KNOWLEDGE AND PRACTICE OF SAFE HANDLING AND ADMINISTRATION OF CHEMOTHERAPEUTIC DRUGS AMONG NURSES IN A TERTIARY HEALTH INSTITUTION, BENIN CITY EDO STATE

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CERTIFICATION PAGE

This is to certify that this project was carried out by **OKEKE ESTHER OGOCHUKWU** with matriculation number **BMS1807280**, Faculty of Nursing Sciences, University of Benin, Benin City.

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DEDICATION

This work is dedicated to GOD ALMIGHTY who is providing me with the strength to complete my academic journey.

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ABSTRACT

This study assessed the knowledge and practice of safe handling and administration of

chemotherapeutic drugs amongst nurses in tertiary health institution, Benin City. The study aims to evaluate the level of knowledge and practice in the safe handling and administration of chemotherapeutic drugs among nurses in a tertiary health institution; and to identify the perceived factors that support the practice of safe handling and administration of chemotherapeutic drugs among nurses in a tertiary health institution. Three research questions were raised and answered while two hypotheses were tested at 0.05 significance value. The study adopted the descriptive cross-sectional design and simple random sampling method was used to select 278 nurses in the University of Benin Teaching Hospital, Benin City. A well-structured questionnaire was used as instruments for data collection. The instrument was validated by the research supervisor and two other experts in the field. To ensure the reliability of the instrument, a pilot study was conducted and a reliability value greater than (>0.5) was obtained. The data collected were analysed using both descriptive (frequency, percentages, mean value) and inferential statistics (chi-square statistical test) to test the hypotheses at 0.05 significance level using International Business Machine (IBM) Statistical Package for Social Sciences (SPSS) version 24.0. The result shows that majority of the respondents have fair level of knowledge of chemotherapeutic drugs and low level of practice of safe handling of chemotherapeutic drugs and that none of the sociodemographic characteristics was associated with level of knowledge of chemotherapeutic drugs. Based on the findings, it was recommended among others that regular and mandatory educational programs should be instituted for healthcare professionals handling chemotherapeutic drugs and institutions should implement and enforce standardized procedures for administering chemotherapy, ensuring the use of appropriate PPE and adherence to safety protocols.

Key words: Administration, Chemotherapeutic Drugs, Knowledge, Practice, Safe-Handling.

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CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

Cancer is a disease that results from cellular changes, causing the uncontrolled growth and division of cells. Some types of cancer cells exhibit rapid growth, while others demonstrate slow growth and division. While certain forms of cancer lead to visible growths called tumors, others, like leukemia, do not (Angahar, 2021). Most cells in the body have specific functions and limited lifespans. The natural process of old cells dying, known as apoptosis, results in cell death. During apoptosis, a cell receives instructions to die so that it can be replaced with a newer, better-functioning cell. However, in cancerous cells, the signals that normally instruct them to stop dividing and die are lacking. Consequently, these cells continue to grow in the body, utilizing oxygen and nutrients that would typically nourish them. They can form tumors or invade nearby tissues and organs (Kim *et al*., 2020).

Consequently, cancerous cells proliferate within the body, consuming oxygen and nutrients that would typically nourish other cells. This uncontrolled growth can lead to the formation of tumors and disrupt the normal functioning of the immune system and other bodily processes. Cancer is a significant global health issue, ranking as the second leading cause of death worldwide (Purkayastha, et al., 2021). Each year, over 10 million individuals are diagnosed with cancer, resulting in approximately 6 million deaths (WHO, 2023; Abdullah & Rasheed, 2021). According to the World Health Organization, it is projected that by 2030, there will be an estimated 27 million cancer cases annually, with 17 million cancer-related deaths and 75 million individuals living with cancer (WHO, 2021). This increase in cancer cases is particularly prominent in middle-income and developing countries, influenced by global transformations and changes in population dynamics, including increased urbanization and

sedentary lifestyles.

Cancer is a deadly disease, accounting for nearly 10 million deaths in 2020 alone (Hulvat, 2020; Turner et al., 2020). The most common are breast, lung, colon, rectum and prostate cancers (Boakye et al., 2021). Cancer mortality has been reduced due to advancement in medicine and early detection technology (Boakye et al., 2021). The three events that led to the development of cancer treatment began with three events in the last century: the discovery of X-rays by Wilhelm Konrad Roentgen, the use of transplantable animal-tumor models in cancer research, and the first surgical procedure developed by Halsted (radical mastectomy). In the fight against cancer, various treatment options are available, including surgery, radiation therapy, immunotherapy, targeted therapies, and chemotherapy.

Chemotherapy, one of the mainstay treatments for cancer, involves the use of chemotherapeutic drugs to kill or slow the growth of cancer cells (Cohen, *et al*., 2020). The term ―chemotherapy‖ was coined by German chemist Paul Ehrlich who investigated the use of drugs to treat infectious diseases. He was also the first scientist to study animal models to screen a series of chemicals regarding their potential activity against diseases. Historical documents suggest the use of arsenicals started in the 1900s. Radiotherapy ad surgery were the mainstays of cancer management in the 1960s. As micrometastases and recurrence of cancer after surgery and radiation therapy became evident, combination chemotherapy started gaining significance (DeVita & Chu, 2021). These drugs are designed to target rapidly dividing cells, a characteristic exhibited by cancer cells. Chemotherapy can be administered in different forms, such as intravenous infusion, oral tablets, or injections, depending on the type and stage of cancer. Chemotherapeutic drugs work by interfering with specific processes necessary for cell division and replication. They may inhibit DNA synthesis, disrupt cell signaling pathways, or induce programmed cell death (apoptosis) in cancer cells. By

targeting cancer cells throughout the body, chemotherapy aims to shrink tumors, control their growth, and prevent the spread of cancer to other parts of the body.

However, the administration of chemotherapeutic drugs requires specialized knowledge and practices to ensure optimal outcomes and minimize potential risks. Nurses play a crucial role in the safe handling and administration of these potent medications. They are responsible for drug preparation, calculating accurate dosages, monitoring patients for adverse effects, and providing supportive care during chemotherapy treatments. It is important to assess the knowledge and practices of nurses regarding the safe handling and administration of chemotherapeutic drugs. Identifying any gaps or deficiencies in their understanding and practices can help develop targeted interventions to improve their competency and ensure the provision of safe and effective care to cancer patients (Sargidy, *et al*., 2022).

By focusing on the use of chemotherapeutic drugs, this study aims to contribute to the body of knowledge regarding the safe handling and administration of these medications among nurses. The findings can guide the development of training programs, the improvement of resources and guidelines, and the establishment of standardized protocols. Ultimately, this study aims to enhance patient safety, improve treatment outcomes, and support the nursing profession in delivering quality care to individuals undergoing chemotherapy for cancer.

1.2 Statement of the problem

The safe handling and administration of chemotherapeutic drugs among nurses in selected health facilities in Benin City, is a pressing concern. It is crucial to ensure that nurses in these specific healthcare settings possess the necessary knowledge and adhere to appropriate practices when dealing with these potent medications. Chemotherapeutic drugs are integral to the treatment of cancer and other serious diseases, requiring careful handling to minimize harm to both patients and healthcare workers. Nurses play a vital role in administering

chemotherapy, including drug preparation, delivery, and patient monitoring during treatment.

However, there is a growing concern that nurses in Benin City may have gaps in their knowledge and practices related to the safe handling and administration of chemotherapeutic drugs. These gaps may include inadequate understanding of drug interactions, dosage calculations, proper handling of hazardous materials, adherence to safety protocols, and awareness of potential side effects and adverse reactions.

Factors contributing to these knowledge and practice gaps may include insufficient training and education specific to chemotherapy administration, limited access to updated guidelines and resources, and a lack of standardized protocols within the hospitals. Furthermore, the rapid advancement in chemotherapy treatments and the introduction of new drugs pose additional challenges for nurses to keep up with the latest evidence-based practices.

The consequences of inadequate knowledge and practices among nurses regarding the safe handling and administration of chemotherapeutic drugs are significant. They may include an increased risk of medication errors, exposure to hazardous substances, compromised patient safety, and adverse treatment outcomes. Additionally, healthcare professionals themselves may face potential health risks due to occupational exposure. Addressing these knowledge and practice gaps among nurses in selected hospitals in Benin City is paramount to ensure patient safety, optimize treatment outcomes, and protect the well-being of healthcare professionals. It is essential to develop tailored training programs that specifically address the needs of the nurses, improve access to updated resources and guidelines, and establish standardized protocols for the safe handling and administration of chemotherapeutic drugs.

1.3 Aim and Objectives of the Study

The aim of this study is to assess the knowledge and practices regarding the safe handling

and administration of chemotherapeutic drugs among nurses in a tertiary health institution, Benin City. Specifically, it is:

1. To evaluate the level of knowledge among nurses in a tertiary health institution regarding chemotherapeutic drugs, handling and administering them to patients.
2. To assess the level of practice among nurses in a tertiary health institution in the safe handling and administration of chemotherapeutic drugs.
3. To identify the perceived factors that support the practice of safe handling and administration of chemotherapeutic drugs among nurses in a tertiary health institution.

1.4 Research Questions

1. How extensive is the knowledge of chemotherapeutic drugs among nurses in selected health facilities in Benin City?
2. To what extent do nurses in the selected health facilities in Benin City possess the practice of safe handling and administration of chemotherapeutic drugs?
3. What are the perceived factors that contribute to the practice of safe handling and administration of chemotherapeutic drugs among nurses in selected health facilities in Benin City?

1.5 Hypotheses

1. There is no significant relationship between the social demographic characteristics of nurses in tertiary health institution and their level of knowledge of chemotherapeutic drugs.
2. There is no significant relationship between the social demographic characteristics of nurses in tertiary health institution and their level of practice of safe handling of chemotherapeutic drugs.

1.6 Significance of the Study

Nursing Practice

The safe handling and administration of chemotherapeutic drugs are critical to protecting both patients and healthcare providers from potential hazards associated with cytotoxic agents. This study is significant in identifying gaps in nurses‘ knowledge and practices regarding chemotherapy safety in selected health facilities in Benin City. By understanding these gaps, nurses can adopt improved safety measures, such as the proper use of personal protective equipment (PPE), adherence to standard protocols, and safe disposal of hazardous waste. The findings can also inform hospital administrators and policymakers about the need for stricter enforcement of safety guidelines, provision of adequate protective materials, and reduction of occupational exposure risks. Ultimately, this will enhance the safety of both nurses and patients while ensuring high-quality oncology care.

Nursing Education

This study has important implications for nursing education by emphasizing the need for comprehensive training on chemotherapy safety. Many nurses may lack adequate exposure to best practices for handling chemotherapeutic drugs during their formal education. The study‘s findings can highlight areas where nursing curricula should be strengthened, such as training on the use of closed-system drug transfer devices (CSTDs), safe administration techniques, and emergency procedures for accidental exposure. Additionally, it can encourage continuous professional education programs, workshops, and certifications focused on chemotherapy safety. By integrating this knowledge into nursing education, future nurses will be better prepared to handle these drugs safely and confidently in clinical practice.

Nursing Research

This study contributes to nursing research by providing empirical data on nurses‘ knowledge and practices regarding chemotherapy safety in the Nigerian healthcare context. It serves as a foundation for further research on occupational health risks associated with chemotherapy handling, factors influencing compliance with safety guidelines, and the effectiveness of educational interventions in improving chemotherapy administration practices. The findings can also support policy development and advocacy for improved workplace safety measures. Additionally, this study may inspire further investigations into related areas, such as the psychological impact of handling hazardous drugs on nurses and patient safety outcomes in oncology care.

1.7 Scope of the Study

The scope of this study focuses on the safe handling and administration of chemotherapeutic drugs among nurses in tertiary health institution , Benin City. It encompasses registered nurses in a tertiary health institution.

1.8 Operational Definitions of Terms

Chemotherapeutic Drugs: In this study, chemotherapeutic drugs refer to medications used in the treatment of cancer and other serious diseases. These drugs are administered to inhibit or destroy the growth of cancer cells or other targeted cells in the body.

Knowledge: Knowledge, in the context of this study, refers to the understanding and awareness possessed by nurses regarding various aspects of chemotherapeutic drugs. This includes knowledge of drug interactions, dosage calculations, potential side effects and adverse reactions, and other relevant information related to the safe handling and administration of these medications.

Practices: Practices, in this study, refer to the actions, behaviors, and procedures employed by nurses during the handling and administration of chemotherapeutic drugs. This encompasses adherence to safety protocols, proper handling of hazardous materials, drug preparation and delivery techniques, and monitoring of patients during treatment.

Safe Handling: Safe handling, in the context of this study, pertains to the proper and cautious procedures followed by nurses to minimize the risk of exposure to hazardous substances and prevent harm to patients and themselves during the preparation, administration, and disposal of chemotherapeutic drugs. This includes wearing appropriate personal protective equipment, following established protocols for drug handling, and employing measures to prevent contamination or spills.

Administration: Administration, in this study, refers to the process of giving chemotherapeutic drugs to patients according to prescribed guidelines and protocols. It includes activities such as drug preparation, accurate dosage calculation, proper route of administration (e.g., oral, intravenous, intramuscular), and monitoring patients for potential adverse effects.

Perceived Factors: Perceived factors, in this study, refer to the subjective beliefs, opinions, and perspectives of nurses regarding the elements that influence their practice of safe handling and administration of chemotherapeutic drugs. These factors may include the availability of resources (e.g., guidelines, reference materials), training programs, organizational support, workload, and environmental conditions.

CHAPTER TWO

LITERATURE REVIEW

2.0 Introduction

This chapter presents an overview of the literature currently available, in relation to the safe handling.

2.1 Conceptual Review

Overview of Chemotherapy

Chemotherapy is a type of cancer therapy that uses one or more anti-cancer medications as part of a prescribed treatment regimen. It may be given with the goal of curing a condition, prolonging life, or reducing symptoms. Chemotherapy is a key component of pharmacotherapy for cancer in the field of medical oncology (Alfarouk, et al., 2021).

The word "chemotherapy" has come to refer to any intracellular toxin treatment intended to prevent cell division (mitosis) or cause DNA damage. This explains how preventing DNA repair might improve chemotherapy's efficacy. The phrase itself does not cover other substances that block extracellular signals. Hormone therapy is the term used to describe the development of therapies that specifically target certain biochemical or genetic markers that block growth-promoting signals induced by traditional endocrine hormones. On the other hand, targeted treatment refers to therapies that block growth signals connected to receptor tyrosine kinases. (Rajman , et al., 2022).

Importantly, systemic therapy for cancer include the use of medications, whether they relate to chemotherapy, hormone therapy, or targeted therapy. They have the ability to treat malignant incidences all throughout the body once they are injected into the circulation. Local therapies that target particular anatomical locations, including surgery, radiation therapy, or hyperthermia therapy, are frequently combined with systemic therapies (Rajman et al., 2022).

Traditional chemotherapeutic drugs generally inhibit cell division (mitosis) to cause their lethal effects, although cancer cells show a wide range of sensitivity to these substances. Chemotherapy is simply a method of causing cellular stress or damage, which might result in cell death if apoptosis is triggered. Chemotherapy's side effects typically result from harm to healthy cells that divide quickly, making them vulnerable to anti-mitotic medications. These outcomes frequently take the form of alopecia (hair loss), mucositis (inflammation of the digestive system lining), and myelosuppression (lower blood cell synthesis, which results in immunosuppression). Chemotherapy medications are also used in a variety of illnesses caused by the immune system's excessive self-directed activity, known as autoimmunity, because to their effects on immune cells, particularly lymphocytes. This includes diseases including vasculitis, systemic lupus erythematosus, multiple sclerosis, and rheumatoid arthritis, among others (Rajman, et al., 2022).

Types of Chemotherapy (National Cancer Institute, 2021)

There are various types of chemotherapy, and the choice of which type to use depends on the type of cancer, its stage, and other individual factors. Here are some common types of chemotherapy:

Adjuvant Chemotherapy: Adjuvant chemotherapy is given after surgery or another primary treatment to kill any remaining cancer cells and reduce the risk of cancer recurrence.

Neoadjuvant Chemotherapy: Neoadjuvant chemotherapy is given before the main treatment, often surgery or radiation therapy. It is used to shrink tumors and make them easier to remove. Palliative Chemotherapy: Palliative chemotherapy is administered to relieve cancer-related symptoms and improve the quality of life in cases where the cancer cannot be cured. It aims to slow the cancer's growth and manage symptoms.

Combination Chemotherapy: This approach uses a combination of different chemotherapy drugs. Combining drugs with different mechanisms of action can be more effective in killing cancer cells and reducing the risk of resistance.

Chemoradiation: Chemoradiation involves combining chemotherapy with radiation therapy. This approach is often used for cancers that are sensitive to both treatments, such as certain types of lung and esophageal cancer.

High-Dose Chemotherapy with Stem Cell Transplant: High-dose chemotherapy is used to treat some types of cancer, especially blood cancers like leukemia and lymphoma. Stem cells are collected from the patient or a donor and then returned to the patient's body after high-dose chemotherapy to help regenerate healthy blood cells.

Intrathecal Chemotherapy: Intrathecal chemotherapy involves injecting chemotherapy drugs directly into the cerebrospinal fluid, which surrounds the brain and spinal cord. It is used to treat cancers that have spread to the central nervous system.

Intra-arterial Chemotherapy: Intra-arterial chemotherapy is administered directly into the artery that supplies blood to the tumor. It is used for some liver and brain cancers.

Systemic Chemotherapy: Systemic chemotherapy is administered through the bloodstream, and it circulates throughout the body to reach cancer cells wherever they may be. It is the most common form of chemotherapy.

Targeted Therapy: While not traditional chemotherapy, targeted therapies are drugs designed to target specific molecules or pathways involved in cancer growth. They are often used in combination with chemotherapy or as standalone treatments.

Immunotherapy: Immunotherapy is a type of treatment that stimulates the body's immune

system to recognize and attack cancer cells. It can be used alone or in combination with other treatments.

Hormone Therapy: Hormone therapy is used to treat hormone-sensitive cancers like breast and prostate cancer. It works by blocking the effects of hormones that promote cancer growth.

The specific chemotherapy regimen and approach chosen by a healthcare team will depend on the individual patient's diagnosis, the type and stage of cancer, and their overall health.

Routes of Administration

Chemotherapy can be administered through various routes, depending on the specific drug, the type of cancer, and the individual patient's needs. Here are some common routes of chemotherapy administration:

Intravenous (IV) Administration: This is one of the most common routes for chemotherapy. The drugs are injected directly into a vein, allowing for rapid distribution throughout the body. IV chemotherapy can be given through a regular IV line or a central venous catheter (such as a PICC line or port).

Oral Administration: Some chemotherapy drugs are available in pill or liquid form and can be taken orally. Patients can take these medications at home, following their healthcare provider's instructions.

Intramuscular (IM) or Subcutaneous (SC) Injection: In some cases, chemotherapy drugs can be administered as injections into the muscle (IM) or under the skin (SC). This route is less common than IV or oral administration.

Intraperitoneal (IP) Administration: For certain types of cancer, chemotherapy may be

delivered directly into the peritoneal cavity, which is the area around the abdominal organs. This route is used in the treatment of ovarian cancer, for example.

Intrathecal or Intraventricular Administration: In cases where cancer has spread to the central nervous system, chemotherapy drugs may be delivered directly into the cerebrospinal fluid through a lumbar puncture (intrathecal) or a device called an Ommaya reservoir (intraventricular).

Topical Administration: For some skin cancers, chemotherapy can be applied topically in the form of creams, gels, or ointments.

Intra-arterial (IA) Administration: Intra-arterial chemotherapy is delivered directly into the artery that supplies blood to the tumor. This route is used in certain cases of liver cancer and retinoblastoma (eye cancer).

Intravesical Administration: This route involves the direct instillation of chemotherapy drugs into the bladder. It is commonly used in the treatment of bladder cancer.

Inhaled Administration: Some chemotherapy drugs are available in an inhaled form and can be used for the treatment of lung cancer.

Adverse effects of Chemotherapy

Depending on the medications used, chemotherapeutic procedures might result in a range of adverse effects. The majority of medications have an effect on the body's rapidly dividing cells, such as blood cells and the cells lining the mouth, stomach, and intestines. These toxicities associated with chemotherapy might appear acutely soon after administration—within hours or days—or they can appear chronically—lasting for weeks or years (Airley, 2021).

A. Immunosuppression and myelosuppression

By influencing the bone marrow and causing a decline in the number of white blood cells, red blood cells, and platelets, nearly all chemotherapeutic regimens have the potential to depress the immune system. Blood transfusions may be necessary in cases of anemia and thrombocytopenia. With synthetic G-CSF (granulocyte-colony-stimulating factor, such as filgrastim or lenograstim), neutropenia (a decline in neutrophil granulocyte count below 0.5 x 10^9/litre) can be lessened. A significant number of bone marrow stem cells, which are the cells that produce white and red blood cells, can be lost in severe myelosuppression, which can happen with certain regimens, necessitating allogenic or autologous bone marrow cell transplants. Diseases can, however, occasionally arise as a result of this interference with bone marrow. (Estcourt, et al., 2021).

B. Infections and Immune System

Although those receiving chemotherapy are urged to maintain excellent cleanliness and stay away from sick people, over 85% of infections are caused by germs that are naturally present in the person's own skin and digestive tract. This may result in localized outbreaks of herpes simplex or shingles as well as systemic illnesses like sepsis. By taking antibiotics before any symptoms of infection appear, such as quinolones or trimethoprim/sulfamethoxazole, the risk of disease can be decreased. When the immune system is severely weakened, chemotherapy treatments may occasionally be delayed.

C. Neutropenic Enterocolitis

Neutropenic enterocolitis, commonly referred to as typhlitis, is a serious gastrointestinal side effect of chemotherapy that can be brought on by immune system suppression. Symptoms of this disorder include nausea, vomiting, diarrhea, stomach discomfort, and distention.

D. Gastrointestinal disorder

Chemotherapeutic medications that aim to stop rapidly proliferating cells can cause gastrointestinal discomfort, including nausea, vomiting, anorexia, pains in the abdomen, and constipation. Malnutrition and dehydration can happen as a result of frequent vomiting, a decrease in food and liquid consumption, or both. As a result, weight increase or reduction may be observed. Antiemetic medications can frequently be used to control these symptoms (Goriacko & Veltri, 2021).

E. Anemia

Combining myelosuppressive chemotherapy with other cancer-related variables such bleeding, blood cell damage, or nutritional deficits might result in anemia. Iron supplements, hormones that increase blood production, and blood transfusions are all forms of treatment for anemia (Busti, et al., 2021).

F. Hair Loss

Drugs that target quickly dividing cells are the cause of hair loss brought on by chemotherapy. Hair can begin growing again a few weeks after the last treatment if hair loss is frequently transient. Permanent thinning or loss is another possibility. Drugs including doxorubicin, paclitaxel, and cyclophosphamide are the most frequent causes of hair loss (Wikramanayake, et al., 2023).

G. Secondary Neoplasms

After a successful course of chemotherapy or radiation, secondary tumors might form. Secondary acute myeloid leukemia is the most prevalent. Within 30 years following therapy, survivors of childhood cancer are more likely to acquire subsequent neoplasms (Trama, et al., 2022).

H. Infertility

Infertility may result from using some chemotherapy medicines. While some medications have a significant danger, others do so with a medium or low risk. Cryopreservation of semen, ovarian tissue, oocytes, or embryos is one technique for preserving fertility.

I. Peripheral Neuropathy

In 30–40% of chemotherapy patients, peripheral neuropathy brought on by the drug might develop. Pain, tingling, numbness, and sensitivity to cold are symptoms of this disorder that first appear in the hands and feet before spreading to the arms and legs. There are several chemotherapeutic medications linked to Chemotherapy-induced peripheral neuropathy (CIPN).

J. Cognitive Impairment

Chemotherapy side effects include "chemo brain," or fatigue and cognitive issues.

K. Syndrome of Tumor Lysis

Some people can develop tumor lysis syndrome, which is characterized by the fast destruction of cancer cells and release of chemicals that leads to abnormalities in the levels of uric acid, potassium, and phosphate in the blood, in big tumors with high white cell counts.

L. Organ Damage

Chemotherapy can harm the inner ear, heart, liver, and kidneys. While other cytotoxic medicines can produce hepatotoxicity and nephrotoxicity, anthracycline medications are more prominently associated with cardiotoxicity. Platinum-based medications have the potential to cause ototoxicity, which can cause symptoms including vertigo.

M. Other Side Effects

Damage to the inner ear, heart, liver, and kidneys can result after chemotherapy. Anthracycline medicines are known to produce cardiotoxicity, whereas other cytotoxic medications can lead

to hepatotoxicity and nephrotoxicity. Drugs based on platinum can cause ototoxicity, which can cause symptoms including vertigo.

Treatment Strategies

In modern medical practice, a variety of methods are used to administer chemotherapy drugs. Chemotherapy can be used to treat illnesses, prolong life, or relieve symptoms (Airley, 2021).

- The first stage of cancer treatment that uses chemotherapeutic medicines is induction chemotherapy. This strategy seeks a treatment.
- Chemotherapy that uses multiple treatment modalities, such as surgery, radiation therapy, or hyperthermia therapy, is known as combined modality chemotherapy.
- After establishing remission, consolidation chemotherapy is used to extend the amount of time a patient is free from the illness and their overall survival. The medication is the same one that brought on the remission.
- Combination chemotherapy entails administering a number of medications at once to a patient; intensification chemotherapy is similar to consolidation chemotherapy, with the exception that a different agent is administered than in induction chemotherapy. The main benefit of these medications is the decrease in the development of resistance to any one treatment, however their mechanisms and adverse effects differ. Additionally, it is frequently possible to use lesser dosages, reducing toxicity. To reduce the main tumor, neoadjuvant chemotherapy is given before local therapies like surgery. Additionally, tumors with a high risk of micrometastatic illness are treated with it.
- Adjuvant chemotherapy is used after local therapies like surgery or radiation. It is appropriate when there is little evidence of malignancy but a recurrence risk. It also works well against cancer cells that have spread to different body areas. Adjuvant

chemotherapy can treat these micrometastases, lowering the risk of recurrence because of these dispersed cells (Wagner, et al., 2021).

- To prolong remission, maintenance chemotherapy comprises repeated low-dose treatments.
- Palliative or salvage chemotherapy's main goals are to prolong life and reduce tumor burden rather than to treat the disease. These regimens often have a lower toxicity profile (Chabner and Longo, 2021).

Every chemotherapy plan requires the patient to be able to receive treatment. A person's performance status is commonly used to determine if chemotherapy is appropriate for them or whether a dosage decrease is required. Multiple dosages are necessary to keep the tumor from growing larger since only a portion of the cells in the tumor are destroyed with each treatment (fractional kill). The frequency and length of modern chemotherapy treatments are adjusted in cycles depending on toxicity considerations (Chabner & Longo, 2021).

Dosage

It might be difficult to determine the right dose while administering chemotherapy medications. A tumor may not be successfully treated if the dose is too low. On the other hand, overly large dosages may cause the patient to experience extreme toxicity. Instead of utilizing a physical measurement, the traditional approach for estimating chemotherapy dose uses the recipient's body surface area (BSA), which is calculated using their weight and height using a mathematical formula or nomogram (Felici et al., 2022).

The BSA formula was developed in 1916 as a means of converting dosages of medications used on animals to their human counterparts. Its use in establishing uniform dosages, however, is under question. It simply takes into account weight and height, ignoring other elements that affect medication absorption and clearance such as age, sex, metabolism, disease status, organ

function, drug interactions, heredity, and obesity. As a result, people given doses in accordance with BSA have high variability in systemic chemotherapeutic drug concentration, frequently surpassing tenfold (Looney, et al., 2022).

Due to the inadequate dosage caused by this pharmacokinetic heterogeneity, people may either get an overdose or an underdose. For instance, a research found that 85% of patients with metastatic colorectal cancer receiving 5-fluorouracil (5-FU) were not receiving the recommended doses based on BSA, with 68% receiving underdoses and 17% receiving overdoses.

The use of BSA to determine chemotherapy dosages for obese patients has generated debate. Clinicians typically lower BSA-based dosages out of concern about overdose from increased BSA, which might result in less than ideal therapy effects. Individualized dosage has been shown to be beneficial for achieving optimal medication exposure, improving therapeutic response, and minimizing adverse effects in clinical investigations. In the 5-FU research, dose adjustments based on target exposure resulted in an 84% improvement in treatment response rate and a six-month extension of overall survival (Looney, et al., 2022).

Individuals who had altered their doses reported less toxicities, allowing for longer treatment times. The FOLFOX regimen for colorectal cancer was used in trials with similar encouraging results. Through exposure-based dose modifications, better therapeutic responses, fewer toxicities, and longer progression-free survival were attained (Capitain, et al., 2022).

Monitoring medication levels in plasma over time and modifying the dose using an algorithm for optimum exposure is one method for individualized dosing. The doses of carboplatin, busulfan, methotrexate, 5-FU, paclitaxel, and docetaxel are adjusted based on

blood tests. The blood albumin level before to treatment also shows promise as a standalone predictive predictor of survival in a variety of cancer types (Bartelink, et al., 2021).

Delivery

Although some medications (such as melphalan, busulfan, and capecitabine) can be taken orally, chemotherapy is often delivered intravenously. Oral medicines present additional difficulties for patients and medical teams in terms of sustaining and promoting treatment adherence, according to a recent systematic study from 2016 (Wood & Brighton, 2021). Vascular access devices, which are different intravenous medication administration techniques, are available. These include implanted ports, peripheral venous catheters, midline catheters, peripherally inserted central catheters (PICC), and winged infusion devices. Depending on the length of the chemotherapy treatment, the manner of distribution, and the particular chemotherapeutic chemical, these devices are used in various ways. Depending on the patient, cancer type, stage, kind of chemotherapy, and dosage, intravenous chemotherapy may be given as an inpatient or outpatient procedure. It is frequently necessary to surgically install different devices into the vasculature to maintain access for continuous, repeated, or extended intravenous chemotherapy. The PICC line, Port-a-Cath, and Hickman line are frequently used systems. These devices eliminate the need for repetitive peripheral cannula insertion, lower infection risks, and decreased phlebitis or extravasation concerns (O'Grady, et al., 2021).

Certain malignancies have been treated using specific methods, such as isolated limb perfusion (often used in melanoma) and isolated infusion of chemotherapy into the liver or lung. These procedures aim to deliver high chemotherapy dosages directly to tumor locations while minimizing systemic side effects. They are systemic by nature and do not treat disseminated metastases or micrometastases, although they can handle isolated or small

metastases well. Topical chemotherapies like 5-fluorouracil are employed in specific non-melanoma skin cancer instances. Intrathecal chemotherapy may be used to treat meningeal illness or cancer of the central nervous system (Chitwood, et al., 2021).

Mechanism of Action

Chemotherapy can be administered in neoadjuvant, adjuvant, combined, and metastatic settings. Neoadjuvant therapy is a treatment given before the primary treatment. Adjuvant therapy is the treatment given in addition to the initial therapy, which can suppress or eliminate the growth of occult cancer cells. Adjuvant therapy is now the standard for breast, lung, colorectal, and ovarian cancers. Combined modalities like chemotherapy and radiation are used to shrink the tumor before the surgery or curative intent in cancers like head and neck, lung, anal.

The combination of chemotherapeutic agents is delivered cyclically based on the three basic principles.

Fraction kill hypothesis: A uniform drug dose kills a constant fraction of tumor cells rather than a constant number regardless of tumor burden.

Neoplastic tumor cells have a linear response between the dose administered and the efficacy.

Goldie-Coldman hypothesis: Cancer cells acquire spontaneous mutations that cause drug resistance.

Henceforth, multitargeted therapy or combination therapy is more superior to single-agent therapy in most cancer treatments. Additionally, combination chemotherapy agents with different mechanisms of action and also nonoverlapping toxicities can be chosen to decrease

the resistance and toxicities. Curative regimen like bleomycin/vinblastine/cisplatin for testicular cancers is an example of combination chemotherapy. Combination chemotherapy is a common choice to produce adequate responses as well. They appear to prevent the development of resistant clones by promoting cytotoxicity in resting and dividing cells.

Chemotherapeutic agents can classify according to the mechanism of action:

Alkylating Agents

Examples of alkylating agents are as follows:

Nitrogen mustard- bendamustine, cyclophosphamide, ifosfamide Nitrosoureas – carmustine, lomustine

Platinum analogs – carboplatin, cisplatin, oxaliplatin Triazenes- Dacarbazine, procarbazine, temozolamide Alkyl sulfonate- Busulfan

Ethyleneimine- Thiotepa

Mechanism of action (MOA): These drugs yield an unstable alkyl group, R-CH2+, reacting with nucleophilic centers on proteins and nucleic acids. Inhibit DNA replication and transcription.

Toxicity: Dose-limiting toxicity: myelosuppression (neutropenia nadir: 6 to 10 days with recovery in 14 to 21 days). Mucositis, nausea and vomiting, neurotoxicity, alopeciaLong-term toxicities: pulmonary fibrosis, infertility, secondary malignancies

Antimetabolites

Mechanism of Action: Inhibit the replication of DNA Examples of antimetabolites are as follows

A. Cytidine analogs – azacitidine, decitabine, cytarabine, gemcitabine

MOA: Directly incorporate into DNA and inhibit DNA methyltransferase (azacitidine, decitabine) or DNA polymerase (cytarabine, gemcitabine)

Indications: Azacitidine and decitabine for MDS, AML, cytarabine for MDS, AML, and gemcitabine for breast, NSCLC, ovarian, pancreatic, bladder, sarcoma, HL, NHL

Toxicity: Myelosuppression in general. Cytarabine high dose causes neurotoxicity, conjunctivitis. Gemcitabine causes liver enzyme elevations, interstitial pneumonitis.

B. Folate antagonists – methotrexate, pemetrexed

MOA: reduces folate, which is essential in the synthesis of purine nucleotides and thymidylate Indications: Methotrexate for ALL, NHL, CNS, sarcoma, and pemetrexed for malignant pleural mesothelioma, NSCLC (non-squamous).

Toxicity: Myelosuppression, mucositis, hepatotoxicity, nephrotoxicity, cutaneous reactions Toxicity prevention: Hydration and alkalization of the urine, leucovorin rescue.

C. Purine analogs – cladribine, clofarabine, nelarabine

MOA: structural analogs of guanine and act as false metabolites

Indications: Cladribine for hairy cell leukemia, AML, CLL, NHL. Clofarabine for ALL, AML. fludarabine for CLL, AML, NHL, BMT conditioning agent. Nelarabine for T-ALL, lymphoma. Pentostatin for hairy cell leukemia, CTCL, CLL.

Toxicities: Myelosuppression, immunosuppression (suppress CD4+ cells) put patients at risk for opportunistic infections

D. Pyrimidine analogs – fluorouracil (5-FU), capecitabine (prodrug of 5-FU).

MOA: Active metabolite (F-dUMP) forms a stable covalent complex with thymidine synthetase in the presence of reduced folate, therefore, interfering with DNA synthesis and repair.

Indications: 5-FU for colorectal cancer, anal cancer, pancreatic cancer, gastric cancer. Capecitabine for colorectal cancer, breast cancer.

Toxicity: Dose-limiting hand-foot, mucositis, diarrhea. Dose-limiting myelosuppression.

Toxic levels of 5FU can occur in patients with Dihydropyrimidine Dehydrogenase (DPD) deficiency or drug overdose. This can lead to cardiac dysfunction, colitis, neutropenia, and encephalopathy. Uridine triacetate is approved for the toxicity of these patients.

Antimicrotubular Agents

Examples of antimicrotubular agents are as follows:

E. Topoisomerase II inhibitors: Anthracyclines [doxorubicin, daunorubicin, idarubicin, mitoxantrone inhibit RNA and DNA synthesis. In addition, it inhibits topoisomerase II, causing inhibition of DNA repair resulting in blockade of DNA and RNA synthesis.

Indications: Daunorubicin for ALL, AML, APL. Doxorubicin is used for ALL, AML, Wilms tumor, neuroblastoma, sarcomas, breast, ovarian, bladder, thyroid, HL, and NHL. Liposomal doxorubicin has a longer half-life and is less cardiotoxic.

Toxicity: Myelosuppression, cardiotoxicity (cumulative), mucositis. The lifetime cumulative dose of adriamycin is 550 mg/m^2. Secondary malignancies like treatment-related MDS/AML(t-MDS/t-AML) is a rare complication with poor prognosis have been reported often from alkylating agents and topoisomerase II inhibitors (-16. These patients usually present 5 to 7 years after the drug exposure.

Epipodophyllotoxins (Etoposide and Teniposide). Indications: Testicular, SCLC, ALL, AML, Breast, CNS, Sarcoma, HL, NHL, Merkel cell, NSCLC, BMT conditioning agent. Dose- limiting myelosuppression – primary leukopenia

A. Topoisomerase I inhibitors: Irinotecan, Topotecan

MOA: prevents relegation by blocking the release of Top I from the cleavable complex & forming a ternary complex

Indications: Irinotecan for colorectal, cervical, esophageal, sarcoma, pancreatic, lung. topotecan for cervical, ovarian, SCLC

Toxicity: Irinotecan causes dose-limiting diarrhea. Topotecan causes dose-limiting neutropenia, thrombocytopenia.

B. Taxanes – paclitaxel, docetaxel, cabazitaxel

MOA: Disruption in the equilibrium of polymerization and depolymerization of microtubules causing abnormal cellular function and disruption of replication leading to apoptosis. Inhibit assembly of microtubules—M phase-specific.

Indications: Docetaxel for breast, lung, prostate, ovarian, cervical, sarcoma. paclitaxel for breast, lung, and ovarian. Abraxane is protein bound paclitaxel. Cabazitaxel for prostate cancer. Toxicity

Hypersensitivity reactions, myelosuppression, peripheral neuropathy

C. Vinca alkaloids: vinblastine, vincristine, vinorelbine

MOA: Bind to tubulin and inhibit microtubule formation arrests cell in metaphase. M-phase specific.

Indication: Vincristine for ALL, HL, NHL, Neuroblastoma, SCLC

Toxicity: Peripheral neuropathy (both motor and sensory function affected), myelosuppression Antibiotics

Examples of antibiotics used as chemotherapy agents are as follows: actinomycin D. bleomycin, daunomycin:

MOA: inhibit RNA and DNA synthesis

Bleomycin binds to DNA, producing single and double-strand DNA breaks. Indications: Testicular, HL, Head, and neck cancers

Toxicity: Cumulative pulmonary toxicity, hyperpigmentation Miscellaneous

D. Hydroxyurea: MOA: inhibits ribonucleoside diphosphate reductase; S-phase specific

Indications: AML, CML, sickle cell disease

Toxicity: Myelosuppression, dermatologic reactions

E. Tretinoin:
MOA: vitamin A derivative; targets RAR-α promoting cell differentiation Indication: APL

Toxicity: APL differentiation syndrome – fevers, cardiopulmonary symptoms

F. Arsenic trioxide

MOA: Induces cell differentiation Indication: APL

Toxicity: QT prolongation – baseline and serial EKG monitoring, replace K, Mg. APL differentiation syndrome

G. Proteasome inhibitors:

Indication: bortezomib used in multiple myeloma.

Toxicity: Peripheral neuropathy

Chemotherapy agents can be given per oral (PO), intravenous (IV), subcutaneous (SC), intramuscular (IM), intrathecal (IT). Most of the chemotherapy agents are IV because of the 100% absorption rate. Some compounds like paclitaxel are poorly soluble, so they need to be mixed with solvents like cremophor for better absorption. Physicians should be aware of factors that influence absorption, like surgery and gastric motility, especially in cancer patients using opioids.

Most of the chemotherapy agents are metabolized and excreted by either liver or kidney. Some of the chemotherapy drugs are toxic to the liver or kidneys. In such cases, toxic levels can build up in these leading to organ dysfunction. Therefore, it is essential to consider dose adjustments in these organ failure patients. For example, capecitabine dose needs to be

adjusted for patients with renal disease.

Chemotherapy agents are generally administered using body surface area (BSA) dosing. Drug- drug interactions are expected. The cytochrome P450 (CYP) enzyme is involved in the metabolism of various chemotherapeutic drugs. Drugs like bortezomib, docetaxel, etoposide, imatinib, sunitinib, sorafenib, vinca alkaloids are metabolized by CYP3A4/5. It is imperative to be aware of some of the common drugs with strong inducers like phenobarbital and phenytoin and inhibitors of CYP enzymes like grapefruit juice, ketoconazole since these drugs can alter the drug levels of the chemotherapy agents and can decrease efficacy or increase toxicity.

Chemotherapeutic agents are commonly associated with side effects. Usually, the side effects of chemotherapy are a reflection of their mechanism of action. Often cytotoxic chemotherapy targets DNA and proteins expression in both cancer cells and normal host cells. Hence, the therapeutic index leading to toxicity is very narrow. In addition, most chemotherapy drugs show activity in rapidly multiplying cells, so they quickly affect multiplying cells, e.g., bone marrow, GI tract, hair follicles. Common toxicities associated with such agents include myelosuppression, mucositis, nausea, vomiting, diarrhea, alopecia, fatigue, sterility, infertility, infusion reactions. Furthermore, there is an increased risk of infections due to immunosuppression.

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Furthermore, there is an increased risk of infections due to immunosuppression. The side effects of cancer chemotherapy can be acute or prolonged, may need monitoring. In addition, it would require multi-disciplinary monitoring as specific patient populations may be at higher risk for complications.

Management of common side effects of chemotherapy:

Infusion reactions, from hypersensitivity reactions: Management options include using pre-medications like diphenhydramine, methylprednisolone, epinephrine

Chemotherapy-induced nausea and vomiting: Treatment options include prochlorperazine, haloperidol, metoclopramide, lorazepam, dexamethasone, ondansetron, granisetron, dolasetron, palonosetron, dronabinol, aprepitant, fosaprepitant. Palonosetron has a longer half-life, better efficacy, and higher binding affinity than granisetron.

Mucositis: Using magic mouthwash, avoidance commercial mouthwashes, and lemon glycerin swabs

Fatigue: Interventions like exercise, optimizing sleep quality, and behavioral therapies such as relaxation can help fatigue.

Chemotherapy-induced diarrhea: Using agents like loperamide, diphenoxylate, atropine, octreotide.

Chemotherapy-induced constipation: Using agents like docusate, senna, milk of magnesia, bisacodyl, lactulose, polyethylene glycol, enemas

Neurotoxicity: Using agents like vitamin B6, glutamine, gabapentin, pregabalin, carbamazepine, or tricyclic antidepressants (amitriptyline).

Toxic levels of 5FU can occur in patients with Dihydropyrimidine Dehydrogenase (DPD) deficiency or drug overdose. This can lead to cardiac dysfunction, colitis, neutropenia, and encephalopathy. Uridine triacetate is approved for the toxicity of these patients.

Chemotherapy resistance: there are before drug exposure) or secondary resistance

(resistance after exposure to a drug).

Mechanisms: many chemotherapy drug resistance mechanisms include: efflux, inactivation of drug, alteration of drug targets, and cell death inhibition.

A particular efflux pathway involves the tumor producing a substance known as p-glycoprotein, which essentially removes the drug from the tumor cell.

Tumor cell heterogeneity is another mechanism that follows the Goldie-Coldman hypothesis in which every tumor cell has a variable degree that is directly proportional to the tumor size.

Routes of administration of chemotherapy: include oral, intravenous, intrathecal (into the cerebrospinal fluid via spinal cord), injections (subcutaneous, intraperitoneal), or into the bladder (intravesicular instilling)

Complications of Extravasation of Vesicants and Management

A vesicant refers to a drug's ability to cause tissue necrosis if infiltrated from the vein into the subcutaneous tissue (extravasation)

Complications include pain, burning, stinging, erythema, sudden onset edema, and tissue necrosis. Tissue necrosis occurs as a spectrum, from partial skin thickness (appearing as blisters) to full-thickness (skin appearing white)

Management: after confirming extravasation, vesicant administration should stop, residual medication or blood should be aspirated with a separate 10mL syringe, which is then disconnected and replaced by a new 10mL normal saline syringe. The IV cannula is then removed, the irritation site should be covered lightly (to avoid excess pressure) with a sterile dressing, and either cold or hot packs should be applied based on the drug. The affected limb should be elevated for 48 hours (if applicable), and surgical consult and photographs should be taken.

Cold pack: dactinomycin, daunorubicin, doxorubicin, epirubicin, idarubicin, mechlorethamine, mitomycin-C, streptozocin Hot pack: vincristine, vinblastine, vinorelbine

Enhancing Healthcare Team Outcomes

Since the administration of most chemotherapy agents occurs at infusion centers, nursing and allied health professionals play a significant role in taking care of patients on such drugs. They are usually the first point of contact for the patients. All health professionals need to understand the type of drug in use and its associated side effects for the patient. Close monitoring and early recognition of side effects can help prevent significant morbidity and mortality. For example, patients with a history of anemia, thrombocytopenia should avoid the use of NSAIDs. Intra- muscular injections and rectal suppositories should be avoided in such patients.

Thorough buccal cavity assessments and avoidance of commercial mouthwashes in patients with mucositis can help decrease patient discomfort. Many chemotherapeutic agents have specific known side effects that are minimizable prophylactically. For instance, following folate inhibitors such as methotrexate with folate analogs such as leucovorin help reduce bone marrow suppression severity. This concept applies to general chemotherapy side effects. For example, oral mucositis is a common chemotherapy side effect, which can be minimized by administering Palifermin, a keratinocyte growth factor that helps reduce mucosal endothelial cell damage.

Patients undergoing chemotherapy usually need strong emotional support, and they are going through anxiety, depression, and anticipatory grief from the expected side effects of the drugs. Multidisciplinary and interprofessional interventions at various stages of their treatment regimen can promote mental health.

Patients undergoing chemotherapy require a team-based approach for monitoring any adverse events. The role of nursing and allied health professionals includes providing supportive care, preventing infections, monitoring for adequate nutrition and hydration, and monitoring patient safety: handwashing and infection precautions like isolation protocols

require strict adherence. Since patients require frequent laboratory monitoring, it is essential to understand and equip themselves with the infusion protocols parameters and alert the treating clinicians if they notice abnormal parameters. Early nursing interventions can revert worse outcomes in patients.

It is crucial to recognize the common causes and the magnitude of the impact of errors involving cancer chemotherapy. Improving communication, standardizing protocols, utilizing read back and verifying dosages, working with pharmacists are all interventions that can help reduce medical errors in a multidisciplinary setup.

Uncontrolled cell growth and malignancy traits like invasion and metastasis are all part of cancer. This is caused by a confluence of genetic predisposition and environmental variables that result in genetic alterations in the oncogenes and tumor suppressor genes that govern cell development and give cancer cells their aberrant properties including unchecked proliferation. The majority of chemotherapy medications, especially those that impact rapidly dividing cells, target cell division (mitosis) in general. Because they harm cells, these medications are referred to as cytotoxic. They obstruct mitosis in a number of ways, including as DNA damage and inhibition of the cellular machinery required for division. One theory explaining their efficiency is because they cause apoptosis, or planned cell death. Cancers with rapid growth rates, such as acute myelogenous leukemia and aggressive lymphomas, are more sensitive to chemotherapy because they have a higher percentage of actively dividing cells. Malignancies that develop more slowly, such indolent lymphomas, react less well. Based on their subclonal makeups, tumors with various populations may respond to chemotherapy treatments differently.

The anticancer effects of chemotherapy are also influenced by the immune system. Certain medications can induce cancer cells to die in a way that the immune system can recognize, activating immune cells with anticancer capabilities. This kind of tumor cell death can make

cancers that have not responded to immune checkpoint treatment more sensitive.

Occupational Exposure and Safe Handling

Antineoplastic medications were deemed dangerous in the 1970s. The idea of hazardous medications was first suggested by the American Society of Health-System Pharmacists (ASHP) in 1983. The U.S. Occupational Safety and Health Administration (OSHA) then produced federal rules in 1986, 1996, 1999, and 2006.

The National Institute for Occupational Safety and Health (NIOSH) has continuously evaluated the amount of these medications that are exposed at work. Workplace exposure to antineoplastic medications is associated with a number of negative health outcomes, including infertility and possible carcinogenicity. The hazards of exposure to reproductive and genotoxic effects on healthcare professionals are highlighted by reported instances.

Routes of Exposure

Drugs used to treat cancer can be given subcutaneously, intrathecally, intramuscularly, or intravenously. Workers who handle, administer, prepare, or dispose of these medications run the risk of exposure. Potential modes of exposure include dermal contact, ingestion through hand-to-mouth contact, inhalation of drug fumes, and injection by needle sticks.

Hazards

When exposed to harmful drugs, healthcare staff face serious health risks. The reproductive system has shown to be negatively impacted by several research, including infertility, fetal loss, and congenital abnormalities. Children of healthcare workers who take these medications may experience learning disabilities, irregular periods, and reproductive issues.

These medications have been linked in research to genotoxic and cancer-causing properties, as well as having carcinogenic effects. Nurses and other healthcare professionals have a higher

risk of developing certain malignancies when exposed to antineoplastic medications.

Safe Handling in Health Care Setting

As of 2018, there were no specified occupational exposure limits for anti-cancer medications. When preparing and administering medications, NIOSH advises taking safety precautions such as utilizing vented cabinets, training workers, donning the proper safety equipment, and adhering to disposal guidelines.

Employee training

Training on drug risks, detection techniques, and preventive measures must be provided to healthcare professionals who are at risk of exposure. All phases of drug management, from preparation to administration to disposal, should be included in training.

Housekeeping and Waste Disposal

To avoid airborne drug concentrations, it is necessary to ventilate work locations where antineoplastic medications are handled. When cleaning, disposable gowns and double gloves should be worn. Items contaminated with these medications need to be thrown away in special trash cans.

Spill Control

It is crucial to have a defined procedure for managing medication spillage. Procedures and safety equipment for various spill sizes should be specified. Larger spills should be handled by trained people to ensure correct disposal of cleanup supplies in accordance with laws.

2.2 Theoretical Framework

The theoretical framework will describe the theory and explain why the research problem under this study exist. It will relate the topic under study to the theory and explain why postulated solution may work.

The health belief model asserts that when a person believes he or she is susceptible to a health problem with severe consequences, the person will more likely conclude that the benefits outweigh the barriers associated with changing one's behavior to prevent the problem. The health belief model is a great tool for nursing research offering a theoretical framework for helping patients prevent chronic disease or, if disease is present, improve quality of life.

The Health Belief Model (HBM) was developed in the early 1950s by social scientists at the U.S. Public Health Service in order to understand the failure of people to adopt disease prevention strategies or screening tests for the early detection of disease. Later uses of HBM were for patients' responses to symptoms and compliance with medical treatments. The HBM suggests that a person's belief in a personal threat of an illness or disease together with a person's belief in the effectiveness of the recommended health behavior or action will predict the likelihood the person will adopt the behavior.

The HBM derives from psychological and behavioral theory with the foundation that the two components of health-related behavior are 1) the desire to avoid illness, or conversely get well if already ill; and, 2) the belief that a specific health action will prevent, or cure, illness. Ultimately, an individual's course of action often depends on the person's perceptions of the benefits and barriers related to health behavior.

There are six constructs of the HBM. The first four constructs were developed as the original tenets of the HBM. The last two were added as research about the HBM evolved.

Perceived susceptibility - This refers to a person's subjective perception of the risk of acquiring an illness or disease. There is wide variation in a person's feelings of personal vulnerability to an illness or disease.

Perceived severity - This refers to a person's feelings on the seriousness of contracting an illness or disease (or leaving the illness or disease untreated). There is wide variation in a person's feelings of severity, and often a person considers the medical consequences (e.g., death, disability) and social consequences (e.g., family life, social relationships) when evaluating the severity.

Perceived benefits - This refers to a person's perception of the effectiveness of various actions available to reduce the threat of illness or disease (or to cure illness or disease). The course of action a person takes in preventing (or curing) illness or disease relies on consideration and evaluation of both perceived susceptibility and perceived benefit, such that the person would accept the recommended health action if it was perceived as beneficial.

Perceived barriers - This refers to a person's feelings on the obstacles to performing a recommended health action. There is wide variation in a person's feelings of barriers, or impediments, which lead to a cost/benefit analysis. The person weighs the effectiveness of the actions against the perceptions that it may be expensive, dangerous (e.g., side effects), unpleasant (e.g., painful), time-consuming, or inconvenient.

Cue to action - This is the stimulus needed to trigger the decision-making process to accept a recommended health action. These cues can be internal (e.g., chest pains, wheezing, etc.) or external (e.g., advice from others, illness of family member, newspaper article, etc.).

Self-efficacy - This refers to the level of a person's confidence in his or her ability to successfully perform a behavior. This construct was added to the model most recently in mid- 1980. Self-efficacy is a construct in many behavioral theories as it directly relates to whether a person performs the desired behavior.

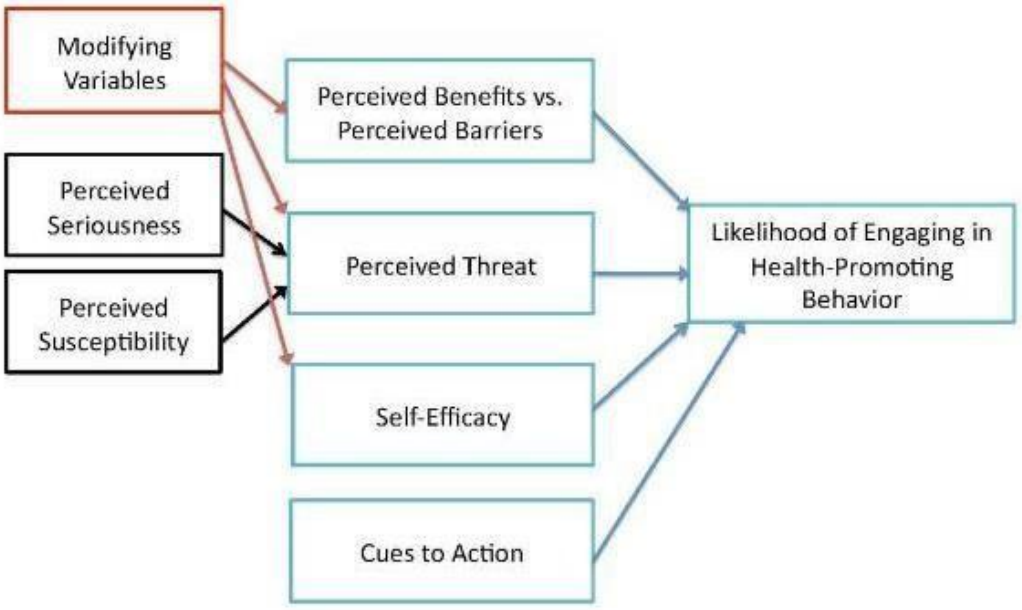

Figure 2.1: Health Belief Model

Application of Health Belief Model to this Study

The application of the Health Belief Model to this study is presented below:

Perceived Susceptibility: This construct refers to an individual's belief in their vulnerability to a particular health condition or risk. In the context of your topic, nurses' understanding of the potential risks and harmful effects of handling chemotherapeutic drugs would fall under perceived susceptibility.

Perceived Severity: This construct involves an individual's perception of the seriousness of a health condition or risk. Nurses' awareness of the potential consequences of inadequate safe handling practices and the severity of potential health hazards associated with chemotherapeutic drugs align with perceived severity.

Perceived Benefits: Nurses' perception of the advantages of following safe handling practices is important. If nurses understand that proper handling reduces their own risk of exposure and improves patient safety, it can positively impact their behavior.

Perceived Barriers: This construct involves identifying potential obstacles or challenges that could prevent individuals from engaging in a health behavior. In the context of your topic, identifying barriers that nurses face in adopting safe handling practices, such as lack of proper training, time constraints, or inadequate resources, can be crucial.

Cues to Action: These are external stimuli that motivate individuals to take action regarding a health behavior. In your study, cues to action could include educational programs, guidelines from healthcare organizations, or awareness campaigns aimed at promoting safe handling practices among nurses.

Self-Efficacy: This refers to an individual's confidence in their ability to perform a behavior. Exploring nurses' confidence in their ability to properly handle chemotherapeutic drugs and their level of training and support can contribute to understanding self-efficacy.

2.3 Empirical Review

Knowledge of chemotherapeutic drugs, handling and administering

Kapucu, et al., (2021) conducted a study published in the Asia-Pacific Journal of Oncology Nursing, aiming to assess the knowledge levels of oncology nurses regarding the administration of chemotherapy through peripheral and central venous catheters. The study was conducted through a descriptive methodology, collecting data from April 15, 2020, to July 15, 2020, from 165 nurses. Data were collected using a questionnaire related to sociodemographic qualifications and knowledge levels of nurses, distributed via email to members of the Turkish Oncology Nursing Society. The study revealed that the nurses' mean age was 33.60 ± 7.34 years, and their mean duration of oncology nursing experience was 2.65 ± 0.91 years. The findings highlighted correct knowledge among nurses about various aspects of safe catheter administration, including selecting catheter types, placement area, pre-administration checks, management of extravasation, and proper use of port catheters.

The study concluded that the nurses demonstrated a knowledge level related to catheter care of 50% or higher, suggesting the need to enhance nurses' knowledge through evidence-based information to ensure safe chemotherapy practices.

Saker, et al., (2022) conducted a study that addressed the essential subject of nurses' knowledge concerning the safe administration of chemotherapy. The study was conducted at Tishreen University Hospital in Lattakia City, Syria, and involved 50 nurses from the chemotherapy department. The researchers utilized a constructed tool comprising three parts: demographic data of nurses, general information regarding chemotherapy drugs, and nurses' knowledge about safe chemotherapy administration. The findings unveiled significant gaps in knowledge among the nurses, including a lack of awareness that chemotherapy can lead to delayed wound healing and the destruction of both cancer and healthy cells. A substantial proportion of nurses demonstrated poor levels of general knowledge about chemotherapy drugs, storage practices, and safe administration. This study underscores the need for improved education and training among nurses to ensure safe and effective chemotherapy administration in oncology settings.

In 2022, Khan, et al., conducted a study aimed at assessing the levels of knowledge, skill, and attitude among oncology nurses in chemotherapy administration after an educational session. The research was conducted in two oncology units of a tertiary hospital in Rawalpindi, Pakistan. The study utilized a pre-post test intervention design involving 35 nurses and employed Verity's tools for assessment. The results revealed that the mean knowledge scores significantly increased after the educational training, as demonstrated by Cochran's Q test (p- value < 0.001). However, the difference in nurses' attitudes was not statistically significant according to repeated measures of ANOVA. The study concluded that among the three components (knowledge, skill, and attitude), knowledge appeared to be

the weakest while attitude emerged as the strongest aspect of oncology nurses' competencies in chemotherapy administration.

Pierobon, et al., (2022) conducted a study aimed at identifying nurses‘ knowledge regarding the administration and regulation of high alert medications in an oncology hospital in Brazil. The cross-sectional research, conducted from September to October 2021, involved 26 nurses from five hospitalization units who answered a questionnaire assessing their knowledge of high alert medications. Descriptive statistics were used for data analysis, with scores ≥70% indicating satisfactory knowledge. The study found that most nurses had not participated in training for administering high alert medications. The overall average knowledge was 79.9%, with satisfactory levels observed for drug administration (80.4%) and regulation (78.6%). Specific areas of strength and weaknesses were identified, indicating a need for continued improvement to ensure safe care in the oncological context.

Yu, et al., (2023) conducted a study aimed at assessing nurses' knowledge of chemotherapy through a questionnaire consisting of 20 true-or-false questions. The questionnaire was developed based on literature and expert input and was validated through subject experts. A pilot study was also conducted using a contrasted-groups approach. The study involved 203 nurses and revealed that the average overall correct answer rate was 60.9%. A significant percentage of respondents had scores below 70, indicating insufficient knowledge. Additionally, a majority of nurses expressed the desire for more training in chemotherapy. The sources of their chemotherapy knowledge were mainly consultation with colleagues and in-hospital continuing education. The study's evidence-based results underscored the need for increased education about chemotherapy in nursing schools and through in-hospital continuing education to address nurses' insufficient knowledge in this area.

In this cross-sectional survey conducted in India, Sarita, et al. 2021 explored the knowledge and attitude of nursing personnel towards the safe handling of chemotherapeutic drugs (CDs). Given the potential adverse effects of CDs due to their non-selective mechanism of action on both cancerous and non-cancerous cells, ensuring safe administration is crucial. Through a non- experimental descriptive approach, 60 nursing personnel were sampled conveniently, and a knowledge questionnaire and Likert scale were employed for data collection. The results indicated that a majority of the nursing personnel exhibited poor knowledge (55%) and a mild positive attitude (46.7%) towards safe CD handling. The study identified statistically significant associations between knowledge and gender, as well as education level of the nursing personnel. Additionally, a highly significant association was found between attitude and oncology work experience. These findings underscore the need for enhancing knowledge and fostering a more positive attitude towards safe CD handling among nursing personnel in tertiary care hospitals.

Practice of safe handling and administration of chemotherapeutic drugs

In a study conducted by Nwagbo, et al. (2021), the authors addressed the critical issue of nurses' knowledge and adherence to occupational safety measures when handling chemotherapeutic agents in oncology units. Given the well-documented mutagenic and teratogenic effects of these agents, the study aimed to assess the knowledge of chemotherapy and occupational safety measures among nurses at the University College Hospital, Ibadan. Through a cross-sectional descriptive study involving 100 purposively selected nurses from the oncology unit, data were collected using a validated 54-item questionnaire. The findings revealed that the majority of the respondents demonstrated a high level of knowledge about chemotherapy (mean 13.9 ± 2.2), with 70% understanding the use of gloves and gowns as safety guidelines. However, aspects like handling patients' clothes and proper washing techniques showed room for improvement, indicating the need for consistent education and

reinforcement of safety protocols. The study concluded that continuous updates in nurses' knowledge, coupled with policy enforcement, are recommended to ensure optimal safety practices in oncology units.

In 2022, Zakaria, et al., conducted a study aimed at evaluating the knowledge and practices of oncology nurses related to the safe administration of intravenous chemotherapy. The authors highlighted the crucial role of nurses in cancer care, encompassing safe administration of therapy, management of side effects, patient education about adverse effects, and emotional support. Utilizing a descriptive research design, the study was conducted at the Damanhur Oncology Center, involving a convenience sample of 35 nurses. The results indicated that 60% of the studied nurses possessed good knowledge about safe administration of intravenous chemotherapy. However, the nurses exhibited unsatisfactory practices both before and after administering chemotherapy, particularly in aspects such as patient and chemotherapy verification, administration of chemotherapy, and actions during administration. The study revealed significant associations between nurses' knowledge and factors like sex, working shift, and attendance of patient safety training workshops. Additionally, practice scores were significantly linked to factors such as age, working department, and attendance of training workshops. The study concluded that although nurses demonstrated good knowledge, their practices were unsatisfactory, suggesting a need for in-service education programs to improve patient safety practices.

Factors that support the practice of safe handling and administration of chemotherapeutic drugs

In 2023, Abu-Alhaija et al. conducted an integrative review titled "The Factors That Influence Chemotherapy Exposure Among Nurses: An Integrative Review". This review aimed to identify recent literature that elucidates the risk factors associated with

occupational exposure to chemotherapy among nurses. Employing the Preferred Reporting Items for Systematic Reviews and Meta-Analyses methodology, the researchers searched databases such as Scopus, PubMed, and CINAHL using specific keywords. The inclusion criteria encompassed articles published between January 2010 and February 2022, written in English, conducted in the United States, and involving nurses as participants. Review articles, books, theses, and dissertations were excluded. The Johns Hopkins Nursing Evidence-Based Practice Model was used to evaluate the level of evidence from the included studies. Among the fourteen studies incorporated in the review, the majority were categorized as Evidence Level III. The review identified key risk factors for occupational exposure to chemotherapy, including nurses' familiarity with chemotherapy handling guidelines, adherence to personal protective equipment usage, health beliefs about chemotherapy exposure, and workplace-related factors like workload and managerial support. The conclusion of the review underscores the importance of addressing these risk factors to safeguard nurses from chemotherapy exposure, while also highlighting the need for further research into nurses' health beliefs and adherence cues in the work environment.

Sharour, et al., (2021) conducted a study aimed to exploring the predictors of chemotherapy safe-handling precautions and knowledge among a sample of Jordanian oncology nurses. A cross-sectional design was employed, involving 153 oncology nurses from two hospitals who completed the Chemotherapy Handling Questionnaire. The results indicated that various factors, including age, workload, nurses' knowledge about safe-handling precautions, perceived risk, barriers, self-efficacy, organizational influence, workplace safety climate, conflict of interest, and interpersonal influences, significantly predicted the use of safe-handling precautions. The study concluded that recognizing these predictors is essential for enhancing worker safety and adherence to safe-handling practices in the context of chemotherapy administration.

The empirical study conducted by Callahan et al. (2022) aimed to identify the factors influencing the use of hazardous drug (HD) safe-handling precautions among oncology nurses working in inpatient clinical research units. The research, based at the National Institutes of Health Clinical Center in Bethesda, Maryland, collected survey data from 115 registered nurses (RNs) specializing in high-volume HD administration. The study examined various factors such as exposure knowledge, self-efficacy, barriers to personal protective equipment use, perceived risk, conflict of interest, interpersonal influences, workplace safety climate, and overall HD precaution usage. Despite nurses demonstrating high levels of exposure knowledge, the findings indicated that barriers related to personal protective equipment use and conflicts of interest might contribute to a decreased adoption of personal protective practices among these healthcare professionals. This study underscores the importance of addressing these specific barriers to enhance the safe-handling practices of hazardous drugs among oncology nurses and improve workplace safety within clinical research units.

CHAPTER THREE

RESEARCH METHODS

3.1 Introduction

This chapter carefully presents the methods and procedures utilized in this research study.

3.2 Research Design

A descriptive cross-sectional design was utilized for this study to assess the knowledge and practices regarding the safe handling and administration of chemotherapeutic drugs among nurses in a tertiary health institution, Benin City

3.3 Research Setting

The settings used for this study was Benin City, Edo-State, Nigeria. Edo-State is an inland state in the southern part of Nigeria. It was created on 27th August, 1991 and currently has a population of approximately 4 million (NPC, 2017). The predominant occupation of the people of Edo State is agriculture. Edo State has 34 State hospitals and 3 Federal health institutions. The study was conducted in University of Benin Teaching Hospital (UBTH), Benin City, Edo State. UBTH shares a main boundary with University of Benin and Isiohor. UBTH is situated along Benin-Lagos highway in Egor Lagos Government Area along Benin Lagos express way, Ugbowo Benin City. It was founded in 1973 and has a bed state of 900 beds and 36 departments and services.it was established to compliment her sister institution, University of Benin. It is a tertiary institution which serves as a referral, healing, diagnostic, teaching and record Centre in the government health care delivering system. The hospital is made up of Clinical Oncology and Radiotherapy, Consultant Outpatient Department, Accident and Emergency unit, Medical wards, Surgical wards, Maternity section, Theatre, Laboratory, Infant welfare clinic and General Practice clinics and so on.

3.4 Target Population

This is the entire group of individuals to which the researcher is interested in generalizing conclusion. The target population for the study was all registered nurses working in the departments who are involved in the preparation, handling, transportation, storage, or administration of chemotherapeutic agents. They are 278 nurses as shown below.

Table 3.1: Distribution of nurses in the different wards in UBTH

Wards	Population
Oncology Unit	56
Haematology Unit	48
Surgical Unit	69
Chemotherapy Day Care Unit	20
Medicine Unit	52
Pediatrics Oncology ward	33
Total	**278**

3.5 Sample and Sampling Technique

The sample comprises of all the 278 nurses working in the selected units. The sampling technique for this study was the census sampling technique because the study focuses specifically on nurses who directly handle and administer chemotherapeutic drugs. This means every nurse who meets the inclusion criteria will be invited to participate.

Inclusion criteria

- Registered nurses currently employed in the selected unit.
- Nurses who are directly involved in the handling or administration of chemotherapeutic drugs.
- At least 6 months of work experience in the oncology unit (to ensure adequate exposure to local practice), unless a shorter period is justified and documented.
- Provide informed consent to participate.

3.6 Instrument for Data Collection

A self-developed structured questionnaire was used for this study. The questions was developed through research objectives and literature reviewed by the researcher. It comprised of four sections;

Section A: Socio-Demographic and Background Information of respondents.

Section B: Knowledge of chemotherapeutic drugs, handling and administration.

Section C: Practice of safe handling and administration of chemotherapeutic drugs

Section D: Perceived factors that support the practice of safe handling and administration of chemotherapeutic drugs

3.7 Reliability of the Instrument

This is the degree to which the questionnaire produces stable and consistent results. A pilot study was carried out among patients in Central Hospital, Benin City, Edo State to pre-test the reliability of the instrument. The Cronbach alpha reliability technique was employed in this study and computed with the aid of Statistical Package for Social Sciences (SPSS). The Cronbach alpha value greater than 0.5 was considered reliable.

3.8 Validity of the Instrument

The validity of the research instrument was ascertained by the researcher‘s supervisor and other experts in the field to ensure face and content validity. For revision based on which the instruments was moderated after necessary corrections, the research instruments was considered valid and thereafter administered to the respondents. The items that were difficult for the patients in the questionnaire were restructured for proper comprehension.

3.9 Method of Data Collection

Before administering the questionnaires, the researchers provided an introductory briefing to the potential respondents. This introduction includes an overview of the research topic, its

significance, and the objectives of the study. It is important to note that participation is voluntary, and participants were informed that their responses will be kept confidential. Nurses who express interest in participating in the study were provided with the questionnaire. They were given ample time and space to complete the questionnaire at their convenience. The researcher was available to address any questions or concerns that may arise during the questionnaire completion process. Once the questionnaire was filled, it was collected immediately to ensure the timely retrieval of responses.

3.10 Method of Data Analysis

On retrieving the questionnaires from the respondents, the data were coded, cleaned and analyzed using International Business Machine (IBM) Statistical Package for Social Sciences (SPSS) version 24.0. The statistical techniques to be employed in the data analysis were descriptive statistics (frequency, simple percentages, means as well as inferential statistics (chi-square statistical test) to test the research hypotheses. Multivariate logistic regression was used to test significant demographic variables with practice and knowledge. The level of significance was set at $p < 0.05$.

3.11 Ethical Consideration

Confidentiality and anonymity of participants were carefully maintained by non-inclusion of names and analyses of data done as group data and manage only for the purpose of the study. A verbally informed consent was sought and obtained from each subject prior to enrolment in the study. The written informed consent forms was only be given to participants that accept to sign them as evidence for their consent to be involved in the study after the aim and objectives of the study is explained. The reason for this decision is to avoid some respondents' persisting suspicion or doubt on the implication of signing the consent form.

CHAPTER

FOUR RESULTS

Table 4.1: Sociodemographic characteristics of respondents

	Frequency	Percentage
Age		
Under 18 years	12	4.32%
18-34 years	45	16.19%
35-49 years	63	22.66%
50-64 years	57	20.50%
65 and older	101	36.34%
Gender		
Male	116	41.73%
Female	162	58.24%
Marital Status		
Single	68	24.46%
Married	127	45.68%
Divorced	37	13.31%
Widowed	46	16.55%
Educational Level		
Less than High School	14	5.04%
High School Graduate	62	22.30%
Some College or Vocational Training	81	29.14%
Bachelor‘s Degree	80	28.78%
Postgraduate Degree	41	14.75%
Employment Status		
Employed full-time	120	43.17%
Employed part-time	42	15.11%
Unemployed	29	10.43%
Retired	56	20.14%
Disabled	19	6.83%
Others	12	4.32%

Income Level		
Less than N25,000	31	11.15%
N25,000 - N49,999	59	21.22%
N50,000 - N74,999	65	23.38%
N75,000 - N99,999	47	16.91%
N100,000 or more	76	27.34%
Ethnicity		
Benin	37	13.31%
Hausa	49	17.63%
Igbo	68	24.46%
Yoruba	61	21.94%
Others	63	22.66%
Residential Area		
Urban	128	46.04%
Suburban	87	31.29%
Rural	63	22.66%
Distance to Treatment Center		
Less than 10 kilometers	92	33.09%
10-25 kilometers	97	34.89%
More than 25 kilometers	89	32.02%
Primary Cancer Diagnosis		
Breast Cancer	81	29.14%
Lung Cancer	49	17.63%
Prostate Cancer	37	13.31%
Colorectal Cancer	58	20.86%
Blood Cancer	25	9.00%
Other	28	10.07%
Stage of Cancer		
Stage 0	36	12.95%
Stage I	45	16.19%
Stage II	57	20.50%
Stage III	61	21.94%
Stage IV	53	19.06%
Not sure	26	9.35%

Duration of Chemotherapy Treatment		
Less than 3 months	65	23.38%
3-6 months	71	25.54%
6-12 months	64	23.02%
More than 12 months	78	28.06%

Table 4.1 shows the sociodemographic characteristics of the respondents regarding age distribution, the largest cohort comprised individuals aged 65 and older (36.34%), followed by those aged 35-49 years (22.66%) and 50-64 years (20.50%). The gender distribution demonstrated a slight predominance of females (58.24%) over males (41.73%). In terms of marital status, the majority of respondents were married (45.68%), followed by singles (24.46%) and individuals who were widowed (16.55%). Educational attainment varied, with a significant proportion having completed some college or vocational training (29.14%) or holding a bachelor‘s degree (28.78%). Employment status highlighted a substantial number being employed full-time (43.17%), followed by retired individuals (20.14%). The income level revealed a varied spectrum, with approximately 27.34% of respondents earning N100,000 or more, while 11.15% earned less than N25,000. Ethnicity distribution exhibited diverse representation, with notable proportions from Igbo (24.46%) and Yoruba (21.94%) backgrounds, alongside smaller percentages from Benin (13.31%), Hausa (17.63%), and other ethnicities (22.66%). Residential areas primarily consisted of urban (46.04%) and suburban (31.29%) dwellings, with a smaller representation from rural regions (22.66%). The distance to treatment centers varied, with 34.89% of respondents living within 10-25 kilometers, followed by 33.09% residing within less than 10 kilometers. Concerning primary cancer diagnoses, breast cancer (29.14%), colorectal cancer (20.86%), and lung cancer (17.63%) were the most prevalent. The distribution across cancer stages ranged from Stage 0 (12.95%) to Stage IV (19.06%), with a subset expressing uncertainty about their cancer stage (9.35%). The

duration of chemotherapy treatment was also diverse, with 28.06% of respondents undergoing treatment for more than 12 months, followed by 25.54% receiving treatment for 3-6 months, and 23.38% undergoing treatment for less than 3 months.

Table 4.2: Knowledge of chemotherapeutic drugs

Question	Response	Frequency	Percentage
What is the primary goal of administering chemotherapeutic drugs?	To provide pain relief	33	11.87%
	To boost the immune system	12	4.32%
	To eliminate cancer cells	213	76.62%
	To improve appetite	20	7.19%
Which route of administration is commonly used for chemotherapy drugs?	Oral	46	16.55%
	Intramuscular	8	2.88%
	Intravenous	206	74.10%
	Subcutaneous	18	6.47%
Before administering chemotherapy, what should healthcare professionals wear to protect themselves?	Gloves and a lab coat	171	61.51%
	Goggles and a mask	72	25.90%
	A stethoscope	5	1.80%
	A surgical cap	30	10.79%
Which term describes the use of chemotherapy to shrink a tumor before surgery or radiation therapy?	Adjuvant therapy	142	51.08%
	Palliative care	29	10.43%
	Chemoprevention	21	7.55%
	Neoadjuvant therapy	86	30.94%

What is the main purpose of a central venous catheter during chemotherapy?	To administer chemotherapy directly into the tumor	43	15.47%
	To collect blood samples	26	9.35%
	To provide a portal for drug administration	195	70.14%
	To monitor blood pressure	14	5.04%
Which of the following statements about chemotherapy side effects is correct?	Chemotherapy has no side effects	3	1.08%
	Side effects only occur after the first treatment	11	3.96%
	Side effects are the same for all chemotherapy drugs	9	3.24%
	Side effects vary depending on the drugs used and the patient‘s Response	255	91.73%
What is the purpose of antiemetic drugs in chemotherapy?	To enhance the effectiveness of Chemotherapy	17	6.12%
	To manage and prevent nausea and vomiting	220	79.14%
	To reduce the number of chemotherapy sessions Required	20	7.19%
	To stimulate appetite	21	7.55%

When should patients be educated about potential chemotherapy side effects?	After completing all chemotherapy sessions	17	6.12%
	Before starting chemotherapy	231	83.09%
	During chemotherapy Sessions	13	4.68%
	Only if side effects occur	17	6.12%
What does the term “extravasation” refer to in chemotherapy?	The intentional administration of drugs into the bloodstream	5	1.80%
	The spread of cancer to distant organs	15	5.40%
	The leakage of chemotherapy drugs from the vein into surrounding Tissues	241	86.69%
Which precaution should healthcare professionals take when handling chemotherapy drugs?	Wearing regular gloves	11	3.96%
	Crushing tablets to make them easier to handle	8	2.88%
	Avoiding the use of a biological safety cabinet	15	5.40%
	Using chemotherapy-safe gloves and gowns	244	87.88%

Table 4.2 shows the knowledge of chemotherapeutic drugs. For the primary goal of administering chemotherapeutic drugs, a substantial 213 respondents (76.62%) identified ―To eliminate cancer cells‖ as the primary goal, whereas other goals such as providing pain relief (11.87%), improving the immune system (4.32%), and enhancing appetite (7.19%) received notably lower percentages. Regarding the commonly used route of administration for chemotherapy drugs, the majority of respondents (74.10%) selected―Intravenous‖ administration, followed by ―Oral‖ (16.55%) and ―Subcutaneous‖ (6.47%), with―Intramuscular‖ having the lowest frequency at 2.88%. In terms of safety measures, a significant majority (61.51%) highlighted ―Gloves and a lab coat‖ as the necessary attire for healthcare professionals before administering chemotherapy, followed by ―Goggles and a mask‖ (25.90%), ―A surgical cap‖ (10.79%), and ―A stethoscope‖ (1.80%). Additionally, responses to other questions revealed varying percentages in understanding chemotherapy terminology, drug administration purposes, side effects, patient education, and safety precautions. For example, ―Neoadjuvant therapy‖ had a frequency of 86 (30.94%) in describing chemotherapy to shrink a tumor before surgery or radiation therapy. Similarly, ―Side effects vary depending on the drugs used and the patient‘s response‖ was strongly supported by 255 respondents (91.73%). The majority of respondents (87.88%) emphasized using chemotherapy-safe gloves and gowns as a crucial precaution for healthcare professionals when handling chemotherapy drugs, while other precautions like ―Wearing regular gloves‖ (3.96%), ―Crushing tablets for easier handling‖ (2.88%), and ―Avoiding the use of a biological safety cabinet‖ (5.40%) received lower endorsements.

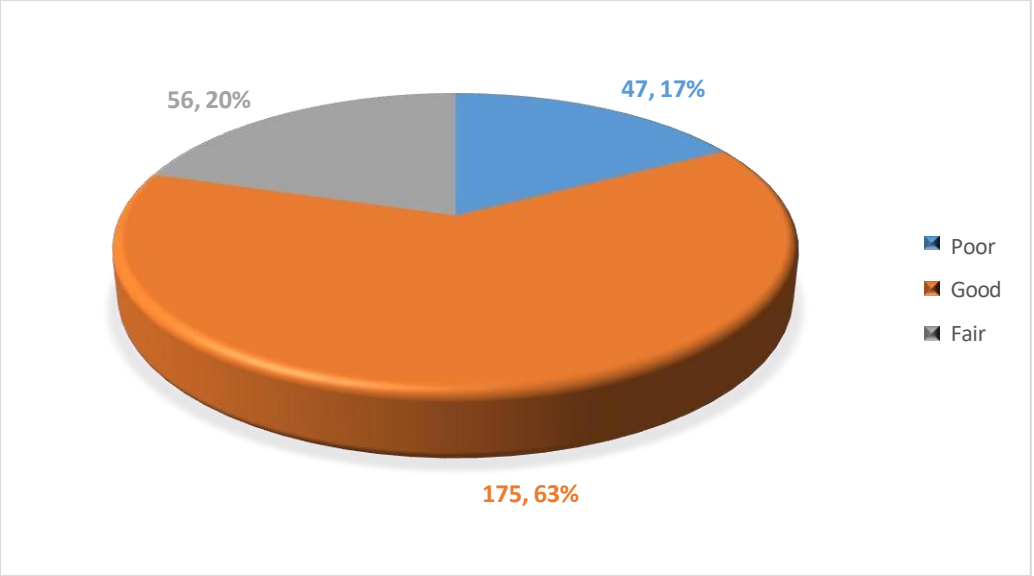

Figure 4.1: Level of Knowledge of Chemotherapeutic drugs

Figure 4.1 shows the level of Knowledge of Chemotherapeutic drugs. It shows that 47(17%) have poor level of knowledge, 175(63%) have fair level of knowledge, while the remaining 56(20%) have good level of knowledge.

Table 4.3: Practice of safe handling and administration of chemotherapeutic drugs

Questions	Response	Frequency	Percentage
How frequently do you administer chemotherapeutic drugs to patients in your current role?	Rarely	45	16.19%
	Occasionally	88	31.65%
	Regularly	105	37.77%
	Frequently	40	14.39%
Have you received formal training or certification in the safe handling and administration of chemotherapeutic drugs?	Yes	190	68.35%
	No	88	31.65%
Do you always wear appropriate personal protective equipment (PPE) when handling or administering chemotherapeutic drugs?	Always	112	40.29%
	Often	95	34.17%
	Sometimes	55	19.78%
	Rarely	16	5.76%
How confident are you in your knowledge of the potential side effects and adverse reactions of chemotherapeutic drugs?	Very confident	78	28.06%
	Somewhat confident	120	43.17%
	Not very confident	55	19.78%
	Not confident at all	25	8.99%
Do you follow a standardized protocol for verifying the patient's identity and treatment plan before administering chemotherapy?	Always	120	43.17%
	Often	95	34.17%
	Sometimes	45	16.19%
	Rarely	18	6.47%
In case of a chemotherapy spill or leakage, do you know the correct steps to take for safe cleanup and disposal?	Yes, I'm well-informed	112	40.29%

	Somewhat, but I'm unsure about some steps	105	37.77%
	No, I'm not sure what to do	61	21.94%
How frequently do you update your knowledge and skills related to chemotherapy safety and administration?	Regularly, through ongoing education	98	35.25%
	Occasionally, when required	90	32.37%
	Rarely, I rely on my existing knowledge	60	21.58%
	Never, I have not received any updates	30	10.79%
Have you ever encountered an incident of chemotherapy drug extravasation or other safety-related issues during administration?	Yes, on multiple occasions	50	17.99%
	Yes, but only once or twice	78	28.06%
	No, I have not encountered such incidents	150	53.96%
Are there written guidelines or protocols in your facility for the safe handling and administration of chemotherapeutic drugs?	Yes, and they are regularly updated	130	46.76%
	Yes, but they are outdated	60	21.58%
	No, there are no written guidelines	88	31.65%
How confident are you in your ability to educate patients and their families about the precautions and side effects of chemotherapy?	Very confident	75	27.01%
	Somewhat confident	100	35.97%
	Not very confident	70	25.18%
	Not confident at all	33	11.87%

Table 4.3 shows the Practice of safe handling and administration of chemotherapeutic drugs. The frequency distribution revealed that a substantial proportion of respondents reported administering these drugs regularly (37.77%) or occasionally (31.65%) in their current roles. Regarding training, the majority of participants (68.35%) confirmed having received formal training or certification in the safe handling of these drugs. However, a considerable percentage (40.29%) admitted to sometimes or rarely wearing appropriate personal protective equipment (PPE) during administration. Confidence in knowledge varied, with a notable portion being somewhat confident (43.17%) while a smaller proportion felt very confident (28.06%). The data also indicated variability in the frequency of updating knowledge, as 35.25% reported regular updates, while 10.79% acknowledged never receiving updates. Incident occurrences varied, with 53.96% reporting no encounters with chemotherapy-related safety issues, but a substantial minority experienced such incidents, either multiple times (17.99%) or once or twice (28.06%). The presence of regularly updated written guidelines for safe drug handling in facilities was confirmed by 46.76% of respondents, while 21.58% cited outdated guidelines. Confidence in educating patients and their families showcased variability, with 35.97% feeling somewhat confident, 27.01% feeling very confident, and a notable 11.87% not confident at all.

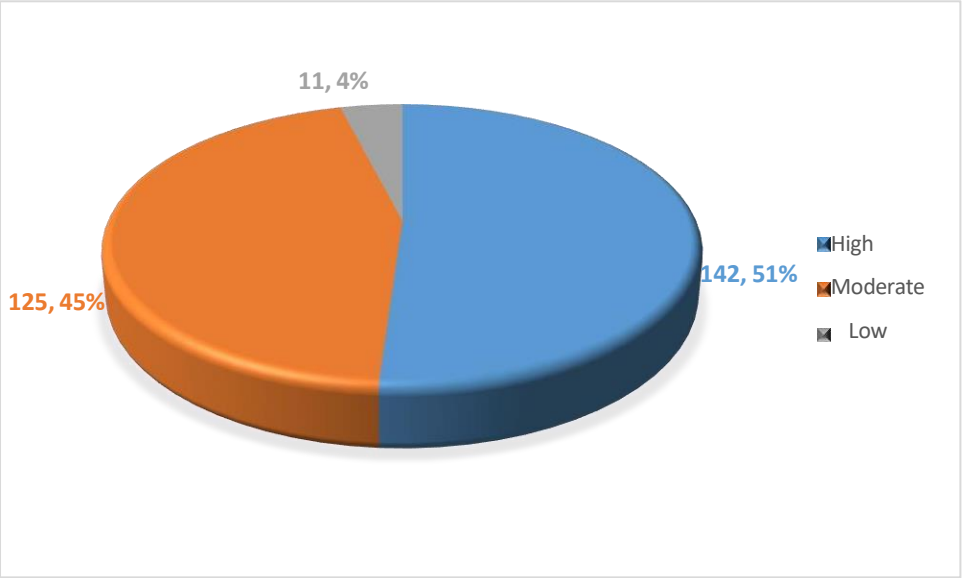

Figure 4.2: Level of Practice of safe handling and administration of chemotherapeutic drugs

Figure 4.2 shows the level of Practice of safe handling and administration of chemotherapeutic drugs. It shows that 142(51%) have low level of practice, 125(45%) moderate practice level, while 11(4%) have high level of practice.

Table 4.4: Perceived factors that support the practice of safe handling and administration of chemotherapeutic drugs

Question	Response	Frequency	Percentage
How frequently do you administer chemotherapeutic drugs to patients in your current role?	Rarely	42	15.11%
	Occasionally	75	27.00%
	Regularly	98	35.25%
	Frequently	63	22.66%
Have you received formal training or certification in the safe handling and administration of chemotherapeutic drugs?	Yes	212	76.26%
	No	66	23.74%
Do you always wear appropriate personal protective equipment (PPE) when handling or administering chemotherapeutic drugs?	Always	98	35.25%
	Often	84	30.22%
	Sometimes	62	22.30%
	Rarely	34	12.23%
How confident are you in your knowledge of the potential side effects and adverse reactions of chemotherapeutic drugs?	Very confident	75	27.01%
	Somewhat confident	103	37.05%
	Not very confident	57	20.50%
	Not confident at all	43	15.45%

Do you follow a standardized protocol for verifying the patient‘s identity and treatment plan before administering chemotherapy?	Always	107	38.49%
	Often	90	32.37%
	Sometimes	49	17.63%
	Rarely	32	11.51%
In case of a chemotherapy spill or leakage, do you know the correct steps to take for safe cleanup and disposal?	Yes, I‘m well-informed	97	34.89%
	Somewhat, but I‘m unsure about some steps	92	33.09%
	No, I‘m not sure what to do	89	32.02%
How frequently do you update your knowledge and skills related to chemotherapy safety and administration?	Regularly, through ongoing education	88	31.65%
	Occasionally, when required	82	29.50%
	Rarely, I rely on my existing knowledge	59	21.22%
	Never, I have not received any updates	49	17.65%
Have you ever encountered an incident of chemotherapy drug extravasation or other safety-related issues during administration?	Yes, on multiple occasions	55	19.78%
	Yes, but only once or twice	81	29.14%

	No, I have not encountered such incidents	142	51.08%
Are there written guidelines or protocols in your facility for the safe handling and administration of chemotherapeutic drugs?	Yes, and they are regularly updated	120	43.17%
	Yes, but they are outdated	60	21.58%
	No, there are no written guidelines	98	35.25%
How confident are you in your ability to educate patients and their families about the precautions and side effects of chemotherapy?	Very confident	72	25.90%
	Somewhat confident	92	33.09%
	Not very confident	64	23.02%
	Not confident at all	50	18.00

Table 4.4 shows the perceived factors that support the practice of safe handling and administration of chemotherapeutic drugs. A substantial proportion reported administering chemotherapeutic drugs regularly (35.25%) and occasionally (27.00%) in their current roles. Moreover, a high percentage (76.26%) had received formal training or certification in the safe handling and administration of these drugs. However, the confidence levels in handling side effects and adverse reactions varied, with a significant portion expressing either _Somewhat confident‘ (37.05%) or _Very confident‘ (27.01%). It was noted that about 38.49% followed a standardized protocol for verifying patient identity and treatment plans _Always.‘ In terms of ongoing education, around 31.65% updated their knowledge regularly, while a lower percentage (17.65%) reported never receiving updates. Furthermore, incidents of chemotherapy drug extravasation or safety-related issues were reported by 48.92% of the participants, with 51.08% having no encounters. Notably, only

43.17% of respondents reported having updated and accessible written guidelines for safe handling and administration. Lastly, confidence in educating patients about chemotherapy varied, with 33.09% feeling _Somewhat confident‘ and 25.90% feeling _Very confident.‘

Hypothesis Testing

Table 4.5: Association between sociodemographic characteristics and level of knowledge

	Poor/Fair	**Good**	$_X$**2**	**P**
Age				
Under 18 years	8 (67%)	4 (33%)	0.050	1.000
18-34 years	30 (67%)	15 (33%)		
35-49 years	42 (67%)	21 (33%)		
50-64 years	38 (67%)	19 (33%)		
65 and older	66 (65%)	35 (35%)		
Gender				
Male	93 (80%)	23 (20%)	0.000	1.000
Female	129 (80%)	33 (20%)		
Marital Status				
Single	46 (68%)	22 (32%)	0.107	0.991
Married	85 (67%)	42 (33%)		
Divorced	25 (68%)	12 (32%)		
Widowed	32 (70%)	14 (30%)		
Educational Level				
Less than High School	11 (79%)	3 (21%)	7.190	0.126
High School Graduate	50 (81%)	12 (19%)		
Some College or Vocational Training	65 (80%)	16 (20%)		
Bachelor's Degree	64 (67%)	32 (33%)		
Postgraduate Degree	32 (67%)	16 (33%)		
Employment Status				
Employed full-time	98 (82%)	22 (18%)	0.197	0.999
Employed part-time	34 (81%)	8 (19%)		
Unemployed	23 (79%)	6 (21%)		
Retired	45 (80%)	11 (20%)		
Disabled	15 (79%)	4 (21%)		
Others	10 (83%)	2 (17%)		

Income Level				
Less than N25,000	25 (81%)	6 (19%)	0.046	1.000
N25,000 - N49,999	48 (81%)	11 (19%)		
N50,000 - N74,999	53 (82%)	12 (18%)		
N75,000 - N99,999	38 (81%)	9 (19%)		
N100,000 or more	61 (80%)	15 (20%)		
Ethnicity				
Benin	25 (68%)	12 (32%)	0.005	1.000
Hausa	33 (67%)	16 (33%)		
Igbo	46 (68%)	22 (32%)		
Yoruba	41 (67%)	20 (33%)		
Others	43 (67%)	21 (33%)		
Residential Area				
Urban	80 (80%)	20 (20%)	3.580	0.167
Suburban	56 (78%)	16 (22%)		
Rural	41 (67%)	20 (33%)		
Distance to Treatment Center				
Less than 10 kilometers	46 (67%)	23 (33%)	0.000	1.000
10-25 kilometers	48 (67%)	24 (33%)		
More than 25 kilometers	44 (67%)	22 (33%)		
Primary Cancer Diagnosis				
Breast Cancer	48 (67%)	24 (33%)	0.051	1.000
Lung Cancer	29 (66%)	15 (34%)		
Prostate Cancer	22 (67%)	11 (33%)		
Colorectal Cancer	34 (67%)	17 (33%)		
Blood Cancer	15 (65%)	8 (35%)		
Other	17 (68%)	8 (32%)		
Stage of Cancer				
Stage 0	24 (67%)	12 (33%)	0.029	1.000
Stage I	30 (67%)	15 (33%)		

Stage II	38 (67%)	19 (33%)		
Stage III	40 (67%)	20 (33%)		
Stage IV	35 (67%)	17 (33%)		
Not sure	17 (65%)	9 (35%)		
Duration of Chemotherapy Treatment				
Less than 3 months	47 (67%)	23 (33%)	0.005	1.000
3-6 months	52 (67%)	26 (33%)		
6-12 months	46 (67%)	23 (33%)		
More than 12 months	56 (67%)	28 (33%)		

Table 4.5 shows the association between sociodemographic characteristics and level of knowledge. It shows that all the variables didn‘t show any significant association between the sociodemographic characteristics and level of of knowledge. We therefore accept the null hypothesis.

Table 4.6: Association between sociodemographic characteristics and level of practice

	Poor/Fair	**Good**	**x2**	**P**
Age				
Under 18 years	8 (67%)	4 (33%)	0.050	1.000
18-34 years	30 (67%)	15 (33%)		
35-49 years	42 (67%)	21 (33%)		
50-64 years	38 (67%)	19 (33%)		
65 and older	66 (65%)	35 (35%)		
Gender				
Male	93 (80%)	23 (20%)	0.000	1.000
Female	129 (80%)	33 (20%)		
Marital Status				
Single	46 (68%)	22 (32%)	0.107	0.991
Married	85 (67%)	42 (33%)		
Divorced	25 (68%)	12 (32%)		
Widowed	32 (70%)	14 (30%)		

Educational Level				
Less than High School	11 (79%)	3 (21%)	7.190	0.126
High School Graduate	50 (81%)	12 (19%)		
Some College or Vocational Training	65 (80%)	16 (20%)		
Bachelor's Degree	64 (67%)	32 (33%)		
Postgraduate Degree	32 (67%)	16 (33%)		
Employment Status				
Employed full-time	98 (82%)	22 (18%)	0.197	0.999
Employed part-time	34 (81%)	8 (19%)		
Unemployed	23 (79%)	6 (21%)		
Retired	45 (80%)	11 (20%)		
Disabled	15 (79%)	4 (21%)		
Others	10 (83%)	2 (17%)		
Income Level				
Less than N25,000	25 (81%)	6 (19%)	0.046	1.000
N25,000 - N49,999	48 (81%)	11 (19%)		
N50,000 - N74,999	53 (82%)	12 (18%)		
N75,000 - N99,999	38 (81%)	9 (19%)		
N100,000 or more	61 (80%)	15 (20%)		
Ethnicity				
Benin	25 (68%)	12 (32%)	0.005	1.000
Hausa	33 (67%)	16 (33%)		
Igbo	46 (68%)	22 (32%)		
Yoruba	41 (67%)	20 (33%)		
Others	43 (67%)	21 (33%)		
Residential Area				
Urban	80 (80%)	20 (20%)	3.580	0.167
Suburban	56 (78%)	16 (22%)		
Rural	41 (67%)	20 (33%)		
Distance to Treatment Center				
Less than 10 kilometers	46 (67%)	23 (33%)	0.000	1.000
10-25 kilometers	48 (67%)	24 (33%)		
More than 25 kilometers	44 (67%)	22 (33%)		
Primary Cancer Diagnosis				
Breast Cancer	48 (67%)	24 (33%)	0.051	1.000
Lung Cancer	29 (66%)	15 (34%)		

Prostate Cancer	22 (67%)	11 (33%)		
Colorectal Cancer	34 (67%)	17 (33%)		
Blood Cancer	15 (65%)	8 (35%)		
Other	17 (68%)	8 (32%)		
Stage of Cancer				
Stage 0	24 (67%)	12 (33%)	0.029	1.000
Stage I	30 (67%)	15 (33%)		
Stage II	38 (67%)	19 (33%)		
Stage III	40 (67%)	20 (33%)		
Stage IV	35 (67%)	17 (33%)		
Not sure	17 (65%)	9 (35%)		
Duration of Chemotherapy Treatment				
Less than 3 months	47 (67%)	23 (33%)	0.005	1.000
3-6 months	52 (67%)	26 (33%)		
6-12 months	46 (67%)	23 (33%)		
More than 12 months	56 (67%)	28 (33%)		

Table 4.5 shows the association between sociodemographic characteristics and level of knowledge. It shows that all the variables didn‘t show any significant association between the sociodemographic characteristics and level of of knowledge. We therefore accept the null hypothesis.

Hypothesis Two

Table 4.7: Association between sociodemographic characteristics and level of practice of safe handling of chemotherapeutic drugs

Category	Low	High		
Age				
Under 18 years	6 (50.0%)	6 (50.0%)	72.304	0.000
18-34 years	18 (40.0%)	27 (60.0%)		
35-49 years	23 (36.5%)	40 (63.5%)		
50-64 years	20 (35.1%)	37 (64.9%)		
65 and older	75 (74.3%)	26 (25.7%)		
Gender				
Male	60 (51.7%)	56 (48.3%)	2.6643	0.1026
Female	82 (50.6%)	80 (49.4%)		
Marital Status				
Single	30 (44.1%)	38 (55.9%)	76.621	0.000
Married	76 (59.8%)	51 (40.2%)		
Divorced	21 (56.8%)	16 (43.2%)		
Widowed	15 (32.6%)	31 (67.4%)		
Educational Level				
Less than High School	8 (57.1%)	6 (42.9%)	58.007	0.000
High School Graduate	28 (45.2%)	34 (54.8%)		
Some College or Vocational	38 (46.9%)	43 (53.1%)		
Bachelor‘s Degree	38 (47.5%)	42 (52.5%)		
Postgraduate Degree	30 (73.2%)	11 (26.8%)		
Employment Status				
Employed full-time	70 (58.3%)	50 (41.7%)	167.6	0.000
Employed part-time	23 (54.8%)	19 (45.2%)		
Unemployed	19 (65.5%)	10 (34.5%)		
Retired	27 (48.2%)	29 (51.8%)		
Disabled	17 (89.5%)	2 (10.5%)		
Others	7 (58.3%)	5 (41.7%)		
Income Level				

Ethnicity				
Benin	22 (59.5%)	15 (40.5%)	11.281	0.024
Hausa	25 (51.0%)	24 (49.0%)		
Igbo	34 (50.0%)	34 (50.0%)		
Yoruba	29 (47.5%)	32 (52.5%)		
Others	32 (50.8%)	31 (49.2%)		
Residential Area				
Urban	63 (49.2%)	65 (50.8%)	23.317	0.000
Suburban	40 (46.0%)	47 (54.0%)		
Rural	39 (61.9%)	24 (38.1%)		
Distance to Treatment Center				
Less than 10 kilometers	44 (47.8%)	48 (52.2%)	0.353	0.838
10-25 kilometers	43 (44.3%)	54 (55.7%)		
More than 25 kilometers	55 (61.8%)	34 (38.2%)		
Primary Cancer Diagnosis				
Breast Cancer	33 (40.7%)	48 (59.3%)	47.986	0.000
Lung Cancer	20 (40.8%)	29 (59.2%)		
Prostate Cancer	15 (40.5%)	22 (59.5%)		
Colorectal Cancer	25 (43.1%)	33 (56.9%)		
Blood Cancer	9 (36.0%)	16 (64.0%)		
Other	11 (39.3%)	17 (60.7%)		
Stage of Cancer				
Stage 0	23 (63.9%)	13 (36.1%)	19.324	0.002
Stage I	26 (57.8%)	19 (42.2%)		
Stage II	23 (40.4%)	34 (59.6%)		
Stage III	31 (50.8%)	30 (49.2%)		
Stage IV	24 (45.3%)	29 (54.7%)		
Not sure	15 (57.7%)	11 (42.3%)		
Duration of Chemotherapy				
Less than 3 months	30 (46.2%)	35 (53.8%)	1.7986	0.615
3-6 months	31 (43.7%)	40 (56.3%)		
6-12 months	26 (40.6%)	38 (59.4%)		
More than 12 months	55 (70.5%)	23 (29.5%)		

Table 4.6 shows the association between sociodemographic characteristics and level of practice of safe handling of chemotherapeutic drugs. It reflects that there is no significant association between gender, distance and duration of chemotherapy, while others showed statistical significant association ($p<0.05$) with level of practice. We therefore reject the null hypothesis.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

This chapter provides the discussion of findings in accordance to the stated objectives and hypothesis, implications for nursing, summary, conclusion, recommendation and suggestion for further studies.

5.1 Discussion of Findings

Knowledge of Chemotherapeutic Drugs

The statistics gathered reveal substantial alignment between the respondents' knowledge and findings from various studies regarding key aspects of chemotherapy administration. Specifically, a significant percentage (76.62%) acknowledged the primary objective of chemotherapy as the elimination of cancer cells, consistent with prior research highlighted by Kapucu et al. (2017), Saker et al. (2022), and Khan et al. (2012). Similarly, the predominance of intravenous administration (74.10%) among respondents corresponds with studies by Kapucu et al. (2017) and Zakaria et al. (2022), emphasizing the importance of safe catheter practices in chemotherapy administration.

Moreover, the respondents' recognition of critical safety precautions, with 61.51% emphasizing the necessity of gloves and lab coats, resonates with previous research by Sarita et al. (2019) and Nwagbo et al. (2017) that underscored the significance of protective attire to ensure the safe handling of chemotherapeutic drugs. Additionally, high frequencies in understanding chemotherapy-related terminology and side effects are consistent with previous studies (Kapucu et al., 2017; Yu et al., 2013) that highlighted the importance of comprehensive knowledge in these areas.

However, the statistics also reveal contrasting findings. The distribution of knowledge levels among the respondents does not completely mirror previous studies, as the majority fell within fair knowledge levels. This contrasts with existing literature that predominantly emphasizes knowledge gaps or variable competencies among nurses handling chemotherapy (Saker et al., 2022; Sarita et al., 2019; Yu et al., 2013). Furthermore, the variability in reported safety precautions—such as the endorsement of less secure measures like wearing regular gloves or crushing tablets for easier handling—contradicts the consistent emphasis in research on the strict adherence to safety protocols for handling chemotherapeutic drugs (Nwagbo et al., 2017; Zakaria et al., 2022). These disparities suggest potential discrepancies between self-reported knowledge and the competencies required for safe chemotherapy administration, underscoring the need for further education and training among healthcare professionals to ensure standardized and safe practices in oncology settings

Practice of safe handling of chemotherapeutic drugs

The finding from this study revealed that a significant majority (68.35%) have received formal training or certification in safe drug handling, aligning with findings from previous studies emphasizing the importance of comprehensive training (Pierobon et al., 2022; Sarita et al., 2019). However, the substantial percentage (40.29%) admitting to sometimes or rarely wearing appropriate personal protective equipment (PPE) during administration raises concerns, highlighting a significant gap in adhering to safety protocols. This correlates with existing literature that emphasizes the need to address barriers to personal protective equipment usage (Callahan et al., 2022; Nwagbo et al., 2017). Regarding confidence levels, the data indicates variability, with a notable portion (43.17%) being somewhat confident and a smaller proportion (28.06%) feeling very confident in their knowledge. This variability aligns with previous research that emphasizes the need for consistent and ongoing knowledge updates (Khan et al., 2012; Saker et al., 2022). Additionally, the frequency of updating

knowledge shows variation, with only 35.25% receiving regular updates, which might contribute to discrepancies in practice levels. Figure 4.2 provides a visual representation of the level of practice in safe drug handling among healthcare professionals. It indicates that 51% exhibit a low level of practice, 45% a moderate practice level, while only 4% demonstrate a high level of practice. These figures contrast somewhat with studies emphasizing satisfactory knowledge and safe administration practices among nurses in some contexts (Sarita et al., 2019; Pierobon et al., 2022). This discrepancy emphasizes the need to bridge the gap between knowledge acquisition and its consistent application in clinical settings. The significant proportion reporting no encounters with chemotherapy-related safety issues (53.96%) aligns with the need to address factors influencing exposure, as outlined in the integrative review by Abu-Alhaija et al. (2023). However, a substantial minority experienced such incidents, either multiple times (17.99%) or once or twice (28.06%). This variation underscores the importance of continually updating guidelines and reinforcing safety protocols to minimize such incidents. Furthermore, confidence in educating patients and their families showcased variability, with a notable 11.87% expressing no confidence at all. This aligns with the studies emphasizing the need for comprehensive nursing education (Khan et al., 2012; Sarita et al., 2019). The disparities in confidence levels emphasize the importance of effective educational programs tailored to enhance patient education and support.

Factors affecting practice of safe handling of chemotherapeutic drugs

The findings on the factors affecting safe handling of chemotherapeutic drugs aligns with several findings from existing studies while revealing disparities in other areas. The high percentage of participants who received formal training (76.26%) resonates with the emphasis placed in studies such as Khan et al. (2012) and Saker et al. (2022) on the necessity of education and training for ensuring safe chemotherapy administration. Additionally, the

reported incidents of chemotherapy drug extravasation or safety-related issues (48.92%) are consistent with the concerns raised in studies like Kapucu et al. (2017), Zakaria et al. (2022), and Nwagbo et al. (2017) that highlighted the need for strict adherence to safety protocols and continuous updates in nurses' knowledge.

However, contrasting elements are notable. The varying confidence levels among participants in handling side effects and adverse reactions deviate from Saker et al.'s (2022) findings, which reported substantial knowledge gaps among nurses. Additionally, the absence of updated and accessible written guidelines for safe handling and administration among only 43.17% of respondents contrasts with Pierobon et al.'s (2022) identification of specific areas for improvement, indicating the need for ongoing enhancement in ensuring safe oncological care. The diverse confidence levels in educating patients about chemotherapy also differ from the emphasis in studies such as Abu-Alhaija et al. (2019) on the necessity of fostering positive attitudes and enhancing knowledge among nursing personnel. These contrasting findings highlight the crucial areas where targeted interventions and improvements are necessary to augment the overall safety and efficiency of chemotherapy practices among healthcare professionals.

5.2 Implication to Nursing

1. Training and Education: A significant proportion of respondents indicated they had received formal training or certification in safe handling and administration of chemotherapeutic drugs. However, there were discrepancies in confidence levels and adherence to protocols. This suggests a need for continuous education, training, and skill development among nursing professionals regarding chemotherapy administration and safety protocols.
2. Practice Gaps: A considerable number reported varying levels of practice in safe handling and administration. It indicates potential gaps in adhering to safety

protocols, personal protective equipment (PPE) usage, and standardized procedures.

3. Level of Knowledge: The distribution of knowledge levels revealed that a substantial number had a fair level of knowledge, indicating the need for improvement and continuous education in this domain.

5.3 Limitation of the study

1. The data collected were primarily through self-reported questionnaires. This method might introduce recall bias, where participants might inaccurately recollect their experiences, and social desirability bias, where they might respond in a manner they believe is more socially acceptable. These biases could affect the accuracy of the reported incidents or experiences.

2. The structure and content of the survey or questionnaire might have limitations. The questions might not have captured the full spectrum of issues or challenges faced by nurses in handling and administering chemotherapeutic drugs. Ambiguity or subjectivity in the survey questions could also lead to varied interpretations by respondents, affecting the consistency and reliability of the data.

5.4 Summary

This study seeks to assess the knowledge and practices of safe handling and administration of chemotherapeutic drugs amongst tertiary health facility, Benin City. The study was outlined into five chapters. Chapter one of this study dealt with the introduction of the topic, statement of problem, objectives of the study, research questions, hypotheses and scope of study, the significance of the study and operational definition of terms. Relevant literature were reviewed in chapter two on the subject under discourse, theoretical framework and empirical review of related studies were also discussed in this chapter. Chapter three dealt with research methodology which adopted the descriptive cross-sectional research design and

simple random sampling method was used to select Two hundred and seventy-eight nurses in the University of Benin Teaching Hospital, Benin City. A well-structured questionnaire was used as instruments of data collection. Analysis and interpretation of data were discussed in chapter four, tables with percentage and others represented as pie-charts. The result shows that majority of the respondents have fair level of knowledge of chemotherapeutic drugs and low level of practice of safe handling of chemotherapeutic drugs and that none of the sociodemographic characteristics was associated with level of knowledge of chemotherapeutic drugs.

5.5 Conclusion

This study assessed the knowledge and practices of safe handling and administration of chemotherapeutic drugs amongst tertiary health facility Benin City. The result shows that majority of the respondents have fair level of knowledge of chemotherapeutic drugs and low level of practice of safe handling of chemotherapeutic drugs.

5.6 Recommendations

1. Continued Education: Regular and mandatory educational programs should be instituted for healthcare professionals handling chemotherapeutic drugs. The goal should be to enhance knowledge, boost confidence, and ensure adherence to safety protocols.
2. Standardized Practices: Institutions should implement and enforce standardized procedures for administering chemotherapy, ensuring the use of appropriate PPE and adherence to safety protocols.
3. Regular Skill Updates: Continuous updates and refreshers on safe handling practices and the latest advancements in chemotherapy should be integrated into nursing practice.
4. Enhanced Patient Education: Focus on enhancing healthcare professionals' ability to

educate patients and their families about the precautions and side effects of chemotherapy. This could help improve patient understanding and compliance with treatments.

5.7 Suggestions for Future Studies

1. Qualitative Investigations: Conduct qualitative studies to delve deeper into the reasons behind varying practices and knowledge levels. This can involve interviews or focus groups to understand the challenges healthcare professionals face in adhering to safe handling practices.
2. Longitudinal Studies: Long-term studies tracking the efficacy of educational programs and the impact on practice improvements can provide insights into the effectiveness of these initiatives.
3. Comparative Studies: Comparative studies between different healthcare settings, such as hospitals, clinics, or rural vs. urban setups, could reveal variations in practice and knowledge levels, providing targeted interventions.
4. Impact Assessments: Assess the impact of improved education and training on patient outcomes, safety incidents, and overall healthcare quality.

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APPENDICES

APPENDIX I: QUESTIONNAIRE

DEPARTMENT OF NURSING SCIENCES
SCHOOL OF BASIC MEDICAL SCIENCES
UNIVERSITY OF BENIN,
BENIN CITY, EDO

Dear Respondent,

KNOWLEDGE AND PRACTICES OF SAFE HANDLING AND ADMINISTRATION OF CHEMOTHERAPEUTIC DRUGS AMONGST NURSES IN TERTIARY HEALTH FACILITIES IN BENIN CITY

I am a 500level student of the department of nursing in the above named institution. I am carrying out a research study on the topic; **"Knowledge and Practices of Safe Handling and Administration of Chemotherapeutic Drugs Amongst Nurses in Tertiary Health Facilities in Benin City"**. Please kindly assist me by indicating your opinion where necessary

Yours faithfully,

OKEKE ESTHER OGOCHUKWU

Instruction: please do not write your name, provide and tick the appropriate answer.

Section A: Socio-Demographic Data

Please tick (✓) as appropriate:

1. Age:
   ☐ 20–30 years
   ☐ 31–40 years
   ☐ 41–50 years
   ☐ Above 50 years
2. Gender:
   ☐ Male
   ☐ Female

3. Marital Status:
   ☐ Single
   ☐ Married
   ☐ Divorced
   ☐ Widowed
4. Highest Educational Qualification:
   ☐ RN
   ☐ RN/RM
   ☐ B.Sc. Nursing
   ☐ Postgraduate (specify): _____
5. Years of Nursing Experience:
   ☐ Less than 5 years
   ☐ 5–10 years
   ☐ 11–15 years
   ☐ Above 15 years
6. Current Unit of Practice:
   ☐ Medical ward
   ☐ Surgical ward
   ☐ Oncology unit
   ☐ Others (please specify): _____
7. Have you ever received any formal training on safe handling and administration of chemotherapeutic drugs?
   ☐ Yes
   ☐ No

Section B: Knowledge on Safe Handling and Administration of Chemotherapeutic Drugs

Please tick the most appropriate option. (True = T, False = F, Don't Know = DK)

S/N	Statement	T	F	DK
1	Chemotherapeutic drugs can be hazardous to health if not handled properly.			
2	It is safe to crush or split chemotherapeutic tablets before administration.			
3	Personal protective equipment (PPE) should always be used when handling chemotherapeutic drugs.			
4	Only nurses trained in chemotherapy administration are permitted to administer such drugs.			
5	Chemotherapeutic drugs can be absorbed through the skin or inhaled.			
6	Chemotherapeutic waste should be disposed of in regular waste bins.			
7	Hand hygiene is not essential after handling chemotherapeutic agents.			
8	Chemotherapy can be administered through multiple routes including oral and intravenous.			
9	Proper labeling and storage of chemotherapeutic drugs reduces accidental exposure.			
10	Cytotoxic spill kits should be available in units where chemotherapy is administered.			

Section C: Practices on Safe Handling and Administration of Chemotherapeutic Drugs

Please rate the frequency of your practice using the scale:
Always (A), Sometimes (S), Rarely (R), Never (N)

S/N	Practice	A	S	R	N
1	I use gloves and protective clothing when handling chemotherapeutic drugs.				
2	I check patient identification and drug information before administering chemotherapy.				
3	I ensure chemotherapy is prepared in a designated area with appropriate safety measures.				
4	I follow institutional guidelines for disposing of chemotherapeutic waste.				
5	I report any chemotherapy drug spill immediately.				
6	I educate patients about the side effects and precautions related to chemotherapy.				
7	I avoid touching face or other exposed areas when handling chemotherapy.				
8	I document chemotherapy administration accurately in patient records.				
9	I monitor patients closely during and after chemotherapy administration.				
10	I participate in ongoing training on chemotherapy handling and administration.				

Section D: Perceived Factors Supporting Safe Handling and Administration

Please indicate the extent to which you agree with the following statements using this scale:
Strongly Agree (SA), Agree (A), Disagree (D), Strongly Disagree (SD)

S/N	Statement	SA	A	D	SD
1	Regular training programs help improve safe handling practices.				
2	Availability of PPE influences my adherence to safety protocols.				
3	Management support is critical to ensure compliance with chemotherapy handling policies.				
4	Presence of clear and accessible guidelines enhances chemotherapy safety.				
5	High workload limits my ability to practice safe handling of chemotherapy.				
6	Team collaboration makes handling chemotherapy drugs more effective and safer.				
7	Inadequate knowledge and skills among staff affect chemotherapy safety.				
8	Adequate supervision improves adherence to chemotherapy safety procedures.				
9	Routine audits and monitoring promote safe chemotherapy practices.				
10	Fear of exposure or harm motivates me to follow safety protocols diligently.				

Appendix II: Ethical Approval