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DEPARTMENT OF BIOCHEMISTRY

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Laboratory of Pharmacology and Toxicology

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ASSESSMENT OF WASTE MANAGEMENT RISK IN HEALTH CARE FACILITIES IN BAFFOUSAM, CAMEROON

Dissertation presented to the Faculty of Science, University of Yaoundé 1 in partial fulfillment of the requirements for the Award of a Professional Master of Science Degree in Biochemistry.

Option: PUBLIC HEALTH BIOTECHNOLOGY

Presented by:

TATA CLAUDETTE MAH

Bachelor's degree in Medical Laboratory Science
Matricule: 20W2503

Supervised by:

Wilfred Angie Abia, PhD

Senior Lecturer

University of Yaoundé 1

Academic Year 2024-2025

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DEDICATION

I dedicate this work to my sons; **David Caleb** and **Carnell Tyson**

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I want to thank God Almighty for bestowing in me the spirit of endurance, wisdom, strength and grace to be able to accomplish this work and all my daily activities

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LIST OF ABBREVIATIONS

EPA : Environmental protection agency

HCW : Health Care Waste

HCWM : Healthcare Waste Management

HIV : Human immunodeficiency virus

KAP : knowledge, attitudes, and practices

OECD : Organization for Economic Cooperation and Development

RAM : Risk Assessment Matrix

UNEP : United Nations environmental policy

WASH : Water, Sanitation, and Hygiene

WHO : World Health Organization

ABSTRACT

Assessment of waste management risk in healthcare facilities in Bafoussam Cameroon is essential for patients, environmental safety and optimization of healthcare delivery. The management of healthcare waste is critical due to its hazardous nature, which poses a significant risk to human health and the environment. In many developing countries, including Cameroon, healthcare waste is often improperly managed, leading to increased health risks and environmental degradation. The overall objective of this study was to evaluate waste management risk in healthcare facilities in Bafoussam, Cameroon, and to propose possible management strategies to enhance hospital waste handling (disposal and management) processes. A descriptive cross-sectional study was carried out from the 1st of June, 2024 to August, 30th 2024 in fourteenth (14) selected hospitals in Bafoussam. healthcare personnel with working experience of 6 year and above were included in the study. Socio-demographic data, knowledge, practices and methods, and longevity in service were collected using a well-structured questionnaire. Collected data was entered into a spreadsheet and analyzed using SPSS version 20.4 to get frequencies and associations between variables. The following types of waste are being generated in the healthcare facilities in Bafoussam: 56.8% of solid waste, 25.7% sharps and 17.5% biomedical waste. With 79.7% (85/150) of the studied healthcare workers were of proper waste segregation practices, and 58.1% (81/150) of them reported that they receive regular training on waste management protocols. Additionally, 60% (90/150) of the facilities lacked adequate waste disposal infrastructure, leading to improper disposal methods such as mixing hazardous waste with general waste. The study identified a significant correlation between training and compliance with waste management practices, including that enhanced training could improve waste management outcomes. The findings from this study highlight critical gaps in waste management practices within healthcare facilities in Bafoussam, Cameroon. This emphasizes the need for comprehensive training programs and improved infrastructure in healthcare facilities in Bafoussam Cameroon. The study underscores the importance of developing a robust waste management policy tailored to local needs, which can significantly mitigate health risks and enhance environmental protection. By addressing these challenges, healthcare facilities can improve their waste management practices, ultimately safeguarding public health and the environment.

Keywords: Waste management, practice, disposal methods, Bafoussam, healthcare facilities

RESUME

L'évaluation des risques liés à la gestion des déchets dans les établissements de santé à Bafoussam, au Cameroun, est essentielle pour la sécurité des patients et de l'environnement, ainsi que pour l'optimisation de la prestation des soins de santé. La gestion des déchets médicaux est cruciale en raison de leur nature dangereuse, qui pose un risque significatif pour la santé humaine et l'environnement. Dans de nombreux pays en développement, y compris le Cameroun, les déchets médicaux sont souvent mal gérés, ce qui entraîne une augmentation des risques pour la santé et une dégradation de l'environnement. Cette étude vise à évaluer les risques de gestion des déchets dans les établissements de santé de Bafoussam, en se concentrant sur les pratiques actuelles, les défis et les améliorations potentielles. Une étude descriptive transversale a été réalisée du 1er juin 2024 au 0 août 2024 dans quatorze (14) hôpitaux sélectionnés à Bafoussam. Professionnels de la santé ayant une expérience de travail d'un an ou plus ont été inclus dans l'étude. Des données sociodémographiques, des connaissances, des pratiques et des méthodes, ainsi que la longévité dans le service ont été collectées à l'aide d'un questionnaire bien structuré. Les données collectées ont été saisies dans un tableur et analysées avec SPSS version 20.4 pour obtenir des fréquences et des associations entre les variables. Les résultats ont révélé que 79.7% (85/150) des travailleurs de la santé étaient conscients des pratiques appropriées de séparation des déchets, et 58.1% (81/150) ont déclaré avoir reçu une formation régulière sur les protocoles de gestion des déchets. De plus, 60% (90/150) des établissements manquaient d'infrastructures adéquates pour l'élimination des déchets, ce qui entraînait des méthodes d'élimination inappropriées, telles que le mélange de déchets dangereux avec des déchets généraux. L'étude a identifié une corrélation significative entre la formation et la conformité aux pratiques de gestion des déchets, indiquant qu'une formation renforcée pourrait améliorer les résultats de la gestion des déchets. Les résultats de cette étude mettent en évidence des lacunes critique dans les pratiques de gestion des déchets. Les déchets solides sont de plus en plus présent dans les établissements de sante de Bafoussam au Cameroon. Cette situation souligne la nécessite de programme de formation complète et d'infrastructures améliorées dans les établissements de sante de Bafoussam. Etude souligne l'importance d'élaborer une politique de gestion des déchets solide et adaptée aux besoins locaux, qui peut atténuer considérablement les risques sanitaires et renforcer la protection de l'environnement. En relevant ces défilés établissements de sante peuvent améliorer leurs pratiques de gestion des déchets préservant ainsi la sante publique et l'environnement.

Mots clés : Gestion des déchets, Pratique, Modes d'élimination, Bafoussam, Etablissements de santé.

INTRODUCTION

Introduction

Healthcare facilities generate a significant amount of waste, including infectious, hazardous, and general waste. Improper management of this waste poses serious risks to human health and the environment (WHO, 2023). In Bafoussam, Cameroon, where healthcare infrastructure and waste management systems may be limited, the risks associated with healthcare waste can be particularly acute (OECD, 2022). This research aims to assess the waste management risks in healthcare facilities in Bafoussam, Cameroon. By identifying the specific risks associated with different types of healthcare waste and evaluating the current waste management practices, this study will provide valuable insights into the potential public health and environmental hazards. The research will focus on the following key areas: identifying the types and quantities of waste generated by different healthcare facilities in Bafoussam, evaluating the existing systems for collection, storage, treatment, and disposal of healthcare waste, determining the factors that contribute to improper waste management, such as inadequate infrastructure, lack of training, and poor enforcement of regulations, assessing the risks associated with exposure to healthcare waste, including infectious diseases, chemical hazards, and environmental pollution (EPA, 2023**).**

Background

Waste management is a critical process that involves the collection, transportation, treatment, and disposal of waste materials in a manner that safeguards human health and the environment. It encompasses various activities, including waste generation reduction, waste collection, waste treatment, and waste disposal. Effective waste management is essential for minimizing the negative impacts of waste on public health and the environment (WHO, 2023).

Several factors influence the effectiveness of waste management systems including, population growth, economic development, innovations in technology which enhance waste management efficiency, such as through automated sorting systems and advanced treatment methods (OECD, 2022).

Improper Waste Disposal can leak contaminants, and open burning of waste can release harmful pollutants into the air. More so, Waste decomposition contributes to greenhouse gas emissions, exacerbating climate change (EPA, 2023) contributing to respiratory diseases and other health issues especially in low income regions. Healthcare waste management is a critical issue globally, with significant implications for public health (Giusti , 2009**)** The improper handling and disposal of healthcare waste (HCW) can lead to increased morbidity and mortality rates, particularly in low- and middle-income countries (Gullakota *et al*., 2020). Globally,

approximately 85% of healthcare waste is classified as non-hazardous, while the remaining 15% is hazardous, which includes infectious, toxic, and radioactive materials (Cook *et al.,* 2021**)**. Healthcare facilities generate about 5.9 million tonnes of HCW annually, contributing to the overall 1.47 billion tonnes of solid waste produced each year (Yazie *et al.,* 2019**).** Unsafe disposal practices, particularly in low-income countries, have been linked to significant health risks. For instance, unsafe injections are responsible for approximately 33,800 new HIV infections, 1.7 million hepatitis B infections, and 315,000 hepatitis C infections annually. Healthcare waste can harbor harmful microorganisms, leading to infections among healthcare workers, patients, and the general public. The risk of infection from needle-stick injuries is particularly high, with a 30% risk of hepatitis B, 1.8% for hepatitis C, and 0.3% for HIV from a single exposure (Hasan *et al*., 2018).

These regions often lack proper waste segregation and disposal systems, leading to higher risks of exposure to hazardous waste. For example, studies in Ethiopia indicated that 35% of healthcare facilities improperly disposed of sharps, increasing the risk of injury and infection (Yazie *et al,* 2019**) .**Countries in sub-Saharan Africa are faced with limited healthcare infrastructure, only 25% of health facilities have basic healthcare waste management services, exacerbating the risks associated with HCW (McPhail , 2016) .

However, in Africa presents significant challenges that directly impact public health. The continent faces a dual burden of inadequate waste management systems and high rates of morbidity and mortality associated with poor healthcare practices. Many African nations are classified as low-income, where healthcare systems are underfunded and lack the necessary infrastructure for effective waste management. This leads to higher risks of disease transmission and environmental contamination. Rapid urbanization in Africa has strained existing waste management systems, leading to increased health risks in densely populated areas where waste is often improperly disposed of waste (Abdel *et al.,* 2018). Healthcare facilities in Africa generate substantial amounts of waste, but many do not have effective systems for waste segregation and disposal. For instance, studies indicate that in some countries, healthcare facilities lack basic waste management services, with only about 25% having adequate systems in place (McPhail, 2016**).** Unsafe healthcare waste management practices contribute to the transmission of diseases. The World Health Organization (WHO) estimates that unsafe injections alone lead to approximately 33,800 new HIV infections and millions of hepatitis infections annually, with a significant portion occurring in Africa (Hasan *et al.,* 2018**)** . Poor water, sanitation, and hygiene (WASH) practices, which are often linked to inadequate waste management, result in high morbidity and mortality rates from waterborne diseases. In Africa,

approximately 1.4 million deaths were associated with suboptimal WASH practices in 2019, with millions more suffering from related health issues (Aboelnour *et al.*, 2019**).**

In a study in Ghana by (Bhada *et al.*, 2018) in Accra, the waste generation rate was approximately 0.8 kg per capita per day, leading to a total of about 1,200 tons of waste generated daily. The study highlighted that 70-80% of the waste generated is recyclable, yet only about 4%is actually recycled. In another study in Nigeria (Lagos} conducted by (Hoornweg *et al.*, 2012) focusing on collection methods and the involvement of the private sector, shows that Lagos generates approximately 13,000 tons of waste daily, with a collection coverage of about 40%. The study noted that private sector involvement in waste collection is significant, with private companies handling about 60% of the waste in Lagos In addition, (UNEP, 2018) carried a study in the Democratic Republic of Congo (Kinshasa) which indicated that Kinshasa generates about 7,800 tons of municipal solid waste daily. The current waste management system emits approximately 640,673 tons of CO2 equivalent per year.

In Cameroon, a study conducted on the "Clinical Waste Management Practices in Hospitals" focused on the practices of clinical waste management in various hospitals across Cameroon, showed approximately 70% of hospitals did not have proper waste segregation systems in place, resulting in hazardous waste being disposed of alongside non-hazardous waste. The study indicated that 60% of hospitals relied on substandard incinerators for waste disposal, which posed significant health risks due to incomplete combustion and emissions (Wassie *et al.*, 2022**).**

Statement of the problem

Waste management and risk in healthcare facilities in Bafoussam, Cameroon, is critical due to several pressing issues that threaten public health and the environment (Ministry of Public health, Cameroon, 2019**).** Poor waste management practices, especially in healthcare settings, have been linked to higher morbidity rates due to infectious diseases. For instance, children living near clinical waste disposal sites have shown increased rates of respiratory, intestinal, and skin infections (Ministry of Public health Cameroon, 2019). A study indicated risk ratios of 3.54 for respiratory infections and 3.20 for intestinal infections among children exposed to poorly managed waste sites compared to unexposed children (Mochungong *et al.*, 2010**).** The lack of proper waste disposal methods can result in outbreaks of diseases. The environmental degradation caused by poor waste management can indirectly contribute to mortality rates. Contaminated water sources and soil can lead to widespread health issues, including cholera and other waterborne diseases, which can be fatal if not addressed promptl .

To harmonized this fast growing problem hospital are expected to manage waste by constructing a medical waste treatment units, following the national medical waste management guidelines, training and capacity building of hospital workers, regulatory Framework and enforcement of existing laws that mandate safe waste disposal practices in healthcare facilities, and community awareness programs about the dangers of improper waste disposal (Ministry of Public health, Cameroon, 2019). However, many hospitals in Cameroon, including those in Bafoussam locality fall short of this recommendation.

Despite the availability of methods and guidelines for managing hospital waste, healthcare facilities face numerous challenges that hinder effective waste management including; lack sufficient training in waste management practices, limited access to proper disposal facilities, limited financial resources can impede hospitals' ability to implement waste management technologies and training programs, cultural and Behavioral factors, which eventually lead to poor disposal methods, such as open burning or landfilling of medical waste, causing significant environmental pollution (Chowdhury *et al.*, 2019). Hence, Assessment of waste management risk in health care facilities in Bafoussam, Cameroon, is crucial to identify areas for improvement and ensure the delivery of high-quality care and better waste management techniques.

Significant of the study

The significance of the study on poor waste management in Bafoussam is multifaceted. To begin, it seeks to enhance community health outcomes. Also, to address environmental sustainability by highlighting the detrimental effects of waste mismanagement on natural resources, guiding policymakers toward implementing effective waste management systems. Additionally, to examine existing legal frameworks, revealing gaps that need to be addressed to strengthen regulations and ensure compliance with waste management standards.

Research Question

Main research question

Can compliance to proper health care waste management handling and disposal among health care facilities in Bafoussam West region of Cameroon enhance hospital waste handling (management and disposal) processes.

Specific research question

1. Can surveillance on hospital waste handling and disposal reveal the various types and magnitude of healthcare waste produced in healthcare facilities in Bafoussam, their handling and disposal procedures, and the knowledge of both healthcare professional, patients and or care givers?
2. Can knowledge, attitude and practices of health personnel towards hospital waste management in healthcare facilities reveal the actual hospital hygiene and hazard/waste exposure associated health risk to healthcare professional and patients and or care givers?
3. Can well designed and validated series of standard operating procedures/approaches (SOP) for proper handling and disposal of selected health care waste classes, if applied, increase hospital hygiene and safety of healthcare professional and patients and or care givers?

Hypothesis

- Hospital waste is not properly managed in health care facilities Bafoussam and the personnel have inadequate knowledge on hospital waste management.

Research objective

Main research objective

To evaluate waste management risk in healthcare facilities in Bafoussam, Cameroon, and to propose possible management strategies to enhance hospital waste handling (management and disposal) processes.

Specific Research Objectives

The specific research objectives of this study were:

1. To identify the types and magnitude of healthcare waste produced in healthcare facilities in Bafoussam, Cameroon.
2. To assess the knowledge, attitude and practices of health personnel towards hospital waste management in healthcare facilities in Bafoussam, Cameroon.
3. To develop a manual of procedures on how to properly manage the handling and disposal of healthcare waste in health care facilities in Bafoussam Cameroon.

CHAPTER ONE

CHAPTER ONE:

LITERATURE REVIEW

1.1. Introduction

Healthcare facilities produce a substantial volume of waste, which includes infectious, hazardous, and general waste. If not managed properly, this waste can pose significant dangers to both human health and the environment (Mochungong *et al.,* 2012**).** In Bafoussam, Cameroon, where healthcare infrastructure and waste management capabilities may be limited, the risks tied to healthcare waste can be particularly severe (Ministry of Public Health, Cameroon, 2019). This study aims to evaluate the risks associated with waste management in healthcare facilities in Bafoussam, Cameroon. By pinpointing the specific risks linked to various types of healthcare waste and reviewing current waste management practices, the research will offer valuable insights into potential public health and environmental threats (Ministry of Public health Cameroon**,** 2019).

The research will concentrate on several key aspects: identifying the types and volumes of waste produced by different healthcare facilities in Bafoussam, assessing the existing systems for the collection, storage, treatment, and disposal of healthcare waste, examining the factors that lead to inadequate waste management—such as insufficient infrastructure, lack of training, and weak enforcement of regulations—and evaluating the risks related to exposure to healthcare waste, which may include infectious diseases, chemical hazards, and environmental pollution(Mochungong *et al.,* 2012).

Definition

Waste management is a critical process that involves the collection, transportation, treatment, and disposal of waste materials in a manner that safeguards human health and the environment. It encompasses various activities, including waste generation reduction, waste collection, waste treatment, and waste disposal. Effective waste management is essential for minimizing the negative impacts of waste on public health and the environment (WHO, 2023**).** Several factors influence the effectiveness of waste management systems including, population growth, economic development, innovations in technology which enhance waste management efficiency, such as through automated sorting systems and advanced treatment methods (Maranzano *et al*, 2022**).**

1.2. Types of biomedical wastes

In healthcare facilities, effective waste management is crucial to minimize health risks and environmental impacts. Wastes can be categorized into several distinct types, each requiring specific management practices (Chowdhury *et al.*, 2010).

Infectious Waste: This includes waste that is known or suspected to contain pathogens capable of causing disease. Examples are used bandages, surgical gloves, and any materials contaminated with blood or other body fluids (Chowdhury *et al.*, 2010).

Pathological Waste: This type encompasses human tissues, organs, body parts, and fluids removed during surgeries or autopsies. It also includes contaminated animal carcasses .

Sharps Waste: Sharps are items that can puncture or cut the skin, such as needles, syringes, scalpels, and broken glass. Proper disposal is critical to prevent injuries and the spread of infections (Chowdhury et al., 2010).

Chemical Waste: This includes any chemical substances that are no longer needed, such as solvents, disinfectants, and heavy metals from medical devices. Improper disposal can pose significant risks to human health and the environment.

Pharmaceutical Waste: This category consists of expired or unused medications, as well as items contaminated with pharmaceuticals. It also includes cytotoxic waste, which contains substances with genotoxic properties, often used in cancer treatments (Mochungong *et al.*, 2012)**.**

Radioactive Waste: Generated from the use of radioactive materials in diagnostics and treatment, this waste requires special handling and disposal methods to prevent exposure to radiation.

Non-Hazardous or General Waste: This includes waste that does not pose any particular biological, chemical, radioactive, or physical hazard, such as paper, packaging, and food waste .

1.2.1. Proper waste management

Proper management of waste in healthcare facilities is essential to ensure safety for patients, healthcare workers, and the environment. Effective waste management involves several key practices tailored to the different types of waste generated in these settings (Yazie *et al.*, 2019).

Waste Segregation

Segregation is the first and most crucial step in waste management. Healthcare facilities must separate waste at the point of generation to ensure that each type of waste is disposed of safely and appropriately

Infectious Waste Should be placed in leak-proof biohazard bags or containers marked with the biohazard symbol (Yazie *et al.*, 2019)

Pathological Waste: Requires separate containers that are securely closed and labeled.

Sharps Waste: Must be disposed of in puncture-resistant containers specifically designed for sharps, ensuring they are not recapped or bent before disposal (Yazie *et al.*, 2019).

Chemical and Pharmaceutical Waste: Should be stored in clearly labeled containers that comply with hazardous waste regulations (Ngambi *et al.*, 2015**).**

Non-Hazardous Waste: Can be disposed of in regular waste bins but should still be separated from hazardous materials (Tini, 2013**).**

Safe Storage

Once waste is segregated, it must be stored safely until it can be treated or disposed of.

Labeling: All waste containers should be clearly labeled to indicate the type of waste they contain.

Containment: Waste should be stored in leak-proof, puncture-resistant containers to prevent spills and contamination (Yazie *et al.*, 2019).

Ventilation: Storage areas should be well-ventilated and maintained at appropriate temperatures to minimize odors and prevent pest infestations (Tini, 2013).

Access Control: Storage areas should be secured and accessible only to authorized personnel to prevent unauthorized access and potential .

Waste Treatment

Treatment methods vary depending on the type of waste and its associated risks.

Autoclaving: This method uses steam under pressure to sterilize infectious waste, rendering it safe for disposal. It is effective for most types of biohazardous waste (Gagoa *et al.*, 2020).

Incineration: High-temperature incineration is used for pathological and some pharmaceutical wastes. It reduces waste volume and eliminates pathogens but must comply with environmental regulations to minimize emissions (Ndam, 2020).

Chemical Disinfection: This method involves using chemical agents to neutralize hazardous waste, particularly for certain types of pharmaceutical and chemical waste (Ndam, 2020).

Microwave Treatment: An emerging technology that uses microwaves to treat infectious waste, effectively sterilizing it before disposal (Ndam, 2020).

Disposal

After treatment, waste must be disposed of in accordance with local regulations.

Landfilling: Treated non-hazardous waste can be sent to landfills that meet regulatory standards.

Specialized Facilities: Hazardous waste, including certain chemical and pharmaceutical wastes, should be disposed of at facilities equipped to handle such materials safely (Belomo, 2014).

Regular Disposal Schedule: Healthcare facilities should establish a regular schedule for waste collection and disposal to prevent accumulation and potential hazards (Belomo 2014).

Training and Compliance

Training healthcare workers on proper waste management practices is essential.

Education on Waste Types: Staff should be educated about the different types of waste and the importance of segregation .

Safety Protocols: Training should cover safety protocols for handling and disposing of hazardous waste to minimize risks

Regulatory Compliance: Facilities must ensure that all waste management practices comply with local, state, and federal regulations to avoid legal issues and protect public health (Belomo, 2014).

1.2.2 Significance of proper waste management for public health and environmental protection

Proper waste management in healthcare facilities is crucial for both public health and environmental protection

Public Health Protection

1. **Reduction of Infectious Diseases**: Proper segregation and disposal of infectious waste minimize the risk of disease transmission to healthcare workers, patients, and the general public. This is particularly important in preventing outbreaks of infections that can arise from improperly handled medical waste (Ndam, 2020).

2. **Prevention of Injuries:** Effective management of sharps waste, such as needles and scalpels, reduces the incidence of injuries that can lead to infections, including bloodborne diseases like HIV and hepatitis **(**Belomo, 2014).

3. **Mitigation of Chemical Exposure**: Proper disposal of hazardous chemical waste prevents toxic exposure to healthcare workers and the surrounding community, reducing the risk of chemical burns and long-term health effects from hazardous substances (Tini, 2003)

4. **Control of Antimicrobial Resistance:** Safe disposal of pharmaceutical waste, particularly antibiotics and cytotoxic drugs, helps prevent the spread of antimicrobial resistance, which is a growing public health concern.

1.2.3 Environmental Protection

1. **Reduction of Pollution:** Proper waste management practices, such as recycling and safe disposal methods, help prevent the contamination of soil and water sources. This is essential for protecting ecosystems and maintaining biodiversity.
2. **Minimization of Greenhouse Gas Emissions:** Effective waste management can reduce the amount of waste sent to landfills, thereby decreasing methane emissions, a potent greenhouse gas produced from decomposing organic waste.
3. **Sustainable Resource Use:** By promoting recycling and recovery of materials, healthcare facilities can reduce the demand for raw materials, leading to more sustainable resource use and less environmental degradation.
4. Compliance with Regulations: Proper waste management ensures compliance with local and international regulations, which are designed to protect public health and the environment. This compliance is essential for maintaining the facility's reputation and avoiding legal penalties (Ngambi, *et al.,* 2015).

1.3 National and international guidelines on healthcare waste management

It is essential for ensuring the safe handling, treatment, and disposal of waste generated in healthcare settings. The World Health Organization (WHO) has developed comprehensive guidelines that serve as a framework for countries to manage healthcare waste effectively (Ngambi, *et al.*,2015).

1.3.1 WHO Guidelines on waste management

Classification of Healthcare Waste

WHO categorizes healthcare waste into several types, including infectious waste, pathological waste, sharps waste, chemical waste, pharmaceutical waste, radioactive waste, and non-hazardous waste. Each category requires specific management practices to mitigate health risks and environmental impacts c

Waste Segregation

Proper segregation at the point of generation is emphasized to prevent the mixing of hazardous and non-hazardous waste. This practice is crucial for ensuring safe disposal and treatment (Ngambi, *et al,*. 2015).

Storage and Transportation

Guidelines recommend secure and safe storage of waste until it can be treated or disposed of. Waste containers should be clearly labeled, leak-proof, and puncture-resistant. Transportation of waste should also follow strict protocols to prevent spills and exposure.

Treatment Methods

WHO advocates for environmentally sound treatment methods, such as autoclaving, incineration, and chemical disinfection. The choice of treatment should be based on the type of waste and available resources, with a preference for methods that minimize environmental impact.

Disposal Practices

Safe disposal methods must be employed for treated waste, including landfilling or specialized disposal facilities for hazardous waste. Compliance with local regulations is essential to ensure public health and environmental protection.

Training and Awareness

WHO emphasizes the importance of training healthcare workers on proper waste management practices. This includes educating staff about the risks associated with healthcare waste and the importance of following established protocols .

Monitoring and Evaluation

Continuous monitoring and evaluation of waste management practices are recommended to ensure compliance with guidelines and to identify areas for improvement (Ngambi, *et al*,. 2015).

1.3.2 National guidelines

In Cameroon, healthcare waste management is governed by a combination of national regulations and international guidelines. Cameroon has established specific laws and frameworks to address the challenges associated with healthcare waste, ensuring public health and environmental protection (Belomo, 2014).

Environmental Management Law

The primary legal framework for environmental protection in Cameroon is the Law No. 96/12 of August 5, 1996, which outlines the principles of environmental management, including waste management. This law emphasizes the need for sustainable development and the protection of public health and the environment (Belomo, 2014).

Decree No. 2005/0574/PM

This decree, issued on February 16, 2005, specifically addresses the management of healthcare waste. It provides guidelines for the classification, segregation, storage, treatment, and disposal of healthcare waste. The decree mandates that healthcare facilities develop waste management plans and implement appropriate waste handling practices (Belomo, 2014).

Ministerial Orders

Various ministerial orders complement the above laws by providing detailed technical guidelines for waste management in healthcare settings. These orders specify the responsibilities of healthcare facilities in managing waste, including the need for training staff and ensuring compliance with waste management protocols (Tini, 2003).

National Health Policy

The National Health Policy of Cameroon includes provisions for the management of healthcare waste as part of broader public health initiatives. It emphasizes the importance of reducing health risks associated with waste and promoting safe disposal practices (Tini, 2003).

1.3.3 Enforcement Mechanisms

Regulatory Bodies: The enforcement of healthcare waste management regulations is overseen by several government bodies, including the Ministry of Public Health and the Ministry of Environment, Protection of Nature and Sustainable Development. These ministries are responsible for monitoring compliance with waste management laws and regulations.

Inspections and Audits: Regular inspections and audits of healthcare facilities are conducted to ensure adherence to waste management protocols. Facilities found to be non-compliant may face penalties, including fines or closure until compliance is achieved .

Training and Capacity Building: The government, in collaboration with international organizations, conducts training programs for healthcare workers on proper waste management practices. This capacity-building initiative aims to enhance the skills and knowledge of staff involved in waste handling**.**

Public Awareness Campaigns: Efforts are made to raise awareness among healthcare workers and the public about the importance of proper waste management. These campaigns aim to foster a culture of compliance and responsibility regarding healthcare waste (Gagoa *et al.*, 2006).

1.4 Challenges and Recommendations

Waste management in healthcare settings presents numerous challenges that can impact both public health and environmental safety. Despite the existing regulations, challenges remain in the effective management of healthcare waste in Cameroon. Issues such as inadequate infrastructure, limited resources, and insufficient training can hinder compliance. To improve the situation, it is important to (Gagoa *et al.,* 2006).

Diverse Waste Types

Healthcare facilities generate a wide variety of waste, including hazardous, medical, pharmaceutical, infectious, solid, food, and general waste. Each type requires specific handling, storage, and disposal methods, complicating the waste management process .

Regulatory Compliance

Healthcare waste is subject to stringent federal, state, and local regulations. Compliance with these regulations requires extensive training, documentation, and resources, which can be burdensome for healthcare facilities, especially smaller ones.

Cost Implications

Proper waste management can be costly, encompassing expenses related to segregation, collection, transportation, treatment, and disposal. These costs can strain the budgets of healthcare facilities, particularly those serving underserved communities (Gagoa *et al,*. 2006).

Infection Control Risks

Improperly managed healthcare waste can pose significant health risks, including the potential spread of infectious diseases. Waste containing infectious pathogens can endanger healthcare workers, patients, and the community if not handled correctly .

Staff Training and Awareness

Ensuring that all healthcare staff are adequately trained in waste management protocols is a challenge. Regular training sessions are necessary to foster a culture of compliance and accountability, but they can be resource-intensive

Waste Segregation Issues

Effective waste segregation at the point of generation is critical for efficient waste management. However, improper segregation often occurs, leading to contamination of waste streams and complicating disposal processes.

Environmental Impact

The disposal of healthcare waste, particularly through incineration, can lead to environmental pollution. Inefficient disposal methods can release harmful pollutants into the atmosphere, contributing to broader environmental issues (Kelly *et al*,.2007).

Lack of Infrastructure

In many regions, especially in low-resource settings, there is inadequate infrastructure for the safe disposal and treatment of healthcare waste. This can lead to improper disposal practices and increased health risks (Kelly, *et al*,. 2007).

1.5 Studies on waste management in Cameroon

In Cameroon, the challenges associated with healthcare waste management have been documented in various studies, highlighting the complexities faced by healthcare facilities in managing waste effectively.

Urban Governance and Waste Management

A study focusing on Yaoundé, the capital of Cameroon, examined the urban governance of household waste, including healthcare waste. It identified significant inadequacies in waste management standards and compliance, which directly impact public health and environmental sustainability. The study emphasized that the lack of effective governance structures contributes to the challenges faced in managing healthcare waste, leading to increased health risks and environmental degradation.

Clinical Waste Management Policy

Research evaluating the development of a clinical waste management policy in Cameroon highlighted several challenges, including the absence of a comprehensive waste management framework. Stakeholders identified issues such as cross-contamination, environmental pollution, and inadequate waste management sites as critical risk factors associated with poor clinical waste management. The study underscored the need for strong economic and political support to develop and implement effective waste management policies .

Plastic Waste Management

A longitudinal study on plastic waste management in Cameroon revealed that while there is potential for value creation through improved waste management practices, the current systems are still in their infancy. The study pointed out that the transition to a circular economy is hindered by various challenges, including a lack of understanding of waste management processes, insufficient technological capabilities, and the need for systemic changes in product design and business models (Ngnikam, 2013).

Health Impacts of Poor Waste Management

Another study highlighted the direct consequences of the waste crisis in Cameroon, linking inadequate waste management practices to negative impacts on public health and the environment. The research indicated that improper disposal of healthcare waste contributes to the spread of infectious diseases and poses significant health risks to both healthcare workers and the community (Monseingeon *et al.*, 2014).

Stakeholder Engagement and Compliance

The involvement of various stakeholders in waste management processes was also examined. The study found that effective collaboration among government agencies, healthcare facilities, and non-governmental organizations is crucial for improving compliance with waste management regulations. However, challenges such as limited resources and lack of awareness among healthcare workers hinder effective waste management practices (Ngnikam, 2013).

1.6 Risk assessment in waste management

Risk assessment in waste management is a systematic process used to identify, evaluate, and prioritize risks associated with waste generation, handling, treatment, and disposal. This process is crucial for ensuring public health and environmental safety, particularly in healthcare settings where the waste can be hazardous (Ngnikam, 2013).

This involves recognizing the types of waste generated and their potential hazards. In healthcare, this includes infectious waste, sharps, chemical waste, and pharmaceutical waste. Each type poses different risks to health and the environment. After identifying hazards, the next step is to analyze the risks associated with them. This includes evaluating the likelihood of exposure to these hazards and the potential consequences. For example, improper disposal of infectious waste can lead to disease transmission. This step involves comparing the estimated risks against predetermined criteria to determine their significance. It helps in prioritizing which risks need immediate attention and which can be managed with existing controls (Ngnikam, 2013).

Based on the evaluation, appropriate measures are developed to mitigate identified risks. This may include implementing better waste segregation practices, improving storage conditions, or enhancing treatment methods. Continuous monitoring of waste management practices is essential to ensure that risk control measures are effective. Regular reviews help in adapting to new challenges and improving waste management strategies .

1.7 Theories related to waste management

1.7.1 Risk Assessment Matrix (RAM)

A theory that is a widely used tool in risk management, particularly in healthcare settings, to evaluate and prioritize risks associated with various activities, including waste management. This matrix provides a visual representation of risks based on two key dimensions: the likelihood of an event occurring and the severity of its consequences**.**

This dimension assesses the probability that a specific risk event will occur. It is often categorized into levels such as:

- Rare
- Unlikely
- Possible
- Likely
- Almost Certain

This dimension evaluates the potential impact of the risk event if it occurs. Severity levels may include: Insignificant, Minor, Moderate, Major and Catastrophic**.**

RAM is typically structured as a grid, with one axis representing likelihood and the other representing severity. Each cell in the matrix corresponds to a specific combination of likelihood and severity, allowing for the classification of risks into categories such as low, medium, high, and very high.

By multiplying the likelihood score by the severity score, a risk score is generated. This score helps in determining the overall risk level associated with a particular hazard. For example, if a risk is deemed "Likely" (4) and the consequence is "Major" (4), the risk score would be 16, indicating a high level of risk.

1.7.2 Benefits of Using RAM

The matrix provides a clear visual representation of risks, making it easier for decision-makers to understand and communicate risk levels. By categorizing risks based on their scores, organizations can prioritize which risks require immediate attention and which can be monitored over time. The RAM encourages discussion among stakeholders about the severity and likelihood of risks, promoting a common understanding of potential hazards (Sotamenou, *et al*,. 2010).

1.7.3 Limitations of RAM

The assessment of likelihood and severity can be subjective, leading to inconsistencies in how different users interpret and apply the matrix. While the RAM is a useful tool, it may oversimplify complex risk scenarios, failing to capture the nuances of certain risks. The RAM should be used as part of a broader risk management strategy, including detailed assessments and mitigation plans for high-risk areas **.**

In summary, the Risk Assessment Matrix is a valuable tool for assessing and managing risks in healthcare waste management. By providing a structured approach to evaluate the likelihood and severity of risks, it helps organizations prioritize their efforts to enhance safety and compliance (Sotamenou, *et al*,. 2010).

1.7.4 The ISO 31000 Risk Management Framework

This is a comprehensive and widely recognized standard for risk management applicable across various sectors, including healthcare. This framework provides guidelines for organizations to effectively manage risks, ensuring that they can achieve their objectives while minimizing potential negative impacts (Safitri *et al*., 2017).

ISO 31000 outlines several key principles that underpin effective risk management:

Risk management should be integrated into the organization's governance structure and decision-making processes. The approach to risk management should be structured and comprehensive, ensuring that all relevant risks are considered (Safitri *et al* ., 2017).

Stakeholder involvement is crucial for understanding risks and their impacts, promoting a culture of transparency and accountability. The risk management process should be adaptable to changes in the internal and external environment.

The ISO 31000 framework consists of three main components (Safitri *et al*.,2017**).**

Leadership and Commitment: Strong leadership is essential for fostering a risk-aware culture and ensuring that risk management is prioritized at all levels of the organization.

Integration into Governance: Risk management should be embedded in the organization's governance structure, aligning with its objectives and strategies.

Continuous Improvement: Organizations should continuously improve their risk management processes through regular reviews and updates.

Process: The risk management process outlined in ISO 31000 includes several steps:

- Recognizing and defining risks that could affect the organization's objectives.
- Analyzing and evaluating the identified risks to understand their potential impact and likelihood.

- Developing strategies to mitigate, transfer, accept, or eliminate risks based on their assessment.
- Continuously monitoring the risk environment and reviewing the effectiveness of risk management strategies to ensure they remain relevant and effective.

1.7.5 Benefits of ISO 31000

By providing a structured approach to risk management, ISO 31000 helps organizations make informed decisions that consider potential risks and their impacts (Giusti, 2020).
Organizations that implement ISO 31000 are better equipped to anticipate and respond to risks, enhancing their overall resilience (Giusti, 2020).
Adopting the ISO 31000 framework can help organizations comply with legal and regulatory requirements related to risk management (Giusti, 2020).

1.8 Human Factors Theory in Risk Management

The Human Factors Theory focuses on understanding how human behavior, capabilities, and limitations impact risk management processes, particularly in healthcare settings. This theory emphasizes that effective risk management is not solely about systems and processes but also about the people who operate within those systems (Environment Statistics, 2017**).**
Human factors theory examines how individuals behave in various situations, including their decision-making processes, risk perception, and responses to training. Recognizing that human error can significantly contribute to risks is crucial for developing effective management strategies [G**iusti, L. et al 2020**]. Effective training programs are essential for ensuring that healthcare workers understand the risks associated with waste management and the procedures to mitigate those risks. Training should be tailored to the specific needs of the staff and the types of waste they handle (Environment Statistics, 2017**).**
The design of the work environment can influence how healthcare workers interact with waste management systems. Ergonomic considerations, clear signage, and accessible waste disposal options can reduce the likelihood of errors and improve compliance with waste management protocols. Effective communication among healthcare staff is vital for identifying and managing risks. Encouraging teamwork and open dialogue can help in sharing knowledge about potential hazards and best practices for waste management (Environment Statistics, 2017).
Implementing feedback systems allows healthcare workers to report issues or near misses related to waste management. This information can be used to improve processes and training, ultimately enhancing safety (Environment Statistics, 2017).

Application in Healthcare Waste Management

In the context of healthcare waste management, applying human factors theory can lead to:

Reduced Errors: By understanding the human elements that contribute to waste management failures, organizations can implement strategies to minimize errors, such as simplifying procedures and providing adequate training (Watts *et al.,* 2023**).**

Enhanced Compliance: When healthcare workers are well-trained and the work environment is designed to support safe practices, compliance with waste management protocols is likely to improve (Watts *et al*., 2023**).**

Improved Safety Culture: Fostering a culture that values safety and encourages reporting of risks can lead to more proactive management of healthcare waste, ultimately protecting public health and the environment (Watts *et al.,* 2023**)**.

1.8.1 Health risk Associated with Improper waste Management

Improper waste management in healthcare facilities significantly increases the risk of infectious diseases. This risk arises from the presence of various types of waste that can harbor pathogens capable of causing infections **(**Nzediegwu *et al.*,2020**).**

Types of Infectious Waste

Sharps: Needles, scalpels, and other sharp instruments that can puncture the skin and introduce pathogens.

Biological Waste: Materials contaminated with blood, bodily fluids, or other potentially infectious materials.

Pathological Waste: Human tissues, organs, and body parts that may contain infectious agents.

Transmission Pathways

Improper disposal of infectious waste can lead to disease transmission through various pathways:

Needle-stick Injuries Healthcare workers are at risk of needle-stick injuries when sharps are not disposed of in designated containers. These injuries can transmit bloodborne pathogens such as HIV, hepatitis B, and hepatitis C (Nzediegwu *et al., 2*020**).**

Environmental Contamination: When infectious waste is improperly disposed of in landfills or incinerated without adequate controls, pathogens can contaminate the surrounding environment. This can lead to the spread of infections in the community, particularly if waste leaches into groundwater or is carried by pests (Butterworth *et al,*. 2003**).**

Direct Contact: Healthcare workers and waste handlers may come into direct contact with infectious waste if proper personal protective equipment (PPE) is not used or if waste is not properly segregated and contained (Butterworth *et al*,. 200).

At-Risk Populations

Certain groups are particularly vulnerable to the health risks associated with improper waste management:

Healthcare Workers: They are at the highest risk due to their direct exposure to infectious waste during handling and disposal (Nzediegwu *et al., 2*020**).**

Patients: Infected waste can pose risks to patients, especially those with compromised immune systems, who may be more susceptible to infections **(**Kumari *et a.,l* 2023**).**

Community Members: Improperly managed waste can expose the general public to infectious agents, particularly in areas near healthcare facilities or waste disposal sites(Butterworth *et al* ,.2003**).**

Preventive Measures

To mitigate the risks of infectious diseases associated with improper waste management, healthcare facilities should implement the following measures:

- Waste should be segregated at the point of generation to ensure that infectious waste is handled appropriately.
- Healthcare workers should be trained to use appropriate PPE when handling waste to minimize exposure risks.
- Regular training programs should be conducted to educate staff about the risks associated with infectious waste and the importance of proper waste management practices (Butterworth *et al.,* 2003**)**.

1.8.2 Exposure to Toxic Substances and Improper Waste Management

Improper waste management in healthcare facilities can lead to significant exposure to toxic substances, which poses serious health risks to healthcare workers, patients, and the surrounding community. This exposure primarily arises from the mishandling of chemical and pharmaceutical waste (Parmesan *et al*.,2022).

Healthcare facilities generate various types of toxic waste, including:

- Chemical solvents, disinfectants, and laboratory reagents that can be harmful if inhaled, ingested, or come into contact with skin.

- Expired or unused medications, particularly those that are cytotoxic (e.g., chemotherapy drugs), can be hazardous. These substances may have toxic effects on human health and the environment if not disposed of properly.
- Items like broken thermometers containing mercury or batteries can release toxic heavy metals into the environment (Parmesan *et al*., 2022).

Health Risks Associated with Toxic Exposure

Exposure to toxic substances from improper waste management can lead to various health issues, including:

Immediate exposure to toxic chemicals can cause symptoms such as skin burns, respiratory distress, and eye irritation. For example, exposure to strong disinfectants can lead to chemical burns or respiratory issues if inhaled (Elegba, *et al*,.2021).

Long-term exposure to certain chemicals can result in serious health conditions, including cancer, reproductive health issues, and neurological disorders. For instance, cytotoxic drugs can have carcinogenic effects if they enter the environment and are not handled correctly (Gollakota, *et al***.,** 2020**).**

Improper disposal of toxic waste can lead to environmental contamination, affecting soil and water quality. This contamination can have indirect health effects on the community, as it may lead to the presence of harmful substances in drinking water or food sources (Gollakota, *et al*,. 2020).

Transmission Pathways

Healthcare workers may come into direct contact with toxic substances if waste is not properly contained or if PPE is inadequate. This can occur during waste handling, cleaning, or disposal processes. Fumes from improperly stored or incinerated chemical waste can be inhaled, leading to respiratory problems and other health issues (Gollakota, *et al.*, 2020).

When toxic waste is improperly disposed of, it can leach into the ground or water supply, leading to broader public health risks as these substances can accumulate in the food chain or contaminate drinking water sources (Elegba, *et al*,.2021).

Preventive Measures

To mitigate the risks associated with toxic exposure, healthcare facilities should adopt the following practices:

- Toxic waste should be segregated from general waste and disposed of according to regulatory guidelines to prevent exposure and environmental contamination.

- Healthcare workers should receive training on the hazards associated with toxic waste and the importance of following proper disposal protocols.
- Adequate PPE should be provided and used by staff handling toxic waste to minimize exposure risks (Mochungong, 2012**).**

1.8.3 Environmental Contamination and Improper Waste Management

Improper waste management in healthcare facilities can lead to significant environmental contamination, which poses serious health risks to the community and the ecosystem. This contamination primarily arises from the disposal of hazardous waste, including infectious, chemical, and pharmaceutical waste **.**

When hazardous waste is improperly disposed of in landfills or dumped in open areas, toxic substances can leach into the soil. This can affect local flora and fauna and lead to bioaccumulation of harmful substances in the food chain (Gollakota, *et al* ,.2020).

Contaminants from healthcare waste can seep into groundwater or surface water bodies. This is particularly concerning for communities that rely on these water sources for drinking and irrigation.

Incineration of healthcare waste without proper controls can release toxic fumes and particulate matter into the air, contributing to air quality issues and respiratory problems in the surrounding population (Dhana, *et al*,. 2021).

Health Risks Associated with Environmental Contamination

Individuals exposed to contaminated soil or water may experience a range of health issues, including gastrointestinal illnesses, skin infections, and respiratory problems. For example, exposure to heavy metals and chemicals can lead to acute poisoning or chronic health conditions such as cancer and neurological disorders (Elegba, 2021). Environmental contamination can have indirect effects on public health. For instance, contaminated water sources can lead to the spread of waterborne diseases, while agricultural products grown in contaminated soil may carry harmful residues that affect consumers

Certain groups, such as children, the elderly, and individuals with pre-existing health conditions, are particularly vulnerable to the effects of environmental contamination. They may experience more severe health outcomes due to their increased susceptibility (Gollakota, *et al*,. 2020**).**

Transmission Pathways

- Contaminated water or food can be ingested, leading to various health issues. For example, drinking water contaminated with pharmaceuticals or heavy metals can have serious health implications.
- Airborne pollutants from the incineration of healthcare waste can be inhaled, causing respiratory problems and other health issues.

Individuals may come into contact with contaminated soil or water, leading to skin infections or absorption of harmful substances through the skin **(**Ahirwar *et al*., 2021).

Preventive Measures

To mitigate the risks associated with environmental contamination, healthcare facilities should implement the following practices:

Ensuring that hazardous waste is properly segregated and disposed of according to regulatory guidelines can significantly reduce the risk of environmental contamination.

Conducting environmental monitoring to assess the levels of contaminants in soil, water, and air can help identify potential risks and inform necessary interventions.

Educating the community about the risks associated with improper waste management and involving them in monitoring efforts can enhance public health protection (Ahirwar *et al*., 2021).

Improper waste management significantly contributes to climate change, primarily through the release of greenhouse gases (GHGs) during the decomposition of organic waste and the incineration of hazardous materials. Here's a detailed look at how these processes impact climate change: When organic waste decomposes anaerobically (without oxygen) (Soroya *et al.*, 2021**),** it produces methane, a potent greenhouse gas that is significantly more effective at trapping heat in the atmosphere than carbon dioxide. Landfills are major sources of methane emissions due to the large amounts of organic waste they contain. The incineration of waste, especially plastics and other synthetic materials, releases carbon dioxide and other harmful gases into the atmosphere. These emissions contribute to the greenhouse effect, leading to global warming **(**Soroya *et al* .,2021**)**

The accumulation of greenhouse gases in the atmosphere is linked to an increase in the frequency and intensity of extreme weather events, such as hurricanes, floods, and droughts. These changes in climate patterns can have devastating effects on ecosystems and human communities. Climate change driven by greenhouse gas emissions contributes to the melting of

polar ice caps and glaciers, resulting in rising sea levels. This poses a threat to coastal communities and ecosystems (Ayeleru *et al*., 2014**)**

Climate change can alter habitats, making them unsuitable for many species. As temperatures rise and weather patterns shift, some species may face extinction if they cannot adapt quickly enough or migrate to more suitable environments. The loss of biodiversity can disrupt ecosystems, leading to a decline in ecosystem services that are vital for human survival, such as pollination, water purification, and carbon sequestration (Sotamenou, 2010**).**

Public Health Implications

Climate change can exacerbate health risks by expanding the range of infectious diseases. Warmer temperatures can facilitate the spread of vector-borne diseases, such as malaria and dengue fever, as the habitats for disease-carrying organisms expand. Changes in climate can affect agricultural productivity, leading to food shortages and increased prices. This can result in malnutrition and food insecurity, particularly in vulnerable populations (Soroya *et al.,* 2021).

Disease Risks Associated with Improper Waste Management in Healthcare

Improper waste management in healthcare facilities poses significant health risks due to the potential for disease transmission. The following points outline the key disease risks associated with inadequate handling and disposal of medical waste:

Waste can contain pathogens that lead to various infectious diseases. For instance, improperly disposed of sharps, such as needles, can transmit bloodborne pathogens like HIV, hepatitis B, and hepatitis C through needle-stick injuries

Waste that includes biological materials from patients tested for parasites can harbor live parasites. If this waste is not disposed of correctly, it can lead to the spread of parasitic infections among healthcare workers and the public (Gollakota, *et al,*. 2020**).**

Meningitis can be contracted through exposure to contaminated bodily fluids. Biomedical waste that contains such fluids poses a risk of meningitis to anyone who comes into contact with it accidentally (Zhang, *et al,*. 2020).

Contact with pathogens in medical waste can lead to skin infections. Healthcare workers must wear appropriate protective gear when handling waste to prevent such infections

Bacteremia, a serious condition where bacteria enter the bloodstream, can occur if sharps or other instruments containing pathogens are improperly disposed of. This can lead to severe systemic infections (Dhana, *et al,*. 2021).

Waste from healthcare facilities can contain Candida albicans, a pathogen that can cause infections, particularly in individuals with prolonged hospital stays. Improper disposal increases the risk of exposure to this pathogen

Improper waste management can also lead to broader public health issues. Contaminated waste can attract pests, which can spread diseases, and environmental contamination can affect water sources, leading to further health risks in the community (Zhang, *et al.*, 2020).

CHAPTER TWO

CHAPTER TWO:

MATERIALS AND METHODS

2.1 Study Area

This study was carried out in Bafoussam, West region of Cameroon. Bafoussam is the capital and largest city of the west region. It is a French-speaking region with a minority of the Anglophone population. It is the third most important (financially) city in Cameroon. It has an estimated population of about 1,146,000 people according to a census conducted in 2019. It is the main city of the Bamileke people. Religions include the Bamileke religion, Christianity and Islam. The main economic activities in Bafoussam are farming and business. It has a cold climatic condition **(**Tsoata *et al.,* 2020**)** Figure 2. below illustrates the map of the West region of Cameroon.

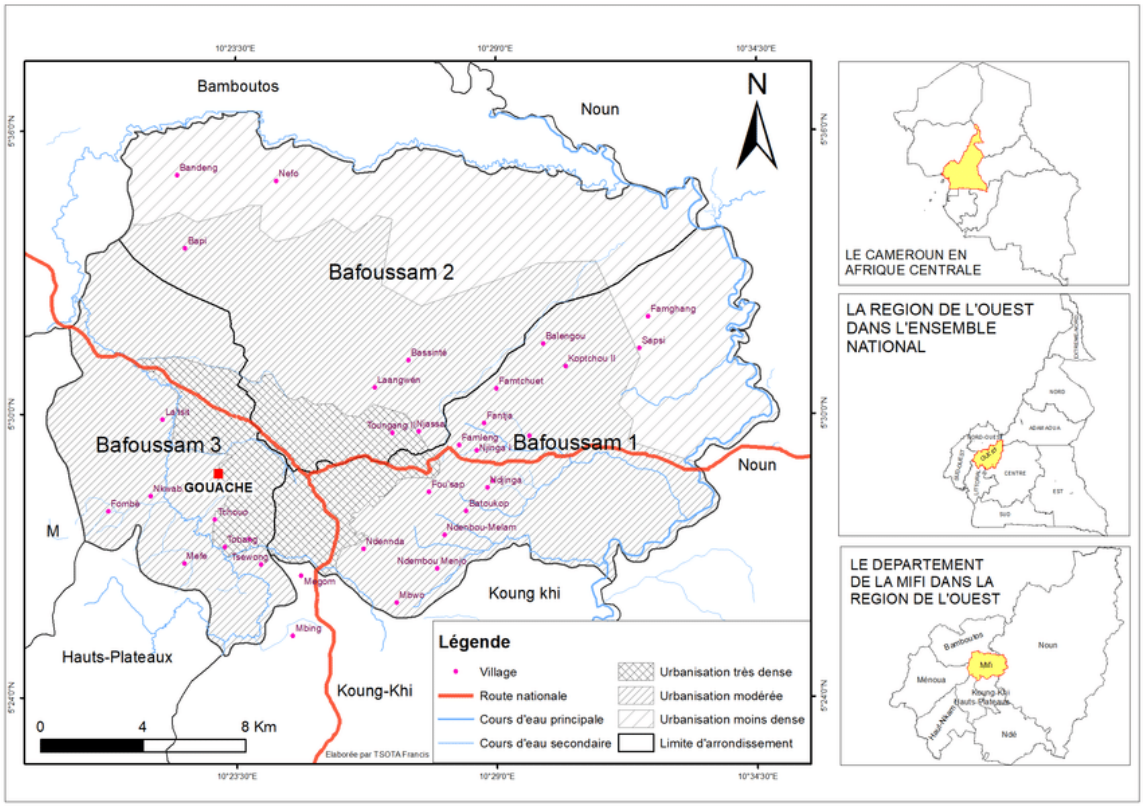

Figure 1 Map of Bafoussam (Tsosta et al., 2020).

2.2 Study Design

A descriptive cross-sectional study design was carried out from the 1st of June, 2024 to August, 30th 2024 with the use of questionnaires, data collection from the respondents was done once which provided data that was of great use in the health system.

2.3 Study Population

The study was made up of health personnel practicing in a health facilities in one of the 3 health districts in Bafoussam, Cameroon. Healthcare personnel randomly participated as volunteers from across 14 health facilities within the study area.

Table 1: Sampling sites in the Bafoussam Health District.

Bafoussam Health Districts	**Number of participating health facilities**	**Participating health facilities**
Bafoussam 1 district	3	Roi Mage at Carrofour trois mort, Mbingo Annex at evercher and Hipep Medical Center at stade de Bamendzi
Bafoussam 2 district	8	Regional Hospital at Marche B,CMA de Tyo at Carrefour Can, CMA de Djeleng at carrefour obeche, ,Centre de Sante Toutoubar, Presbyterian Hospital at Djeleng, Hopital de Soeur ,Hopital District de L'epreserie and Mbingo Annex Bapi
Bafoussam 3 district	3	Clinique Acodess kamkop,Ange Clemence kamkop. Prossaba at Total Kamkop

They were selected because of their high services, reputation and quality, easy accessibility and coverage, geographic distribution, public health focus, transparency and Information, user-centric approach and continuous improvement nature.

2.4 Sampling

2.4.1 Inclusion Criteria

- Health workers of the selected hospital during collection of data.
- Healthcare workers directly involved in waste management.
- Nurses with work experience from one year and more.
- Healthcare workers from a diverse range of departments.

2.4.2 Exclusion Criteria

- Those healthcare workers present at time of data collection, and not willing to answer the questionnaires.

- Health workers who were not present in the hospital during the collection time.
- Healthcare workers from non-hospital settings.

2.4.3 Sample size calculation

The sample size calculation was based on the estimating proportion of health personnel working in the hospital units, the minimum sample size needed for the number of health personnel was calculated using Cochran formula.

$$n_0 = z^2pq/e^2$$

Where:

- n is the required sample size, Z is the Z-score corresponding to the desired level of confidence, p is the estimated proportion, q is the complementary probability of *p (q = 1 - p),* e is the desired margin of error.

Hence:

- *z = 1.96* (corresponding to a 95% confidence level), *P= 0.5* (assuming maximum variability to get the maximum sample size), *q = 0.5* (since *q = 1-p), E = 0.*1 (desired margin of error).

$$n_0 = z^2pq/e^2$$

Substituting these values into the *Cochran formula*:

n = (1.96² x 0.5 x 0.5) / 0.1², n = (3.8416 x 0.25) / 0.01, n = 0.9604 / 0.01, n = ***96.04***

The calculated sample size is approximately 96.04

Rounded down to 96, which is the minimum sample size.

2.5 Sampling Technique

The principal investigator used a convenience sampling method where by all workers met at the hospitals/clinics during data collection were included, that was within the inclusion criteria, and willing to participate in the study were administered the questionnaires and primary data collected.

2.6 Instrument for data collection

Data was collected with the aid of well-structured questionnaires made up of both open and closed ended questions developed by the principal investigator and the participants were expected to tick the corresponding answers. The questionnaires were developed following clarity & Focus, neutrality & Friendliness, and pre-testing & ethics.

2.7 Data collection Procedure

Prior to the distribution of questionnaires to the participants, an approval was obtained from the administration of each health institution. A brief explanation on the purpose of the study was made and clarifications done where needed. A signed consent form of those who were willing to participate was obtain after they showed full understanding of the purpose of the study, then questionnaires were administered for them to fill. Those who participated were verbally appreciated for their time and attention. Questionnaires were filled by participants under supervision by the principal investigator to ensure accuracy of data obtained from the participants. Each participant was given a minimum of 30 minutes to provide answers to the questions in the questionnaire

2.8 Data management

The hard copy of the questionnaires was well preserved in an envelope to ensure confidentiality. The soft copies were saved in a file on the laptop with a password known by the principal investigator alone. The hard copies were kept in a cupboard and locked and the keys were with the principal investigator.

2.9 Data analysis

Data collected was double-checked to ensure accuracy. The data was entered into a computer spreadsheet application and analyzed using the Statistical Package for Social Science (SPSS) version 20.4. This enabled the principal investigator to get the totals and the percentages. The results obtained were displayed in tables and figures. P-value is considered significant when $P \leq 0.05$.

2.10 Research scope and delimitation

This study was restricted to healthcare workers in some selected clinics and hospitals in Bafoussam who gave their consent to be part of the study. The fact that this study was conducted only in one study area (Bafoussam), through, several clinics and hospitals, may interfere with the generalization of the study finding. However, these high activities selected clinics and hospitals, being in Bafoussam, West Region, and the results may be extrapolated to other regions.

2.11 Ethical consideration

Administrative approval was obtained from the Regional delegation of Public health West Region, Cameroon. Administrations of the different hospitals/clinics by explaining the purpose of the study and how it was going to be carried out. The benefit, risk associated with participation and how this is going to be overcome was explained to participants. Respect was given for person's autonomy, beneficence and justice.

An informed consent was obtained before the filling of questionnaires. Participants received background information on the purpose of the research and how it will be done, and then they were allowed to decide whether or not to take part in the study. Only those who proved full understanding of the purpose of the study were recruited.

CHAPTER THREE

CHAPTER THREE:

RESULTS AND DISCUSSION

3.1 Socio-Demographic Characteristics of respondents

Table 1 below shows the socio-demographic data of the respondents. The majority of the participants were females (91/150) representing 71.6% with an age range 19 – 25 years (63) (representing 71.6% and 51.4%, respectively, unlike the males with 59 (28.4%). 50% of the participants (75/150) have been working for over 6 – 10 years, and the majority of them 67 (55.4%) reported to be married.

Table 2: Socio-demographic characteristics of the participants

Variable	Category	Frequency	Percentage (%)
Gender	Female	91	71.6
	Male	59	28.4
	Total	*150*	*100.0*
Age (years)	19-25	63	51.4
	26-35	51	33.8
	36-44	36	14.9
	Total	*150*	*100.0*
Working duration in the hospital (years)	1-5	25	16.2
	6-10	50	33.8
	11-15	75	50.0
	Total	*150*	*100.0*
Marital status	single	49	32.4
	married	67	55.4
	Divorced	34	12.2
	Total	*150*	*100.0*

3.2 Hospital waste handling and disposal procedures, and the knowledge of both healthcare professionals, patients, and or caregivers/community

Table 2 below shows the knowledge of participants on biomedical waste management. The majority of the participants knew about biomedical waste generation (79.7%, 85/150), with the least number of participants (6.8% 30/150) having no knowledge on biomedical waste

generation. 13.5% 35/150 of the participants had inadequate knowledge on biomedical waste generation, Majority (74.3%81/150) of the participants indicated that the state was the agency that regulates waste generation, while 18.9%, 39/150 indicated private agencies and 6.9%, 30/150 had little or no knowledge. The majority (71.6%, 91/150) of the participants thought it was important to know about biomedical waste and 28.4%, 59/150 said it was not important. Majority of the participants (93.2%) had knowledge on the use of personal protective equipment when handling waste. The majority of waste generated is Solid waste generated (56.8%) followed by Sharps (25.7%) and Biomedical waste (17.5)

Table 3 : Health personnel knowledge on biomedical waste management .

Variable	Category	Frequency	Percentage (%)
Do you know of biomedical waste generation	Yes	85	79.7
	No	35	13.5
	not sure	30	6.8
	Total	***150***	***100.0***
What agency regulates waste generation	State	81	74.3
	Private	39	18.9
	do not know	30	6.8
	Total	***150***	***100.0***
Do you think it is important to know about biomedical waste	Yes	91	71.6
	No	59	28.4
	Total	***150***	***100.0***
Biomedical waste management and handling	1997	36	50.0
	1998	18	25.0
	2000	5	6.9
	2016	13	18.1
	Total	***150***	***100.0***
According to biomedical waste rules, waste should be stored beyond	12 hours	52	36.5
	48 hours	63	50.0
	72 hours	35	13.5
	Total	*150*	*100.0*
Do you have knowledge about what type of waste I produced and in what area	Yes	84	78.4
	No	36	14.9
	I cannot say	30	6.8
	Total	***150***	***100.0***
Is waste handler using protective clothing	Yes	43	6.8
	No	107	93.2
	Total	***150***	***100***
What safety measures have been provided by hospital authorities	Universal precautions	70	43.2
	Gloves and mask	80	56.8
	Total	***150***	***100.0***

3.3 Hazard risk analysis amongst healthcare professional.

The table below shows the awareness level of participants on biomedical waste management. The majority (58.1%, 81/150) of the participants were aware of the hazardous nature of biomedical waste while 41.9%, 69/150 were not aware. Most of the participants (59.5%) were aware that labeling the containers before filling them with waste is of clinical significance. 58.1%, 81/150 of the participants had undergone training in biomedical waste management while 41.9%, 69/150 had not undergone any training in biomedical waste.

Table 4: hazard risk

Variable	Category	Frequency	Percentage (%)
Are you aware that biomedical waste is hazardous	yes	81	58.1
	No	69	41.9
	Total	*150*	*100.0*
Do you think that labeling the container before filling it with waste is of any clinical significance	yes	70	59.5
	No	52	36.5
	no comment	28	4.1
	Total	*150*	*100.0*
Do you know of biomedical waste management	yes	70	59.5
	no	52	36.5
	no comment	28	4.1
	Total	*150*	*100.0*
Have you had any training in biomedical waste management	Yes	81	58.1
	No	69	41.9
	Total	*150*	*100.0*
Do you agree that biomedical waste should be segregated	yes	107	93.2
	Don't know	43	6.8
	Total	*150*	*100.0*

3.4 Proposition and validation of series of simple, feasible convincing standard operating procedure/approaches for proper handling and disposal of health care waste.

The results show that most of the participants (64.9%, 74/150) had adequate knowledge of colour coding and segregation (64.9%). 64.9% (74/150) of the participants indicated that the hospital has a good practice of waste disposal whereas 44.6%, 52/150) reported that hospital sharps and other used equipment should be disposed of in a black bag.

Table 5: Respondent practices of biomedical waste

Variable	Category	Frequency	Percentage
Knowledge of colour coding and segregation	yes	74	64.9
	no	35	13.5
	not sure	41	21.6
	Total	*150*	*100.0*
Which of the following is colour coding for containers	yellow, red, black, and pink	51	43.2
	pink, yellow, red, and blue	40	28.4
	yellow, red, black and blue	37	24.3
	yellow, red, blue and pink	22	4.1
	Total	*150*	*100.0*
Correct waste disposal practice in the hospital	Yes	74	64.9
	No	46	28.4
	cannot comment	30	6.8
	Total	*150*	*100.0*
How should hospital sharps and other used equipment be disposed of	black bag	52	44.6
	yellow bag	39	27.0
	clear bag	21	2.7
	sharps container	38	25.7
	Total	*150*	*100.0*
Which bag is used for general waste	black	68	56.8
	yellow	41	21.6
	blue	41	21.6
	Total	*150*	*100.0*
	operating room	45	35.1

Segregation of hospital waste takes place at	out-patient department	40	28.4
	Laboratory	30	14.9
	all of the above	35	21.6
	Total	***150***	***100.0***
Color code for biomedical waste to be autoclaved, disinfection	red	40	28.4
	black	43	32.4
	yellow	45	35.1
	blue/white	22	4.1
	Total	***150***	***100.0***
Approximate proportion of infectious waste generated from a healthcare	10-20%	67	64.9
	30-40%	33	18.9
	50-60%	28	12.2
	80-90%	22	4.1
	Total	*150*	*100.0*
All the following statements about hazardous waste containers are true except	container must be closed except when removing or adding waste	52	36.5
	containers must be cleaned outside	60	45.9
	any can be used to contain	38	17.6
	Total	*150*	*100.0*
Waste management is a teamwork	strongly disagree	44	33.8
	disagree	44	33.8
	agree	24	6.8
	strongly agree	38	25.7
	Total	*150*	*100.0*
Knowledge upgration programs required to enhance knowledge on biomedical waste management	strongly disagree	39	27.0
	Disagree	51	43.2
	Agree	29	13.5
	strongly agree	31	16.2
	Total	*150*	*100.0*
Do you think that infectious waste should be sterilized from infections by	yes	65	52.7
	no	52	36.5
	don't know	33	10.8
	Total	*150*	*100.0*

autoclaving before shredding and disposal			
Do you have storage facilities	Yes	61	48.6
	No	54	38.9
	no idea	35	12.5
	Total	***150***	***100.0***
What kind of precautions is taken to handle and dispose off biomedical waste in the hospital	universal precautions	66	54.1
	gloves, masks, apron and foot wares	54	39.2
	no safety measures	30	6.8
	Total	***150***	***100.0***
Do you have any autoclave machines installed in this hospital	yes	92	72.6
	No	58	27.4
	Total	***150***	***100.0***
Does the hospital have microwave machine	yes	77	68.9
	No	43	24.3
	don't know	30	6.8
	Total	***150***	***100.0***
Treatment adopted to treat biomedical waste	Incineration	86	81.1
	deep burial pits	34	12.2
	don't know	30	6.8
	Total	***150***	***100.0***

Table 6: Comparison of demographic data and the waste management

	Waste management			
Variables	**Yes**	**No**	**Risk ratio (CI)**	**p-value**
Handling of waste using protective clothing Yes No	85(85.5%) 0(o%)	35(14.5%) 30(100%)	0.145 (0.82-0.26)	**0.00**
What safety measures have been provided by the hospital authorities Universal precaution Gloves and mask	48(68.8%) 37(88.1%)	10(31.2%) 5(11.9%)	0.897(0.09-0.98)	0.07
Are you aware that biomedical waste is hazardous to human health Yes No	57(88.5) 40(67.7)	24(11.6) 29(32.3)	3.6(1.1-11.9)	**0.04**
Do you think labeling the container before filling with waste is of any clinical significance Yes No	35(76.2%) 62(81.1%)	24(23.8%) 29(18.9%)	0.74(0.220-2.51)	0.75
How should hospital sharps and other used equipment be disposed of Black bag Yellow bag	59(100%) 51(63.4%)	0(0%) 40(36.6%)	1.577(1.25-1.99)	**0.00**
What is the treatment adopted to treat biomedical wastes	70(83.3%)	30(16.7%)	2.77(0.77-10.06)	0.14
Does the hospital have microwave machine? Yes No	71(80.4%)	40(19.6%)	1.13(0.34-3.81)	1.00
Do you have any autoclave machines installed in this hospital? Yes No	40(81.1%) 15(75.0%)	10(18.9%) 5(25.0%)		0.74

3.5 Discussion

This study investigated healthcare personnel knowledge, practice and method on waste management revealing key findings related to biomedical waste management. Notably, the majority of participants were young females, with majority work experience 11 years and more. These socio-demographic characteristics suggest potential influences on their biomedical waste management. Further analysis revealed that the predominance of young hospital workers with previous studies, such as **(Waste Management, 2021**) in Ghana, where the largest age group was 25-29 years. This suggests that younger workers may be more likely to better manage waste due to their fast-paced and dynamic nature. Additionally, the high proportion of female participants reflects the health personnel profession's overall gender distribution.

3.5.1 To assess health personnel knowledge on biomedical waste management legislative policies.

This study reveals significant insights into health personnel knowledge on biomedical waste legislative guidelines. The findings indicate that a substantial proportion of participants knew the different biomedical waste and management policies relating to them, contradicting with previous studies. For instance, (Mazzarino *et al*., 2019) in India reported that 68% (384) a significant portion of healthcare workers had inadequate knowledge regarding biomedical waste management legislatives, particularly during the COVID-19 pandemic. The study also found that training received on biomedical waste management was a predictor of knowledge levels, while in Saudi Arabia **(** Wang ***et al.,*** **2021)** found that 74% health doctors and nurses had higher mean knowledge scores compared to other healthcare professionals. It emphasized the need for training to improve knowledge and practices related to biomedical waste management. In another study in Turkey by (Wang *et al.*,2021**).** revealed that the average score on the medical waste management legislative knowledge questionnaire was 68.38%. The study found that nurses and auxiliary health staff had higher knowledge scores compared to doctors, indicating a need for targeted education for medical doctors

3.5.2 To evaluate the practice of health personnel towards biomedical waste management

This study reveals valuable insights into the management of biomedical waste. It shows the awareness level of participants on biomedical waste management. Majority 58.1% (81) of the participants were aware of the hazardous nature of biomedical waste, This is in line with a study conducted at National Referral Hospital, Bhutan, where it was found out that 74.4% of

participants were aware of medical waste management practices. 61.3% of observed units correctly segregated waste according to national guidelines. 58% of waste was not segregated into infectious and general wastes, indicating poor practice in waste transportation. Furthermore, our study shows that Most of the participants (59.5%) were aware that labelling the containers before filling with waste is of clinical significance. This also align with a study in Ethiopia where adequate knowledge on healthcare waste management, training on waste management, and the presence of color-coded waste bins were significantly associated with better waste segregation practices. 58.1% of our participants had undergone training in biomedical waste management while 41.9 had not undergone any training on biomedical waste. It also assign with a study in Turkey by **(**Barbalac**e** et al., 2003**)** with 412 healthcare personnel (98 doctors, 206 nurses and midwives, 56 auxiliary health staff, and 52 others) indicated that 68.38% practices varied significantly among different occupational groups, with nurses and auxiliary staff showing better practices compared to doctors

3.5.3 To determine the methods of biomedical waste disposal by health personnel

This study highlight valuable insight on the results show that most of the participants 64.8% (74) had adequate knowledge on color coding and segregation with a percentage of 64.9. 74 (64.9%) of the participants indicated that the hospital have a good practice of waste disposal. In a study on Knowledge, Attitude, and Practice of Biomedical Waste Management Among Doctors and Nurses by with over 384 healthcare workers (111 doctors and 273 nurses) in Puducherry, India. It shows that 78% of participants reported using incineration for hazardous waste disposal, 65% indicated that they used autoclaving for sterilizing waste. The study revealed that while most healthcare workers were aware of the disposal methods, there were gaps in practice, particularly in the segregation of waste before disposal which is in line with a study in Nigeria by (Herbert, 2017**)** shows that 60% of participants reported using incineration as a primary method for hazardous waste highlighted that while incineration was the most commonly reported method, there was a need for improved training on proper waste disposal practices among healthcare professionals.

3.6 Conclusion

Based on the findings from this work, and the aforementioned discussion, the hypothesis of this study that "Hospital waste is not properly managed in hospitals in Bafoussam and the personnel have adequate knowledge on hospital waste management" was confirmed . Therefore, it can be concluded that:

1. Majority of the participants had adequate knowledge on biomedical waste generation approximately 79.7% Incineration emerges as the primary method for hazardous waste disposal, with approximately 60% to 78% of healthcare personnel reporting its use, while autoclaving is utilized by 50% to 65% of workers for sterilization purposes. Despite a high level of awareness regarding the importance of proper biomedical waste disposal, significant gaps in actual practices are evident, particularly in waste segregation and adherence to disposal protocols.
2. This study emphasize the critical need for enhanced training programs to improve the knowledge and practices of healthcare personnel regarding biomedical waste management, as compliance with waste management protocols remains inadequate. Overall, 58.1% participants were aware that biomedical waste is hazardous while 41.9% were not aware. while incineration and autoclaving are widely recognized methods, there is an urgent need for improved training and adherence to waste management protocols to mitigate health risks and environmental impacts associated with improper waste disposal.

3. A series of standard operating procedures have been developed to provide a foundation to raise awareness and build capacities on the impact of health facility's generated waste as well as on the proper disposal and management of such waste in Bafoussam 1, 2 and 3 Health Districts in Cameroon.

3.7 Recommendation

1. To the Government:

It is crucial for the Ministry of Public Health in Cameroon to establish a comprehensive waste management policy that outlines clear guidelines for the segregation, collection, treatment, and disposal of biomedical waste. This policy should be tailored to the specific needs of healthcare facilities in Bafoussam, ensuring that it addresses local challenges and incorporates best practices from successful waste management systems in other regions.

Regular training programs should be implemented for healthcare workers on the proper handling and disposal of biomedical waste. These programs should focus on the importance of waste segregation, the risks associated with improper waste management, and the correct use of disposal equipment. Capacity-building initiatives can empower healthcare personnel to adhere to established protocols, thereby reducing the risk of contamination and exposure to hazardous materials.

2. Healthcare facility managements in Bafoussam:

Healthcare facilities in Bafoussam should be equipped with adequate waste management infrastructure, including designated waste storage areas, reliable incinerators, and autoclaves for sterilization. Investments in modern waste treatment technologies can enhance the efficiency of waste disposal processes and minimize environmental impacts. Additionally, regular maintenance of existing equipment is essential to ensure operational effectiveness.

3. Non-Governmental Organizations and The local community in Bafoussam:

Engaging the local community in waste management initiatives can foster a culture of environmental responsibility. Awareness campaigns should be conducted to educate the public about the risks associated with biomedical waste and the importance of proper disposal practices. Involving community members in waste management efforts can also help in monitoring and reporting improper disposal practices, thereby enhancing accountability.

3.8 Perspectives

In the context of waste management in healthcare facilities, particularly in Bafoussam, several gaps in existing research can be identified. These gaps highlight the need for further investigation to improve waste management practices and ensure public health safety**.**

1. There is limited quantitative data regarding the types and quantities of waste generated by healthcare facilities in Bafoussam. Understanding the specific waste generation rates is crucial for developing effective waste management strategies tailored to the local context**.**
2. Research assessing the current toxins emitted from waste management practices in healthcare facilities in Bafoussam is minimal. Evaluating how waste is collected; segregated, stored, treated, and disposed of is essential for identifying weaknesses and areas for improvement.
3. Research analyzing the existing regulatory frameworks governing healthcare waste management in Bafoussam is insufficient. A thorough examination of local policies and their enforcement can provide insights into compliance issues and areas needing reform**.**
4. There is a lack of exploration into the adoption of technological innovations for waste management in healthcare settings in Bafoussam. Research into automated systems, digital tracking, and advanced treatment technologies could provide valuable insights for improving waste management efficiency**.**

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APPENDICES

QUESTIONNAIRE

Dear Respondent

I am a student of masters 2 at the University of Yaoundé 1,currently carrying out a research on the topic' **WASTE MANAGEMENT RISK IN HEALTH CARE FACILITIES IN BAFFOUSAM CAMEROON** "The main aim of this study is to investigate the harmful effects of health care waste that is not properly handled and disposed of, to health personnel,patients and persons living around this waste disposal areas. To this effect,kindly provide honest and frank responses as you answer this questionnaire. I assure you that the information provided will only be used for academic purposes. Names will not be needed this is to ensure that there is some degree of confidentiality.

Sincere Thanks in advance

Instructions

Please kindly tick or fill the correct information in the spaces provided

Health personnel ( ) Patient ( ) Person Affected ( )

Part 1: Socio Demographic Information

A. **Gender : Male ( ) Female ( )**
B. **Age range 15 -18 ( ) 19-25 ( ) 26-35 ( ) 36-44 ( ) 45+ ( )**
C. **Duration of working in the hospital**
   1-5 Years 6-10 Years 11-15 Years 16-20 Years
D. **Marital status : Single ( ) Married ( ) Separated ( ) Widow or widower ( )**
E. **Location (town)**

Part 2: To assess health personnel knowledge on biomedical waste management legislative policies in Bafoussam.

Please kindly circle one option that best suits your experience ;

1. Do you know about biomedical waste generation and legislation?

A.Yes

B. No

C. Not sure

2. What agency(s) regulate(s) wastes generated at health care facilities?

A. State

B.Private

C.Do not know

3. Do you think it is important to know about biomedical waste generation, hazards and legislation?

A.Yes

B. No

C.Somewhat

4. Biomedical Waste (Management & Handling) Rules were first proposed in:

A.1997

B.1998

C.2000

D.2016

5. According to the Biomedical Waste (Management & Handling) Rules, waste should not be stored beyond:

A.12 hours

B.48 hours

C.72 hours

D.96 hours

6. Do you have any knowledge regarding what type of waste is produced and in which areas?

A.Yes

B.No

C.Cannot say

7. Is the waste handler using protective clothing?

A.Yes

B.No

C.Can not Comment

8. What safety measures have been provided by the Hospital Authorities?

A.Universal Precautions

B.Gloves and Masks

C.Any other

9. Are you aware that biomedical waste is hazardous to human health?

A.Yes

B.No

C. No Comment

10. Do you think labeling the container before filling it with waste is of any clinical significance?

a. Yes

b. No

c. Don't know

Part 2: To evaluate the practice of health personnel towards biomedical waste management in Bafoussam.

11. Do you know about biomedical waste management in your hospital?

A.Yes

B.No

C.No comment

12. Have you had any training in Biomedical waste management?

A.Yes

B.No

C.No Idea

13. Do you agree that biomedical wastes should be segregated into different categories

A.Yes

B.No

C.Don’t Know

14. Do you know about colour-coding segregation of Bio-Medical waste?

A.Yes

B.No

C.Not sure

15. Which of the following is color coding for containers?

a. Yellow, red, black &pink

b. Pink, yellow, red & blue

c. Yellow, red, black & blue

d. Yellow, red, blue & pink Yes No Sometimes

16. Is the waste disposal practice correct in your hospital?

A.Yes

B.No

C.Cannot comment

17. Objects that may be capable of causing punctures or cuts, that may have been exposed to blood or body fluids including scalpels, needles, glass ampoules, test tubes and slides, are considered biomedical waste. How should these objects be disposed of?

A.Black bags

B.Yellow bags

C.Clear bags

D.Sharps container

18. Which bag is used for the general waste?

A.Black

B.Yellow

C.Blue

19. Segregation of hospital waste takes place at ?

a. Operating room

b. Outpatient department

c. Laboratory

d. All of the above

20. The colour code for the BM waste to be autoclaved, disinfected is:

A.Red

B.Black

C.Yellow

D.Blue/white

21. The approximate proportion of infectious waste among total waste generated from a health care facility is:

A.10-20%

B.30-40%

C.50-60%

D.80-90%

22. All of the following statements about hazardous waste containers are true, except for:

A.Containers must be closed except when removing or adding waste.

B.Containers must be clean outside.

C.Contents must be compatible with the type of waste containers.

D.Any type of container, including food containers, can be used to contain hazardous waste.

23. Waste management is a team work/ no single class of people is responsible for safe management.

a. Strongly agree

b. Agree

c. Disagree

d. Strongly disagree

24. Knowledge up-gradation programs are required to enhance knowledge on biomedical waste management.

a. Strongly agree

b. Agree

c. Disagree

d. Strongly disagree

PART3. To determine the methods of biomedical waste disposal of health personnel in Bafoussam

25. Do you think that infectious waste should be sterilised from infections by autoclaving before shredding and disposal?

A.Yes

B.No

C.Don’t know

26. Do You Have Storage Facilities?

A.Yes

B.No

C.No Idea

27. What kind of precautions is taken to handle and dispose of Bio-Medical Waste in your hospital?

A.Universal Precautions

B.Gloves, mask, apron and foot wears

C.No safety measures

28. Do you have any autoclave machine installed in this hospital?

A.Yes

B.No

C.Don’t Know

29. Do the hospital has microwave machine?

A.Yes

B.No

C.Don’t know

30. What is the treatment adopted to treat biomedical waste?

A.Incineration

B.deep burial pits

C.Dont know

Some waste disposal sites

a **b**

Figure 1:Safety box for sharps,different kinds of bins for solid waste disposal

Figure 2: Open pit for liquid waste and open pit for solid waste dumping

Figure 3: Incinerator for all waste.