

**ASSESSMENT OF RADIOGRAPHERS' KNOWLEDGE ON
RADIOGRAPHIC CONTRAST AGENTS AND MANAGEMENT OF
RELATED ADVERSE REACTIONS IN BENIN CITY.**



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OCTOBER 2025.

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**A PROJECT SUBMITTED TO THE DEPARTMENT OF
RADIOGRAPHY, SCHOOL OF BASIC MEDICAL SCIENCES,
IN PARTIAL FULFILLMENT FOR THE REQUIREMENT OF THE
AWARD OF BACHELOR DEGREE IN RADIOGRAPHY (B.RAD),
UNIVERSITY OF BENIN, BENIN CITY, NIGERIA**

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OCTOBER 2025.

CERTIFICATION

This is to certify that the project on **ASSESSMENT OF RADIOGRAPHERS' KNOWLEDGE ON RADIOGRAPHIC CONTRAST AGENTS AND MANAGEMENT OF RELATED ADVERSE REACTIONS IN BENIN CITY** written by **MOHAMMED MARYAM OSHUWA** with Matriculation number **BMS2005197** 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.

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APPROVAL

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DEDICATION

This work is dedicated to Almighty Allah my creator, my lovely parent and siblings who believed in me.

ACKNOWLEDGMENT

I am deeply grateful to the Almighty God for granting me the strength, wisdom, and resilience to complete this research, His unwavering mercy and unconditional love have made all things work out during the course of my studies at the University of Benin. I am immensely grateful to my project supervisor, Dr Akpobasahan E. A. for her patience, guidance, and invaluable feedback throughout this research. Your insights and mentorship have helped shape this work and taught me the importance of hard work and honest work. A special appreciation goes to my amazing parents, Mr. and Mrs. Mohammed, for their unwavering love, sacrifices, and constant support. Your prayers, encouragement, and belief in me have been my greatest motivation. To my siblings - Aishat, Semirat, Jemilat, Nimatallah and Ruth, thank you for always cheering me on and standing by me through every challenge. Your love and support mean everything to me.

To my colleagues - Osanyibi Ayodeji, Ojelabi Samuel, Akanji Peter, Oyedele Baleekis, thank you for making my academic journey less stressful.

To my friends - Aderibigbe Mariam, Itseore Phillip, Chidindu David, Makinde Success, Mohammed Akeem, Oluwatade Timothy, and Akanni Abdulqudus, thank you for your encouragement, motivational talks and unwavering support have made this journey far more delightful than I imagined. Thank you for always being there.

A heartfelt appreciation to all my course mates for sharing this academic journey with me. The memories and shared experiences have been invaluable. I am grateful for the camaraderie and support we have given one another. Finally, my sincere gratitude to everyone who contributed to this research in one way or another, including the respondents who participated in this study. Your willingness to provide valuable insights made this work possible. I appreciate you all and I do not take any of your presence in my life for granted.

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ABSTRACT

Radiographic contrast agents are essential in diagnostic imaging but may cause adverse reactions if not properly managed. This study assessed the knowledge, awareness, and preparedness of radiographers in Benin City regarding contrast media and related adverse reactions. A cross-sectional survey was conducted among 60 licensed radiographers across public and private health facilities using a validated questionnaire. Results showed that while most radiographers demonstrated good knowledge of contrast media (mean score = 79.8%), awareness of risks (66.5%) and preparedness for managing reactions (69.1%) were below the acceptable 70% benchmark. Training significantly improved preparedness levels ($p < 0.05$), though awareness did not differ significantly by training status ($p > 0.05$). The findings reveal that radiographers possess strong theoretical knowledge but moderate readiness for emergency management, underscoring the need for continuous education, refresher courses, and standardized emergency protocols to enhance patient safety.

Keywords: Radiography, Contrast Media, Adverse Reactions, Preparedness, Benin City.

CHAPTER ONE

INTRODUCTION

1.1 Background of the study

Contrast media are chemical agents used in medical imaging to enhance the visibility of anatomical structures and pathological conditions by improving contrast resolution. They are essential in various imaging modalities for accurate diagnosis and characterization of diseases (Khan et al., 2023).

Different types of contrast agents are utilized depending on the imaging modality and anatomical region of interest. Iodinated contrast media are commonly used in X-ray, computed tomography (CT), and fluoroscopy, typically administered intravenously. Barium sulphate is primarily used for gastrointestinal tract studies, while gadolinium-based agents are employed in magnetic resonance imaging (MRI) (Albano et al., 2024).

Although generally considered safe, contrast media are associated with potential adverse drug reactions (ADRs), ranging from mild hypersensitivity reactions to severe anaphylactic responses. Ionic contrast agents have been identified as the third most common cause of ADRs, following non-steroidal anti-inflammatory drugs and chemotherapeutic agents (American College of Radiology, 2022).

Radiographers play a critical role in patient preparation, contrast administration, and monitoring for adverse reactions during imaging procedures. Consequently, adequate knowledge of contrast media, their safe administration, and the prompt management of associated ADRs is essential to ensure patient safety (Albano et al., 2024).

Despite the importance of this knowledge, there is limited data regarding radiographers' preparedness and competence in managing contrast-related adverse reactions in Benin City, Nigeria. A cross-sectional study conducted in Pakistan by Khan et al. (2023) revealed significant knowledge gaps among radiologists, radiology residents, and radiographers. Less than half of the participants could accurately classify iodinated contrast media, and only 28% correctly identified epinephrine as the first-line treatment for anaphylaxis. Awareness of established guidelines, such as the American College of Radiology (ACR) manual, was also poor. These findings underscore the need for improved training and continuous professional development.

Given the potential risks associated with inadequate knowledge of contrast media and emergency management, this study seeks to evaluate the knowledge and preparedness of radiographers in Benin City, Nigeria, regarding the use of contrast media and the management of related adverse drug reactions.

1.2 statement of the problem.

A 2019 case report, conducted at the Southern Illinois University School of Medicine in Springfield, Illinois, USA. Described the fetal anaphylactic reaction of a 45 years old woman, with no prior history of allergy. Following the administration of intravenous Iodinated contrast Media during a CT scan, the patient developed an acute hypotension and respiratory distress, leading to cardiac arrest and death. (Choi et al.,2019).

Another report in the journal of the Korean society of Radiology, described a 66 years old woman who experienced a severe hypersensitivity reaction after the administration of Gadolinium-based contrast Media for an MRI scan. The patient with no known allergies developed acute symptoms that are indicative of anaphylaxis shock, which necessitated prompt medical intervention. This case study highlighted that even contrast that are considered minimal risk, still requires maximum attention, and preparedness for any case of complications. (Kim et al.,2019).

Radiographers are licensed to administer contrast during radiographic procedures. But studies show significant knowledge gaps in the understanding of contrast media, and management of associated adverse drug reaction. Therefore, Inadequate knowledge or improper emergency response to contrast related adverse reactions, can have a serious negative effect on patient's health.

In Benin city, there is little research on radiographers' knowledge on contrast Media and the management of adverse reactions that are associated with contrast media complications. This lack of data impedes targeted training and policy development. This therefore highlights the need for a thorough assessment of radiographers' knowledge in this critical area.

1.3 Research question

The following questions were raised and addressed in this study;

1. What is the level of knowledge of radiographers in Benin city regarding contrast media?
2. How well do radiographers in Benin city, understand the risks and adverse reactions associated with contrast media?
3. What is the level of preparedness of Radiographers in Benin city, in the management of contrast- induced adverse Reactions?

1.4 Hypothesis

The following hypotheses were tested during the course of this study:

Null Hypothesis (H_0): Radiographers in Benin city does not have an acceptable level of knowledge regarding contrast media.

Alternative Hypothesis (H_1): Radiographers in Benin city understand the risks and adverse reactions associated with contrast media.

Null Hypothesis (H₀): Radiographers in Benin city are not well prepared to manage contrast induced adverse reactions.

1.5 Aim of the study

The aim of this study is to assess Radiographers' knowledge on Radiographic contrast agents and management of related Adverse reactions in Benin city.

1.6 Objectives of the study

The Objectives of this research are:

1. To assess the level of knowledge of radiographers regarding contrast media.
2. To evaluate radiographers' understanding of the risks and adverse reactions associated with contrast media.
3. To determine the level of preparedness of radiographers in managing contrast-induced adverse reactions.

1.7 Significance of the study

The study is significant, as it improves patients' safety by recognizing the area that needs improvement in radiographers' knowledge regarding contrast media and its associated risks.

It also provides evidence for a need for targeted training and policy development for radiographers, which will help to improve overall effectiveness of health care by reduction the risks of mortality associated with adverse effects of contrast media.

1.8 Scope of the Study

The study includes all Licensed Radiographers, that are actively practising in public and private healthcare facilities in Benin city, who are involved in procedures that utilize contrast media, who are available during the period of study which is starting on August 2025 and who give informed consent to participate in the study.

1.9 Operational Definition of Terms

ADRs: (Adverse Drug Reactions) are unintended, Harmful responses of our body to drugs that are administered at appropriate dose for the purpose of diagnosis, Treatments or Preventions.

Contrast Media: These are substances that are used to better visualize the anatomy of a structure of interest, which helps to make proper diagnosis of diseases.

Anaphylaxis: This is a severe life-threatening systemic hypersensitivity that occurs suddenly as an allergic response to a drug.

Radiography: a branch of health science that deals with the visualization of body structures that are not normally seen, with ionizing and non-ionizing radiation.

CHAPTER TWO

LITERATURE REVIEW

2.1 Conceptual Review

Contrast media are used in Radiography to properly visualize different body structures (Tate et al.,2023). They are categorised as positive or negative contrast media. Positive contrast Media appear white on radiographs based on their higher atomic number, they exist in various types like Iodinated, Barium sulphate and Gadolinium-based contrast media. Iodinated contrast media are further subdivided into Ionic and Non-Ionic based. (Mortele et al.,2022). While examples of Negative contrast agents include Carbon dioxide, air, methylcellulose. These agents appear black on radiographs, due to their low atomic number and attenuation and are used to displaced internal structures for better visualization. Positive contrast agents are more commonly used in diagnostic examinations and the most commonly used positive contrast are Iodinated contrast agents used for Fluoroscopy and Computed tomography special examinations. (Albano et al.,2021).

Iodinated contrast media can be Ionic or Non-Ionic in nature. Ionic contrast Media dissociates into charged particles this increases their osmolality and makes them more likely to cause Adverse Reactions. While Non-Ionic do not dissociate in water, have lower osmolality and are generally associated with less Adverse reactions. (Tan et al., 2019)

The administration of contrast media takes place via several route, which depends on the imaging modality of choice and the anatomy of interest. The most common route of administration is Intravenous (IV), which is used with Iodinated contrast in CT scans and Fluoroscopy or With Gadolinium-based agents In MRI scans. The second most common route is orally, to examine the GI tract and distinguish it from surrounding structures. Oral administration which is the second most common route is typically used in gastrointestinal studies, especially with barium sulphate or iodinated oral agents, to enhance visualization of the GI tract and distinguish it from surrounding structures. Rectal administrations such as Enemas or CT colonography is usually done to examine the lower GI tract. Other routes include intracavitary, for examining Body cavities such as the uterus in Hysterosalpingography, the urethra and bladder in retrograde urethrography etc. intrathecal routes is used to examine the vertebral canal in myelography, intra-articular routes are used to examine the different joint spaces in the body.

Rectal administration is employed in lower GI studies, such as barium enemas or CT colonography, where contrast is introduced via the rectum to outline the colon. Intra-arterial injection is used in angiographic procedures to directly visualize specific vascular territories, such as in cerebral or coronary angiography, by delivering contrast into arteries. For imaging the spinal canal, intrathecal administration is used in procedures like myelography, where non-ionic iodinated contrast is carefully introduced into the subarachnoid space under aseptic conditions (Beckett et al., 2015)

Adverse Drug Reactions (ADR) to contrast agents are unintended and harmful effects of the body reacting to the use of contrasts. It occurs following the administration of contrast agents. ADRs are classified based on Time of onset, severity and underlying conditions.

Based on onset, ADR is categorised as immediate and delayed. Immediate Adverse Drug Reactions occur within the first hour after administration while delayed reactions may occur beyond an hour, to several days, after administration.

Based on severity, ADR are categorised as mild, moderate and severe. Mild adverse reactions include nausea, vomiting, hives, flushing, itching, sneezing etc. These reactions are often Self-limiting and they may typically resolve on their own. Moderate adverse drug reactions include bronchospasm, pronounced urticaria, abnormal heart rhythms, low blood pressure. These reactions require medical attention to mitigate its effects. Severe adverse reactions are life threatening, and they require immediate medical attention. They Include Laryngeal edema, anaphylactic shock, seizures, cardiac arrest and loss of consciousness.

Adverse drug reactions can occur due to allergic reactions. Allergic reactions mimic allergy responses, but they're not mediated by IgE antibodies. ADRs can also occur due to physiological reactions or the chemical properties of the contrast, such as high osmolality or high volume. Its effects include nephrotoxicity and cardiac effects due to chemotoxicity. (Coupal et al., 2018)

Table 2.1: classifications of adverse reactions (Rukamanee et al., 2021)

Severe	Mild	Moderate
Unconsciousness	Nausea	Hives
Pulmonary Edema	Vomiting	Swellings
Hypertension	Increased Temperature	Bronchitis
Cardiopulmonary arrest	Mild Urticaria	Rigor
Heart failure	Pain in injected extremity	Abdominal pain
		Fragility
		Serious vomiting
		Blood clot and stroke

The incidence of Adverse Drug Reactions to contrast media is relatively low, this is due to the use of modern Non-Ionic contrast media. A study by (Zhang et al.,2023) analysed all ADRs from January 2014 to December 2020. Amongst 68,099 patients that underwent computed tomography examination in a local teaching hospital. The incidence of ADR was measured to be 0.126% with 60 cases classified as mild, 20 cases as moderate and 6 cases as severe. Similarly, a retrospective study case control study conducted by (Trakultivakorn et al.,2013). between January 1st,2008 to December 31st,2010 in Siriraj Hospital, a tertiary Hospital in Thailand. 55,286 patients who were exposed to Iodinated contrast media were enrolled to determine the incidence of Contrast Media Allergy reactions. The overall incidence was calculated to be 1.05% Females with sea food allergy were found to be at greater risks. Effective management of Adverse Drugs Reactions to contrast media requires a comprehensive

approach which requires pre-screening risk assessment, emergency preparedness and use of medications.

Prior to the administration of contrast media, it's important to conduct a thorough patient assessment to identify individuals at high risk for hypersensitivity reactions. These risk factors include history of Previous contrast media reactions, Asthma and multiple allergies. Therefore, implementation of structured risk assessment tools can aid in categorising patients and tailoring preventive actions accordingly. Stratified Assessment Warning regimes have been associated with reduction in the incidence of acute Adverse reactions to Iodinated contrast media (Trakultivakorn et al., 2013).

Healthcare facilities must be well equipped to efficiently manage any event of Adverse reactions to contrast media that may occur. This includes making sure that resuscitation equipment and trained professionals are available. Emergency resuscitation medication includes epinephrine, corticosteroids, and antihistamines. Regular training sessions can enhance the readiness of the medical team to effectively handle medical emergencies. (Trakultivakorn et al., 2013).

Establishment and Adherence to standard protocols is imperative for the effective management of ADRs. These protocols should outline clear steps for the identification and treatment of ADRs ranging from mild to severe. For example, mild reactions such as hivesay require antihistamines while severe reactions such as Anaphylactic shock will require immediate

Adkins of epinephrine and advanced airway management. Documenting the various reactions and appropriate interventions applied is important for future references and Patient safety. (European Society of Urogenital Radiology, 2025).

Preventive strategies to mitigate the risk of reactions to contrast media prior to the administration of contrast involve giving prophylactic treatments such as corticosteroids, antihistamines etc. These treatments will mitigate the risk of hypersensitivity reactions in high-risk patients. However recent studies have questioned the efficacy of such treatments. It has been established while these medications might reduce the incidence of mild Adverse reactions, it does not significantly affect the Incidence of severe reactions. Therefore, the decision to use premedication should be based on individual patient's risk profile and clinical judgement. (Zhang et al.,2023)

Radiographers play an important role in the administration of contrast agents and monitoring of patients during radiological procedures. The responsibility of radiographers includes technical execution and clinical judgments, especially in centers where radiologists may not be immediately available. In Nigeria, the role of radiographers has become even more significant due to the lack of sufficient resources in many healthcare facilities. Radiographers are often tasked with the preparation of contrast media, obtaining informed consent, patient positioning, and patient monitoring for adverse drug reactions. They're also responsible for identifying

early signs of complications such as extravasation, allergic responses, or nephrotoxicity, and ensuring that immediate responses are made. (Koch et al., 2018).

Legally, Radiographers in Nigeria must follow the guidelines provided by the Radiographers Registration Board of Nigeria (RRBN). These guidelines provide professional standards which includes the need for proper training before performing invasive procedures such as contrast media administration under the General duties and ethical responsibilities of a radiographer, Article 2 number 17 (RRBN, 2023). Failure to comply to these guidelines may lead to legal consequences or profession sanctions especially in the case of negligence or harm.

However, multiple studies have shown Significant knowledge gaps among Nigerian Radiographers. Many Nigerian Radiographers lack proper training in Pharmacology, techniques for Intravenous access to blood vessels, and Emergency responses to contrast media allergy reactions. Many radiographers reported to have had limited exposure to contrast safety protocols during their undergraduate training and proper postgraduate trainings remained insufficient. (Eze et al., 2012).

The safe and effectiveness of contrast media in diagnostic Imaging relies on clear understanding of their various types, compositions, routes of administration, associated adverse reactions and appropriate management of said reactions. Radiographers play an important role in diagnostic imaging; therefore, they must possess adequate knowledge and preparedness to Identify contrast reactions and respond appropriately. However, there are gaps in knowledge,

training and institutional supports for Radiographers, which calls for urgent restructuring of education, clarity of Regulations and continuous professional development. Overcoming these gaps is important to improve patients' safety and increase professional standards in Radiography.

2.2 Empirical studies

A cross-sectional study was done by (Khan et al.,2023) to investigate the level of knowledge among Radiologists, Radiology residents, and Radiographers concerning radiographic contrast management of Adverse Drugs Reactions (ADRs. The study was conducted across five Major Hospitals with 9 CT Suites in Peshawar, Pakistan. The study utilized a 30 item Questionnaire, that was adapted and validated through a pilot survey. The Findings showed a significant gap in knowledge of contrast media amongst the Diagnostic imaging professionals.

The study revealed that fewer than half of the participants could correctly classify Iodinated contrast agents by their osmolality. 28% of the participants could identify Epinephrine as the first line treatment of Anaphylaxis, and even fewer could correctly provide the required concentration and dose. Only 6.7% of the participants had read the American College of Radiology (ACR) manual on Contrast Media. There, the overall preparedness for Handling Adverse Drug Reactions to Contrast Media is poor. (Khan et al.,2023)

In an exploratory cross-sectional study conducted at Malaya Medical Centre (UMMC), Kuala Lumpur, to assess radiographers' knowledge of contrast media used in radiological procedures

by (Wan Nur Nadiah, 2017) it was inferred that 77.7% out of the 140 Radiographers who were administered a Questionnaire, demonstrated an overall moderate knowledge on contrast media. Further analysis showed a trend in the level knowledge, which depends on work experience and training exposure. 57.1% of the respondents with more than 10 years of experience showed a higher level of knowledge compared to 52.4% of those with less than 10years of experience. This shows that more experienced Radiographers are better capable in Handling contrast reactions. (Wan Nur Nadiah, 2017)

The study concluded that Radiographers at Malaya medical Centre possess basic knowledge on contrast media, but it also revealed a knowledge gap in critical areas that directly affects patients' safety. Therefore, frequent continuous education was recommended by the author.

A cross-sectional study done by (Hadi et al.,2025) to Investigate computed tomography radiographers' expertise in responding to severe contrast media reactions in Saudi Arabia. The study aimed to evaluate if various variables such as professional experiences, location of practice etc. affects the competency of CT Radiographers in handling a case of severe Contrast Media reactions.

An electronic survey was done and 241 responses were gotten. A significant majority (93.4%) of these participants demonstrated awareness for the precautions in the use of intravenous contrast media. But only 22% showed consistent knowledge across all five assesses knowledge categories. 56% were able to identify epinephrine as the preferred first line of response to

severe contrast allergy. 33% of the participants reported to have received specialized training in management of severe contrast allergy.

Older participants who were 40 years and above were reported to have had the highest level of knowledge of controlling severe contrast media reactions. Also, Participants with PhD achieved higher score compared with others with other degrees. The study did not show any trend in variations in knowledge based on gender, area of experience or Type of Hospital.

An international survey conducted by (Albano et al.,2024) to assess how young radiographers use contrast media and manage adverse reactions. The aim of the study was to identify gaps in the training and confidence levels among radiology residents and early Career radiologists. The study included 454 from 48 countries, the mean age of participants was 31.7 years. 59.7% were residents and 40.73 were board certified. 76.5% of the participants admit to being informed about the use of contrast media but only 31.1 received specific training on contrast media use. 18.1% agreed to have had training on adverse drugs management.

A significant number of participants (58.6%) were aware of the safety protocols, yet (69.6%) lacked confidence in the management of contrast media induced Adverse Drug Reactions. Notably, 95.8% showed an interest in improving their understanding of contrast media reaction management.

Therefore, there's a pressing need to implement comprehensive training on the use of contrast media and Adverse Drug Reactions management. This will boost the confidence and competence of Radiographers while enhancing patients' safety.

In a cross- sectional electronic study to assess Radiographers' confidence in handling iodine-based contrast media hypersensitivity reactions on Radiographers working with computed Tomography in Swedish hospitals by (Tryg et al.,2024). A survey of 290 Radiographers across 31 clinics, unveiled a concerning lack of confidence of radiographers in case of an Emergency. .72% of the respondents answered in the middle of the four-point scale in response to the statement " I have confidence in handling contrast Adverse reactions". 21% felt very confident. 65% reported to not having the proper training for handling this reaction. Majority of the respondents expressed in partial confidence, however 7% reported feeling entirely unprepared. (Tryg et al.,2024).

The study also inferred that Radiographers who have had any form of training or experience on handling contrast media adverse reactions such as administering Epinephrine or performing Cardiopulmonary resuscitation had more confidence than their counterparts. However, a huge 65% of the Respondents had experienced no form of solid training and they also reported that their departments had no protocols for managing hypersensitivity events. (Tryg et al.,2024).

These findings strongly believe in the importance of structured emergency training for radiographers. The study laid emphasis that improving Radiographers' preparedness for

contrast media adverse reactions requires not only theoretical knowledge, but repeated exposure to Emergency scenarios.

These Empirical studies reviewed, demonstrated that although Radiographers are licensed to administer contrast media for radiographic examinations, many lack the required training and preparedness to manage the Adverse reactions that may arise from the administration of contrast media. These findings strongly justify the need for this study in Benin city, Edo state, Nigeria. Therefore, it identifying the various strengths and weaknesses in the knowledge and preparedness of Radiographers. Targeted protocols would be put in place to improve professional competence and enhance patient safety.

CHAPTER THREE

RESEARCH METHODOLOGY

The purpose of this study is to assess Radiographers' knowledge of contrast media and their preparedness in management of related Adverse reactions in Benin city. This Study will employ a cross-sectional survey design to collect and measure data from Licensed and practicing Radiographers across public and private healthcare facilities.

3.1 Research Setting

This study was conducted in Benin city, Edo state including both public and private healthcare facilities within Benin city, these facilities include hospitals, diagnostic centers and clinics where licensed Radiographers are employed. The research focuses on different radiology centers chosen to represent the spectrum of diagnostics service available in the areas. These facilities include University of Benin Teaching Hospital (UBTH), RAYTOUCH DIAGNOSTIC CENTER, LILY HOSPITAL, EDO SPECIALIST HOSPITAL and other accessible centers within Benin city capital of Edo state, Nigeria and majorly urban centers where it is believed that radiographers present has more clinical experience and expertise. The research focuses on different radiology centers chosen to represent the spectrum of diagnostics service available in the area.

UBTH

University of Benin Teaching Hospital (UBTH) is a multi-specialty healthcare provider in West Africa, located in Ugbowo, Benin City. The hospital was established on May 12, 1973, following the enactment of Edict No. 12 under the Nigerian National Health Act, but was taken over by the Federal Government on April 1, 1975. As the sixth of Nigeria's first-generation teaching hospitals, its establishment was intended to complement its sister institution, the University of Benin, and to provide secondary and tertiary health care to the then Mid-Western Region (now Edo and Delta States) and its environs. UBTH spearheads research opportunities for university lecturers and other researchers studying economic morbidity and related healthcare issues the concept of the University of Benin Teaching Hospital (UBTH) originated in 1969, spearheaded by Colonel Samuel O. Ogbemudia, the then Governor of the Midwestern State of Nigeria, and Prof. Tihamiyu Belo-Osagie. The plan to establish a modern medical Centre in the Midwestern Region of Nigeria was conceived after the governor privately visited the Island Maternity Hospital, Lagos, and the Lagos University Teaching Hospital. The Radiology Department at the University of Benin Teaching Hospital (UBTH) is a vital unit dedicated to providing advanced diagnostic and interventional imaging services. Equipped with modern technology, the department offers a wide range of imaging modalities, including X-rays, CT scans, MRIs, ultrasounds, and fluoroscopy, to support accurate diagnosis and treatment planning. Staffed by skilled radiologists, radiographers, and support personnel, the department ensures high-quality care for patients across various specialties. It also plays a

significant role in medical education and residency training, fostering the development of future radiology professionals.

The UBTH Radiology Department comprises of 31 radiographer including staffs and interns which are committed to excellence in healthcare delivery and innovation in medical imaging.

EDO SPECIALIST HOSPITAL

Edo Specialist Hospital is located in Benin sapele Road, Benin City, is a state-of-the-art healthcare facility renowned for its patient-centered approach and advanced medical services, the hospital is wholly owned by the Edo state government and operated by a leading private sector management consulting firm. The Radiology Department stands out as a critical component of the hospital, equipped with cutting-edge diagnostic tools such as X-rays, CT scans, and Magnetic Resonance Imaging (MRI). These technologies enable precise diagnosis and effective treatment planning for various medical conditions. The department is staffed by highly skilled radiologists and about 8 radiographers who ensure accurate imaging and compassionate care. With its commitment to excellence, the Radiology Department at Edo Specialist Hospital plays a pivotal role in delivering top-tier healthcare solutions to the community.

LILY HOSPITAL

Lily hospital in Benin city, located near Airport Road at 16 Edo-Usagie Street, G.R.A., Benin city, Edo state, is part of the Lily hospitals group, a prominent private healthcare network in Nigeria. The hospital was established in 1984 by Dr and Dr. Mrs. Richmond Leigh. Overtime, the hospital underwent a transition when it was leased to a team of three medical doctors (Austin Okogun, Mayomi Onuwaje, Louise Alekwe) in 1998. Lily hospital Benin offers a range of diagnostic services including radiology and diagnostic imaging, automated laboratory services, with licensed 5 radiographers.

RAYTOUCH DIAGNOSTIC CENTRE

Raytouch diagnostic limited is a diagnostic center located in Benin city, Edo state, Nigeria. The center was established in 2017 and is owned mainly by Prof Igbinedion, a consultant radiologist specializing in interventional radiology and other partners. Raytouch offers a range of diagnostic services including CT scan, MRI, X-ray, echocardiography, ECG, hormone profile tests, urine test, and blood test. It has multiple locations in Benin city, including Oghogho street, Dawson Road opposite hotel Felona, and Ikpoba hill, with licensed 7 radiographers.

3.2 study design

This study employs a descriptive cross-sectional survey design. The design was chosen so as to collect data at a single point in time from a defined population of radiographers in Benin city. This allowed the assessment of their knowledge, awareness, and preparedness concerning the use of contrast media and the management of associated adverse reactions. This design was

suitable for determining the prevalence of knowledge levels and identifying patterns or relationships with demographic and professional characteristics.

3.3 Target Population

The target population for this study included all licensed radiographers that are currently practicing in Benin city, Nigeria. This will include radiographers that are working in both public and private healthcare facilities, who are actively involved in diagnostic imaging procedures that utilize contrast media.

The inclusion Criteria for this study will include Radiographers that have their license to practice, that are currently working in a Healthcare facility, that are practicing in Benin city, that are available during the data collection period and consent to take part in this study. Radiographers who do not meet all above was excluded from the study.

3.4 sampling technique and sample size

This study employs a census survey, in which the total population was included, in order to achieve data that accurately describes the population. However, to compensate for possible non- compliance or unavailability of some participants the final dataset will represent a near-census convenience sampling, with the response rate calculated.

Radiographers that are registered and practicing radiographers in Benin City who met the inclusion criteria were invited to participate. A census approach was chosen because the study

population was relatively small and accessible, making it feasible to include the entire population. This method minimizes sampling bias and enhances the representativeness of the findings.

3.5 Instruments for data collection

An adapted questionnaire from a previously validated Questionnaire by (Khan *et al.*,2023) *which* was modified to suit the objective of the study was used as the method of data collection (See APPENDIX I). The questionnaire will comprise of four sections with questions carefully drafted and constructed to obtain in-depth data, relevant to this research.

Section A: Demographic data of the participant

Section B: Knowledge of contrast media among radiographers in Benin city

Section C: Awareness of adverse reactions associated with contrast media

Section D: Level of preparedness in managing contrast-induced adverse events

This Questionnaire was created using Google forms, which provided an online avenue to reach out to Participants, who naturally would've been difficult to reach, due to the barriers of distance. It also gave participants an avenue to answer the questionnaire at their leisure time, which improved their chances of answering truthfully.

3.6 Validity of the Instrument

The questionnaire that was used in this study was adapted and modified from a previously validated instrument developed by (Khan et al.,2023). Which demonstrated a strong Content Validity Index (CVI) of 0.966 and a Content Validity Ratio (CVR) of 0.79. Necessary adjustments were made, so as to fulfil the objectives of the research without compromising the integrity of the instrument.

3.7 Reliability of the Instrument

The instrument that this study was adapted from, provides sufficient assurance of its internal consistency, and its reliability for Assessing knowledge, awareness and preparedness of Radiographers regarding the knowledge and administration of contrast media and its related adverse reactions. As this study adopted this instrument with only minor contextual adjustments, a separate reliability test such as Cronbach's Alpha was deemed unnecessary

3.8 Method of Data collection

Data was collected using a Self-administered questionnaire, with questions that aligned with the objectives of this study. The questionnaire was distributed online via Google forms, allowing participants to respond at their own convenience, without Interference from the researcher. The link to the form was shared through professional platforms such as WhatsApp

groups etc. Participants were informed of the study's purpose, and confidentiality was assured. Data collection occurred over a specified period, with reminders sent to improve response rates.

3.9 Method of Data Analysis

Data collected was analysed, using Descriptive and Inferential statistical methods. Data exported from the Google sheets was compiled using Microsoft Excel or Statistical packages for the social sciences (SPSS) software (version 30.) Descriptive statistics such as frequencies, means, standard deviations etc. was used to summarise demographic data and assess trends in General knowledge of the participant on contrast media. Inferential statistics was used to determine relationships between variables such as knowledge levels and demographic factors, experience and competence etc. Results were presented as tables for clarity and ease of interpretations. A significant level of $p < 0.05$ was considered statistically significant.

The mean scores of knowledges, Awareness of risks, and preparedness against the benchmark of 70%, which was selected as the minimum acceptable level. Although a formal standard-setting panel was not used, this benchmark is aligned with practices seen in recent healthcare education studies that employed the Modified-Angoff method (Kim et al., 2025).

3.10 Potential Biases

1. Non-response bias: Participation was voluntary, so radiographers who were unavailable or unwilling to participate may differ systematically from respondents, potentially affecting representativeness.
2. Self-reporting bias: The use of a self-administered questionnaire may result in overestimation or underestimation of knowledge and preparedness due to social desirability or recall bias.
3. Online data collection constraints: Although Google Forms increased accessibility, participants with limited internet access or low digital literacy may have been unintentionally excluded.

3.11 Ethical Considerations

Ethical approval for this study was obtained from a recognized ethics review board, such as The Health Research Ethics Committee of University of Benin Teaching Hospital. Participation in the study was entirely voluntary, and informed consent was obtained from all participants prior to data collection. The rights of the participants, including the right to withdraw at any time without penalty was clearly explained. Anonymity and confidentiality of all respondents was strictly maintained. Data collected for this research was used solely for research purposes and stored securely to prevent unauthorized access.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Presentation of Results

Table 4.1: Demographic Characteristics of Radiographers in Benin city.

Variable	Category	Frequency (n)	Percentage (%)
Age	20–29 years	52	86.7
	30–39 years	8	13.3
Gender	Male	43	71.7
	Female	17	28.3
Years of Radiography Experience	<1 year	20	33.3
	1–5 years	38	63.3
	6–10 years	2	3.3
Highest Academic Qualification	B.Rad	58	96.7
	PGC CT	1	1.7
	M.Rad	1	1.7
Type of Healthcare Facility	Public	41	68.3
Department Type	Private	19	31.7
	Mixed	28	46.7
	General Radiography	25	41.7
	CT	6	10.0
	MRI	1	1.7
Average Number of Contrast Procedures/Week	1–5	44	73.3
	6–10	7	11.7
	10+	5	8.3
	>10	4	6.7
Training on Contrast Media	Yes	47	78.3
	No	13	21.7

Table 4.1 summarizes the demographic characteristics of the radiographers in Benin City. Most respondents were aged 20–29 years (86.7%) and male (71.7%). The majority had 1–5 years of professional experience (63.3%) and held a B.Rad degree (96.7%). Most participants worked in public healthcare facilities (68.3%), with 46.7% in mixed departments. About 73.3% performed 1–5 contrast procedures weekly, and 78.3% had received prior training on contrast media.

Table 4.2: Frequency of Refresher Courses Attended by Radiographers in Benin city

Frequency of Refresher Courses	N	%
Once every few years	24	40.0
Never	19	31.7
Annually	11	18.3
>1 per year	6	10.0

Table 4.2 shows the frequency of refresher courses attended by radiographers in Benin City. Most respondents (40.0%) attended refresher courses once every few years, while 31.7% had never attended any. Only 18.3% participated annually, and 10.0% attended more than once per year.

Table 4.3: Distribution of Radiographers in Benin city by Preparedness Items in the Management of Contrast-Induced Adverse Reactions

Preparedness Item	Yes (n, %)	No (n, %)
Department has a protocol	53 (88.3)	7 (11.7)
Emergency drugs available	46 (76.7)	14 (23.3)
Ever managed a contrast reaction	36 (60.0)	24 (40.0)
Can recall adrenaline dosage	25 (41.7)	35 (58.3)
Regular refresher courses	41 (68.3)	19 (31.7)

Table 4.3 Shows the distribution of radiographers in Benin City preparedness regarding contrast-induced adverse reactions. Most departments (88.3%) had established protocols, and 76.7% reported having emergency drugs available. About 60.0% had previously managed a contrast reaction, while only 41.7% could recall the correct adrenaline dosage. Additionally, 68.3% indicated participation in regular refresher courses.

Table 4.4: Summary of Knowledge Scores and Related Variables of Radiographers in Benin city Regarding Contrast Media.

Category	Subcategory / Statistic	Count (n)	Mean (%)	Mode (%)	Median (%)	Std. Dev.	Min (%)	Max (%)	Percentage (%)
Overall, Knowledge Score		60	79.83	80	80	10.33	60	100	100.0
Knowledge Level classification	Excellent ($\geq 80\%$)	40	85.75	80	80	6.75	80	100	66.7
	Good (70–79%)	16	70.00	70.00	70	0.00	70	70	26.7
	Fair (60–69%)	4	60.00	60.00	60	0.00	60	60	6.7
	Poor ($< 60\%$)	0	0.00	0.00	0	0	0	0	0.0
Years of Experience	<1 year	20	79.50	80	80	9.45	60	90	33.3
	1–5 years	38	80.26	70	80	11.02	60	100	63.3
	6–10 years	2	75.00	70	75	7.07	70	80	3.3
Training on Contrast Media Use	Yes	55	80.00	80	80	10.18	60	100	91.7
	No	5	78.00	90	80	13.04	60	90	8.3

Table 4.4 summarizes the knowledge scores of radiographers in Benin City concerning contrast media. The overall mean knowledge score was $79.83 \pm 10.33\%$, with most respondents (66.7%) classified as having excellent knowledge ($\geq 80\%$), and 26.7% having good knowledge (70–

79%). None scored below 60%. Knowledge scores were comparable across experience levels and training status, with those trained on contrast media recording slightly higher mean scores (80.00%) than those without training (78.00%).

Table 4.5: Performance distribution of level of Awareness of Radiographers in Benin city Regarding risks and adverse reactions associated with Contrast Media.

Category	Count	Percentage	Mean	Median	Std_Dev	Min	Max	Range
Excellent ($\geq 80\%$)	15	25.00	90.00	87.50	5.18	87.50	100.00	12.50
Good (70–79%)	8	13.33	75.00	75.00	0.00	75.00	75.00	0.00
Fair (60–69%)	20	33.33	62.50	62.50	0.00	62.50	62.50	0.00
Poor (50–59%)	12	20.00	50.00	50.00	0.00	50.00	50.00	0.00
Very Poor (<50%)	5	8.33	37.50	37.50	0.00	37.50	37.50	0.00

Table 4.5 Most radiographers demonstrated suboptimal awareness of contrast media risks and adverse reactions. Only 25.0% had excellent awareness and 13.3% had good awareness, while the majority fell within fair (33.3%), poor (20.0%), and very poor (8.3%) categories. The overall mean awareness score of 62.5% indicates generally inadequate knowledge of contrast-related risks.

Table 4.6: Impact of training on awareness of Radiographers in Benin City Regarding risks and adverse reactions associated with Contrast Media.

Training Type	Status	n	Mean (%)	Median (%)	Std. Dev (%)	Difference (%)	t-value	P-value	Result
Contrast Media Training	Trained	55	66.36	62.5	17.33	-1.14	-0.1420	0.8876	Not Significant
	Not Trained	5	67.50	62.5	14.25				
Adverse Reaction Training	Trained	48	67.45	62.5	16.66	+4.95	0.9000	0.3713	Not Significant
	Not Trained	12	62.50	62.5	18.46				

Table 4.6 Training had no significant effect on radiographers' awareness of contrast media risks or adverse reactions. Those trained in contrast media recorded a mean awareness score of 66.36% compared to 67.50% for the untrained group ($p = 0.888$). Similarly, radiographers trained in adverse reaction management scored 67.45%, while untrained participants scored 62.50%, with no significant difference ($p = 0.371$). Overall, training did not significantly improve awareness levels.

Table 4.7: Level of Preparedness of Radiographers in Benin City in the Management of Contrast-Induced Adverse Reactions

Category	Score Range	Count	Percentage
Excellent	$\geq 80\%$	19	31.67%
Good	70–79%	14	23.33%
Fair	60–69%	9	15.00%

Poor	50–59%	7	11.67%
Very Poor	<50%	11	18.33%
TOTAL	—	60	100.00%

Table 4.7 presents the preparedness levels of radiographers in managing contrast-induced adverse reactions. Nearly one-third of participants (31.7%) demonstrated excellent preparedness ($\geq 80\%$), while 23.3% were classified as good (70–79%) and 15.0% as fair (60–69%). A smaller proportion scored poorly (11.7%) or very poorly (18.3%), indicating that overall preparedness was suboptimal among a significant number of radiographers.

Table 4.8: Impact of training on preparedness of Radiographers in Benin City Regarding risks and adverse reactions associated with Contrast Media.

Training Type	Status	n	Mean (%)	Median (%)	Std. Dev (%)	Difference (%)	T-statistic	P-value	Result
Contrast Media Training	Trained	55	70.70	72.2	17.49	+19.60	2.41	0.0190	Highly Significant
	Not Trained	5	51.10	50.0	15.91				
Adverse Reaction Training	Trained	48	72.68	77.8	17.11	+18.06	3.35	0.0014	Highly Significant
	Not Trained	12	54.62	55.55	14.76				

Table 4.8 presents the effect of training on radiographers' preparedness. Those who received contrast media training ($n = 55$) had a mean preparedness score of 70.70%, significantly higher

than 51.10% among the untrained group ($t = 2.41$, $p = 0.019$). Similarly, radiographers trained on adverse reactions ($n = 48$) scored 72.68%, markedly higher than 54.62% for those untrained ($t = 3.35$, $p = 0.001$). These results indicate that both types of training had a highly significant positive impact on preparedness.

Table 4.9: Mean Comparison and ANOVA Summary for Knowledge, Awareness, and Preparedness of Radiographers in Benin City Regarding Contrast Media

Metric	Value	Interpretation
Knowledge Mean	79.83%	Good to Excellent
Awareness Mean	66.46%	Fair to Good
Preparedness Mean	69.07%	Fair to Good
Range of Means	13.37 percentage points	Noticeable variation among domains
ANOVA F-statistic	12.53	Large F-value
P-value	0.000008*	Highly significant
Degrees of Freedom (df)	(2, 177)	Between = 2, Within = 177
Eta-squared (η^2)	0.124	Medium effect (12.4% variance explained)
Decision	Reject H_0	Means significantly different
Conclusion	—	Knowledge, awareness, and preparedness differ significantly

Table 4.9 Radiographers showed the highest mean score in knowledge (79.83%), followed by preparedness (69.07%) and awareness (66.46%), indicating better performance in knowledge than in awareness and preparedness. ANOVA revealed a highly significant difference among these three domains ($p < 0.001$) with a medium effect size ($\eta^2 = 0.124$), confirming that levels of knowledge, awareness, and preparedness differed meaningfully.

Table 4.10: Pairwise Mean Differences (Post-Hoc Comparison of Knowledge, Awareness, and Preparedness)

Comparison	Mean 1	Mean 2	Difference ($\Delta\%$)	t-Statistic	p-Value	Cohen's d	Significance	Effect Size
Knowledge vs Awareness	79.83 %	66.46 %	+13.37%	5.77	< 0.001	0.75	Highly Significant	Medium
Knowledge vs Preparedness	79.83 %	69.07 %	+10.76%	3.90	0.00025	0.50	Highly Significant	Medium
Awareness vs Preparedness	66.46 %	69.07 %	-2.61%	-0.94	0.35	-0.12	Not Significant	Negligible

Table 4.10 presents the post-hoc pairwise comparisons of knowledge, awareness, and preparedness. Knowledge scores were significantly higher than awareness (+13.37%, $t = 5.77$, $p < 0.001$, Cohen's $d = 0.75$) and preparedness (+10.76%, $t = 3.90$, $p = 0.00025$, Cohen's $d = 0.50$), both indicating medium effect sizes. The difference between awareness and preparedness was not significant (-2.61%, $t = -0.94$, $p = 0.35$, Cohen's $d = -0.12$), suggesting negligible effect.

Table 4.11: Summary of Hypothesis Testing Results Comparing Radiographers' Knowledge, Awareness, and Preparedness Levels to the 70% Acceptable Competency Benchmark

Variable	H ₁ : Knowledge Level	H ₂ : Understanding of Risks	H ₃ : Preparedness
Null Hypothesis (H ₀)	Radiographers do not have acceptable knowledge ($\mu \leq 70\%$)	Radiographers do not understand risks ($\mu \leq 70\%$)	Radiographers are not well prepared ($\mu \leq 70\%$)
Alternative Hypothesis (H ₁)	Radiographers have acceptable knowledge ($\mu > 70\%$)	Radiographers understand risks ($\mu > 70\%$)	Radiographers are well prepared ($\mu > 70\%$)
Sample Size (n)	60	60	60
Mean (%)	79.83	66.46	69.07
Median (%)	80.00	62.50	72.20
Std. Deviation	10.33	16.99	18.08
Minimum (%)	60.00	37.50	33.30
Maximum (%)	100.00	100.00	94.40
T-Statistic	7.37	-1.61	-0.40
P-Value	0.00	0.94	0.65
Significance Level (α)	0.05	0.05	0.05
Decision	Reject H ₀	Fail to Reject H ₀	Fail to Reject H ₀
Conclusion	Acceptable Level	Below Acceptable Level	Below Acceptable Level

Table 4.11 presents the results of one-sample t-tests comparing radiographers' competency metrics to the 70% benchmark. The mean knowledge score (79.83%) was significantly above

the benchmark ($t = 7.37$, $p < 0.001$), indicating an acceptable level of knowledge. In contrast, awareness (66.46%) and preparedness (69.07%) did not significantly exceed the benchmark ($t = -1.61$, $p = 0.94$; $t = -0.40$, $p = 0.65$), suggesting that these domains remain below the acceptable competency threshold.

4.2 Discussion of Results

This section presents a detailed interpretation of the findings gotten from the statistical analysis in this study, which assessed radiographers' knowledge, awareness, and preparedness regarding the use of radiographic contrast agents and the management of associated adverse reactions in Benin City. The results are discussed in relation to the study objectives and hypotheses, as well as compared with findings from previous research.

The demographic distribution of respondents as shown in Table 4.1 indicates that the majority of participants were young professionals aged 20–29 years (86.7%), predominantly male (71.7%), and with 1–5 years of working experience (63.3%). This demographic trend aligns with the findings of Wan Nur Nadiah (2017), who reported that radiographers below the age of 30 formed the majority of the workforce in similar surveys. The dominance of early-career radiographers may suggest that the radiographic workforce in Benin City is relatively young, which could influence both knowledge and preparedness levels since experience often correlates with practical competence.

Most respondents held a B. Rad degree (96.7%), and about 78.3% had received training on contrast media, reflecting a relatively strong academic foundation. However, the limited proportion of those who regularly attended refresher courses (only 18.3% annually, Table 4.2) points to a gap in continuous professional education. This is consistent with the findings of (Trygg et al., 2024), who reported that limited exposure to structured training significantly affects confidence and response capability during contrast-related emergencies.

In the preparedness indicators (Table 4.3), 88.3% of respondents indicated that their departments had protocols for contrast reaction management, and 76.7% confirmed that emergency drugs were available. However, only 41.7% could recall the correct adrenaline dosage, which is critical for managing severe anaphylactic reactions. This reveals a partial preparedness level among radiographers. Similar observations were made by (Khan et al., 2023) and (Hadi et al., 2025), where only a minority of radiographers demonstrated precise knowledge of adrenaline administration despite general awareness of emergency response protocols.

The knowledge scores summarized in Table 4.4 reveal a high level of competence among radiographers in Benin City, with an overall mean score of 79.83%, falling within the good-to-excellent range. This suggests that most radiographers possess substantial theoretical knowledge of contrast media, their types, and general usage. This outcome aligns with (Albano et al., 2024), who found that young radiology professionals generally exhibit strong

foundational knowledge of contrast media but still require improved hands-on and emergency response training. The result of this data thus supports the rejection of the null hypothesis (H_{01}) and acceptance of the alternative hypothesis (H_{11}), confirming that radiographers in Benin City possess an acceptable level of knowledge regarding contrast media.

The awareness level concerning risks and adverse reactions was moderate, with a mean score of 66.46% (Table 4.5). Only 25% of respondents achieved an “excellent” awareness rating. This indicates that while radiographers may understand the basic functions and classifications of contrast agents, their depth of knowledge regarding potential adverse reactions remains inadequate. This finding resonates with the results of (Khan et al., 2023), where only 28% of respondents identified epinephrine as the first-line treatment for anaphylaxis, highlighting global gaps in emergency preparedness and risk management. It also supports the conclusion of (Wan Nur Nadiah, 2017), who observed that radiographers’ awareness levels tend to depend heavily on experience and prior exposure to contrast-related incidents.

The preparedness results in Table 4.7 further reveal that only 31.7% of respondents demonstrated excellent readiness to handle contrast-induced adverse reactions, with 30% scoring poor or very poor. These findings underscore the need for strengthened institutional protocols, simulation training, and emergency drills. This aligns with (Trygg et al., 2024), who emphasized that theoretical training without recurrent practical exposure leaves radiographers underprepared during emergencies.

Furthermore, as shown in Table 4.8, radiographers who had received specific training on contrast media and adverse reaction management demonstrated significantly higher preparedness levels ($p < 0.05$). This confirms that targeted education and training have a measurable impact on professional readiness. This finding supports (Coupal et al., 2018), who reported that structured simulation-based training improves both the confidence and performance of radiology personnel in emergency situations. Therefore, the null hypotheses (H_{02} and H_{03}) were rejected in favor of the alternative hypotheses, establishing that prior training significantly enhances preparedness in managing contrast-induced reactions.

The ANOVA results in Table 4.9 revealed statistically significant differences ($p < 0.001$) among knowledge, awareness, and preparedness scores, indicating that these domains do not develop uniformly. Specifically, the post-hoc comparisons (Table 4.10) showed that knowledge was significantly higher than both awareness and preparedness, suggesting that while radiographers in Benin City understand the theoretical aspects of contrast media, this knowledge does not fully translate into practical readiness or emergency management skills. This pattern has been reported by (Hadi et al., 2025) and (Albano et al., 2024), who noted that a high theoretical understanding often coexists with low confidence and inconsistent preparedness, especially in younger practitioners.

In summary, the study demonstrates that radiographers in Benin City possess adequate theoretical knowledge of contrast agents but exhibit moderate awareness and suboptimal

preparedness regarding adverse reaction management. These findings emphasize the urgent need for continuous professional development programs, regular simulation-based emergency drills, and interventions programmes that reinforce compliance with the Radiographers Registration Board of Nigeria (RRBN,2023) guidelines on contrast administration and patient safety.

CHAPTER FIVE

CONCLUSION, RECOMMENDATIONS, LIMITATIONS AND SUGGESTED AREAS FOR FURTHER RESEARCH

5.1 Conclusion

This study assessed radiographers' knowledge on radiographic contrast agents and their preparedness in managing associated adverse reactions in Benin City, Edo State. The findings revealed that while most radiographers demonstrated a commendable level of theoretical knowledge on contrast media, there were notable deficiencies in awareness of contrast-related risks and practical preparedness for managing adverse reactions. The overall mean knowledge score (79.83%) indicated that radiographers in Benin City possess good-to-excellent understanding of contrast media types, indications, and applications. However, the mean awareness score (66.46%) and preparedness score (69.07%) were both below the acceptable benchmark of 70%, suggesting gaps in the translation of theoretical knowledge into clinical readiness.

These findings present a key challenge within the radiography profession. While academic instruction provides a strong foundation, there is limited reinforcement through practical emergency training and institutional support. The study further showed that radiographers who had received formal training on contrast administration and adverse reaction management recorded significantly higher preparedness scores compared to their untrained counterparts.

This demonstrates the vital role of structured, continuous professional education in promoting patient safety during radiographic procedures involving contrast agents.

This study highlights the importance of maintaining high standards of professional development within the radiography practice. Strengthening emergency preparedness not only ensures patient safety but also upholds the ethical and regulatory obligations outlined by the Radiographers Registration Board of Nigeria (RRBN, 2023). A coordinated approach that combines theoretical knowledge, practical training, and institutional readiness will significantly reduce the risks associated with contrast media use in diagnostic imaging.

5.2 Recommendation

Regular training and continuous professional development programs should be institutionalized for all practicing radiographers. These programs should emphasize the pharmacology of contrast agents, identification of high-risk patients, recognition of early signs of adverse reactions, and prompt administration of first-line treatments such as adrenaline in cases of anaphylaxis. Simulation-based emergency drills should also be implemented periodically to enhance radiographers' confidence and competence during real-life emergencies.

Hospitals and diagnostic centers should develop and enforce standardized departmental protocols for the administration of contrast media and management of adverse reactions. These

should include clear procedural guidelines, availability of emergency kits, and routine mock drills to ensure that all staff members are adequately prepared for contrast-related emergencies.

Finally, the Radiographers Registration Board of Nigeria (RRBN) and other regulatory agencies should consider incorporating contrast reaction management as a compulsory component of license renewal and continuing professional development requirements. This will ensure that all practicing radiographers maintain updated knowledge and practical competence consistent with global best practices.

5.3 Limitations of the Study

This study had several limitations that should be considered when interpreting the findings:

1. Geographical Limitation: The study is limited to a geographical area, Benin city, which may not be a representative of radiographers' knowledge in other parts of the country.
2. Knowledge Assessment: While the study assessed radiographers' knowledge, this may not necessarily reflect their practical skills or actual performance in managing contrast-induced adverse reactions.
3. Professional Limitation: The study is limited to only Radiographers, excluding other medical professionals who may also administer contrast agents or manage contrast-induced reactions.

5.4 Suggested Area for Further Studies

Based on findings and limitations of this study, future research could:

1. Investigate the factors influencing radiographers' preparedness and confidence in managing contrast media-induced adverse reactions, including years of experience, institutional support, and access to continuous professional education.
2. Assess knowledge and preparedness levels of radiographers across different states or regions of Nigeria to establish national trends and identify areas requiring intervention.
3. Examine the role of other healthcare professionals involved in contrast administration to gain a broader understanding of preparedness within the healthcare team.
4. Evaluate actual performance in managing contrast-induced adverse reactions through practical assessments or observational studies

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APPENDICE
QUESTIONNAIRE

Dear respondents

I am a final year student in the department of Radiography, University of Benin, Benin City. I am currently conducting research on **"ASSESSMENT OF RADIOGRAPHERS' KNOWLEDGE ON RADIOGRAPHIC CONTRAST AGENTS AND MANAGEMENT OF RELATED ADVERSE REACTIONS IN BENIN CITY.**" This questionnaire aims to collect relevant information for this study. Kindly answer the following questions to the best of your knowledge. Your responses are crucial to this study, so I would appreciate your honest response. All information provided would be treated with confidentiality and would be used solely for research purposes. Thank you for your time and participation

SECTION A: DEMOGRAPHIC INFORMATION

(Please tick ☐ or fill in as appropriate)

Age:

☐ 20–29 ☐ 30–39 ☐ 40–49 ☐ 50+

Gender:

☐ Male ☐ Female

Years of radiography experience:

☐ < 1 ☐ 1–5 ☐ 6–10 ☐ > 10

Highest academic qualification:

☐ B.Rad ☐ M.Rad ☐ PhD ☐ Other (specify): _____

Type of healthcare facility:

☐ Public ☐ Private

Department type:

☐ General radiography ☐ CT ☐ MRI ☐ Mixed

Average number of contrast procedures per week:

☐ 0 ☐ 1–5 ☐ 6–10 ☐ 10+

Have you ever received training on contrast media use?

☐ Yes ☐ No

Years since last contrast-related training:

☐ < 1 ☐ 1–5 ☐ 6–10 ☐ > 10

Have you received training on managing adverse reactions to contrast media?

☐ Yes ☐ No

SECTION B: KNOWLEDGE OF CONTRAST MEDIA

(Choose one correct option unless otherwise stated)

Iodinated contrast media can be:

☐ Ionic only ☐ Non-ionic only ☐ Both ionic and non-ionic ☐ Unsure

Non-ionic iodinated contrast media have:

☐ Higher osmolality ☐ Lower osmolality ☐ Same osmolality as ionic ☐ Unsure

Which route is commonly used for barium sulphate in lower GI studies?

☐ Oral ☐ Rectal ☐ Intravenous ☐ Intra-arterial

Contrast media with high osmolality are more likely to cause:

☐ Mild reactions ☐ Severe reactions ☐ No reaction ☐ Unsure

Which contrast is safest in patients with severe renal impairment?

☐ High-osmolality iodine ☐ Gadolinium ☐ Low-osmolality iodine ☐ Avoid all if possible

Which parameter best reflects kidney function before contrast administration?

☐ Serum creatinine ☐ Blood pressure ☐ Heart rate ☐ Respiratory rate

Which agency in Nigeria provides professional standards for radiographers in contrast administration?

☐ WHO ☐ RRBN ☐ ESUR ☐ NAFDAC

Extravasation refers to:

☐ Contrast entering the bloodstream ☐ Contrast leaking into surrounding tissues ☐ Allergic reaction ☐ None of the above

Positive contrast agents appear:

☐ White on images ☐ Black on images ☐ Grey on images ☐ Colourless

Negative contrast agents appear:

☐ White on images ☐ Black on images ☐ Grey on images ☐ Colourless

SECTION C: AWARENESS OF ADVERSE REACTIONS

Immediate adverse reactions occur:

☐ Within 1 hour ☐ Within 24 hours ☐ After 24 hours ☐ Unsure

Delayed adverse reactions occur:

☐ Within 1 hour ☐ 1–7 days ☐ After 7 days ☐ Unsure

Which of the following is a mild reaction?

☐ Nausea ☐ Anaphylaxis ☐ Cardiac arrest ☐ Seizures

Which of these is a moderate reaction?

☐ Loss of balance ☐ Weakness ☐ Flushing ☐ Pain at injection site

Which of these is a severe reaction?

☐ Nausea ☐ Anaphylactic shock ☐ Paralysis ☐ Mild swelling

Which drug is first-line for anaphylaxis management?

☐ Adrenaline (epinephrine) ☐ Antihistamines ☐ Corticosteroids ☐ Oxygen therapy

Recommended site for intramuscular adrenaline injection:

☐ Deltoid ☐ Thigh ☐ Gluteal ☐ Forearm

Premedication with steroids and antihistamines is most effective in:

☐ Preventing severe reactions ☐ Preventing mild/moderate reactions ☐ Eliminating all risks ☐ None of the above

SECTION D: PREPAREDNESS IN MANAGING ADVERSE REACTIONS

My department has a protocol for managing contrast media reactions.

☐ Yes ☐ No ☐ Unsure

Emergency drugs (epinephrine, corticosteroids, antihistamines) are readily available in my workplace.

☐ Yes ☐ No ☐ Unsure

I am confident in recognising early signs of a severe contrast reaction.

☐ Strongly agree ☐ Agree ☐ Disagree ☐ Strongly disagree

I am confident in initiating emergency management (e.g., epinephrine injection) during anaphylaxis.

☐ Strongly agree ☐ Agree ☐ Disagree ☐ Strongly disagree

Have you ever been involved in managing an actual contrast reaction?

☐ Yes ☐ No

If yes, how did you feel during the event?

☐ Very confident ☐ Somewhat confident ☐ Not confident at all

How often do you participate in training or drills on contrast media reaction management?

☐ Never ☐ Once every few years ☐ Annually ☐ More than once a year

I can recall the exact dosage of adrenaline for an adult anaphylaxis patient.

☐ Yes ☐ No

My department conducts regular refresher courses on contrast safety.

☐ Yes ☐ No

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/2025/221

PROPOSAL TITLE: "ASSESSMENT OF RADIOGRAPHERS KNOWLEDGE ON RADIOGRAPHIC CONTRAST AGENTS AND MANAGEMENT OF RELATED ADVERSE REACTIONS IN BENIN CITY"

PRINCIPAL INVESTIGATOR(S): MOHAMMED MARYAM OSHUWA

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

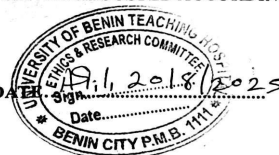
THIS APPROVAL DATES 20/8/2025 TO 19/8/2026. IF THERE IS DELAY IN STARTING THE RESEARCH, PLEASE INFORM THE HREC SO THAT THE DATES OF APPROVAL CAN BE ADJUSTED ACCORDINGLY

REMARK:

CHAIRMAN: PROF. (MRS) A.N. OFILI

SIGNATURE & DATE

SUPERVISOR (S): AKPOBASAHAN E.A. (DR)



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