infection control training into radiography curricula and give frequent continuing education for practicing radiographers, addressing the 30.2% knowledge gap on TB transmission routes.
4. **Improve Ventilation and Infrastructure:** Invest in proper ventilation systems with appropriate air exchange rates, negative pressure rooms when practicable, and spatial layouts that limit crowding in waiting and imaging areas.
5. **Establish Occupational Health Programs:** Implement baseline TB screening, regular follow-up testing, quick exposure evaluation, and treatment assistance for radiographers, with regular audits to monitor compliance and enhance infection control methods.

5.4 Limitations of the Study

1. **Small Sample Size and Limited Generalizability:** The study included only 43 radiographers from three hospitals in Benin City, with 72.1% from UBTH. This limits generalizability to other regions and healthcare settings in Nigeria.

2. **Self-Reported Data Bias:** Self-reported attitudes and practices are subject to social desirability bias. The contrast between 90.7% self-reported adherence to universal precautions and 48.8% good practice rating suggests potential overestimation of actual compliance.
3. **Cross-Sectional Design:** Data captured at a single time point prevents assessment of temporal trends, seasonal variations in TB case load, or changes in knowledge, attitudes, and practices over time.
4. **Limited Practice Assessment:** Practice evaluation relied on questionnaire responses rather than direct observation or infection control audit records, which may not fully capture real-world practices.
5. **Inadequate Assessment of Systemic Barriers:** The study did not systematically assess specific infrastructural barriers such as actual PPE availability, ventilation measurements, or staffing ratios that might explain identified practice gaps.

5.5 Suggestions for Further Studies

1. Observational Studies: Employ direct observational methods using standardized tools to assess actual infection control behaviors and eliminate self-report bias.
2. Assessment of Systemic Barriers: Systematically document infrastructural barriers including PPE availability, ventilation adequacy, staffing levels, and organizational safety culture to inform targeted interventions.
3. Intervention Studies: Conduct randomized controlled trials evaluating the effectiveness of different interventions (enhanced training, PPE provision, infrastructure improvements) on radiographers' TB infection control practices.

4. Expanded Geographic Scope: Extend research beyond Benin City to include diverse regions, healthcare facility levels, and urban/rural settings across Nigeria to assess geographic and institutional variations.
5. Longitudinal Monitoring: Establish surveillance systems to track radiographers' knowledge, attitudes, and practices over time, enabling evaluation of intervention effectiveness and identification of temporal trends.

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APPENDIX I

This questionnaire is part of a research study titled **"Knowledge, Attitudes, and Practices of Radiographers Towards Tuberculosis Cases in Selected Hospitals Within Benin City, Edo State, Nigeria."**

The researcher is **Tiamiyu Ayobami Omowale**, a final-year student of the **Department of Radiography**, University of Benin. All information provided will be treated with **strict confidentiality** and will be used **solely for academic and research purposes** related to this study. Your honest responses are highly appreciated.

Instruction: Please tick [√] for any option(s) chosen or write in the space provided for additional answers

SECTION A

NB: You can tick more than one answer(s) where applicable

1) In which age group do you belong? (a) 20-24yrs [ ] (b) 25-29yrs [ ] (c) 30-34yrs [ ] (d) 35-39yrs [ ] (e) 40-44yrs [ ] (f) 45 and above [ ]

2) What is your sex? (a) Male [ ] (b) Female [ ]

3) What is your highest educational qualification? (a) DCR/DIR [ ] (b) B Sc [ ] (c) M Sc [ ] (d) PhD [ ] (e) Others specify …….

4) Where is your place of work? (a) UBTH [ ] (b) LILY [ ] (c) RAYTOUCH[ ]

5) Number of years of Practice (a) Less than 1yr [ ] (b) 1-5yrs [ ] (c) 6-10yrs [ ] (d) More than 10yrs [ ]

SECTION B

6) How can Tuberculosis (TB) be transmitted? (a) Droplets [ ] (b) Touching [ ] (c) Hand shaking [ ] (d) Sexual relations [ ] (e) others specify ……

7) What are the symptoms of TB? (a) Cough with expectoration for more than 21 days [ ] (b) Haemoptysis [ ] (c) Weight loss [ ] (d) Fever [ ] (e) Night sweat [ ] (f) others specify …….

8) TB is caused by ……..? (a) Virus [ ] (b) Bacteria [ ] (c) Fungi [ ] (d) Protozoa [ ]

9) Diagnoses of TB can be made through which ways? (a) Sputum examination [ ] (b) Chest X-ray [ ] (c) Blood examination [ ] (d) Don't know [ ]

10) How can TB be prevented? (a) Bacillus of Calmette and Guerin [ ] (b) Clean house/environment [ ] (c) Nutritious food [ ] (d) Don't know [ ]

SECTION C

11) Do you think that you have a professional duty to care for tuberculosis patients (a) Yes [ ] (b) No [ ]

12) How do you feel about patients with TB cases (a) Sympathy [ ] (b) Empathy (c) Anger [ ] (d) Dispassionate [ ] (e) Indifferent [ ]

13) Do you think that patients with TB cases are entitled to the same care as any other patient? (a) Yes [ ] (b) No [ ]

14) If No, why? (a) It is their fault [ ] (b) treating them takes more time [ ] (c) other specify.....

15) What would be your reaction if you have to attend to TB cases on a regular basis? (a) Gladly accept [ ] (b) Resign and leave the profession [ ] (c) Do it grudgingly [ ] (d) other specify ……..

SECTION D

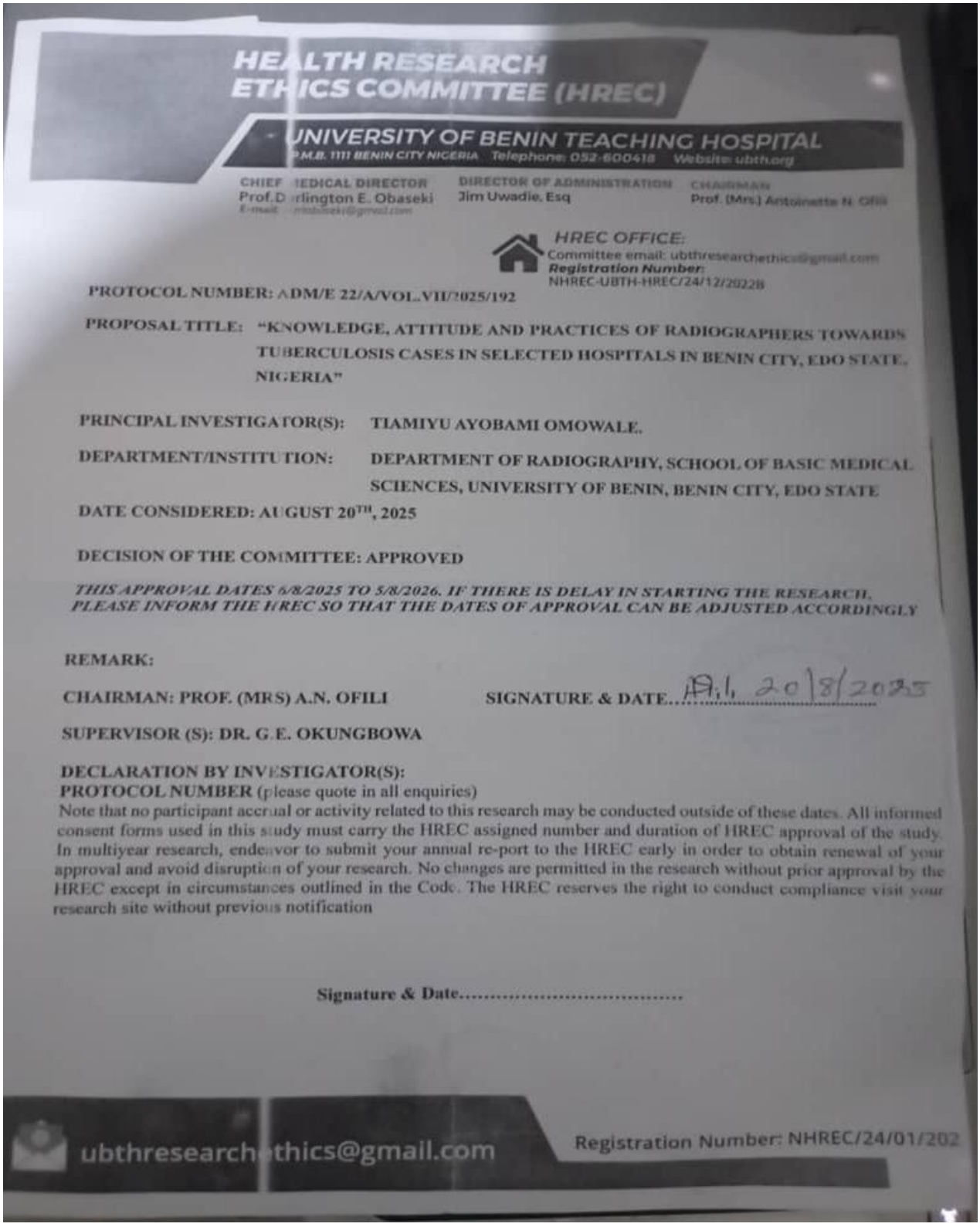
16) What do you know about Universal Precautions? (a) No idea [ ] (b) It is a means of instructing TB infected patients [ ] (c) Ways of protection against infection in work place [ ] (d) Means of aseptic procedure [ ]

17) Do you follow this rule in your daily patient care? (a) Yes [ ] (b) No [ ]

18) If No, why? (a) Inadequate facilities for it [ ] (b) Large patients through put [ ] (c) Not Important [ ] (d) I am always careful [ ] (e) others specify …….

19) If yes in 17 above, which protective measure do you adopt when handling TB cases? (a) Examine and wash hand [ ] (b) Instruct them not to cough and sneeze [ ] (d) Keep a distance [ ] (d) Ventilation of room [ ] (e) Use of personal protective equipment [ ]

APPENDIX II



HEALTH RESEARCH
ETHICS COMMITTEE (HREC)

UNIVERSITY OF BENIN TEACHING HOSPITAL
P.M.B. 1111 BENIN CITY NIGERIA Telephone: 052-600418 Website: ubth.org

CHIEF MEDICAL DIRECTOR
Prof. Darlington E. Obaseki
E-mail: robaseki@gmail.com

DIRECTOR OF ADMINISTRATION
Jim Uwadie, Esq

CHAIRMAN
Prof. (Mrs.) Antoinette N. Ofili

HREC OFFICE:
Committee email: ubthresearchethics@gmail.com
Registration Number:
NHREC-UBTH-HREC/24/12/2022B

PROTOCOL NUMBER: ADM/E 22/A/VOL.VII/2025/192

PROPOSAL TITLE: "KNOWLEDGE, ATTITUDE AND PRACTICES OF RADIOGRAPHERS TOWARDS TUBERCULOSIS CASES IN SELECTED HOSPITALS IN BENIN CITY, EDO STATE, NIGERIA"

PRINCIPAL INVESTIGATOR(S): TIAMIYU AYOBAMI OMOWALE.

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

DATE CONSIDERED: AUGUST 20TH, 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... 20/8/2025

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.....

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

APENDIX III

INTELLECTUAL PROPERTY & TECHNOLOGY TRANSFER OFFICE (IPTTO)
Vice Chancellor's Office
University of Benin
PMB1154, Benin City, Nigeria

CLEARANCE FORM

DATE: December 1st 2025
NAME: Ayobami Omavale Tiamiyu
MATRIC NO: BM5202906b
DEPARTMENT: Radiography
FACULTY: Basic Medical Sciences
SESSION OF GRADUATION: 2024/2025

DIRECTOR
Unit:
Head Of Unit (IPTTO)