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Pharmaceutical Waste Management Practices in Pharmacies and Medicine Stores: Evidence from Bamenda Health District, Cameroon.

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Abstract

Introduction: The steep growth in the pharmaceutical industry over the last several decades has led not only to more medications in markets, but also to significant environmental and public health hazards when these drugs are not properly disposed. More than 3,000 active pharmaceutical substances are being administered worldwide in prescription medicines, over-the-counter therapeutic drugs, and veterinary drugs. Their active ingredients comprise a variety of synthetic chemicals produced by pharmaceutical companies in both the industrialized and the developing world at a rate of 100,000 tons per year. Antimicrobial Resistance (AMR) accounts for an estimated 700,000 deaths per year worldwide. Over 23 million people have been tested with the aid of swab sticks for the novel Corona virus disease-19(Covid-19) in many parts of the world. This paints a gloomy picture on the quantum of pharmaceuticals that would have been used and eventually disposed.

Purpose: This study explored and described pharmaceutical waste management practices by pharmacies and medicine stores operating in Bamenda Health District of the North West Region of Cameroon.

Methodology: A mixed research design (Exploratory and Descriptive) was used. The study was cross-sectional. Exponential non-discriminative snowball sampling was used to identify 187 medicine stores while an official list from the Bamenda Health District of the NWR of Cameroon was sought to identify 13 pharmacies. Structured closed ended questionnaires and unstructured oral interviews were used to collect primary data. Descriptive statistics was used to describe the data while inferential statistics was used to test statistical significance.

Results: In addition to sale of drugs, medicine stores offered services such as consultation, wound dressing, injection administration, laboratory tests, Rapid Diagnostic Tests (RDTs). Pharmacies carried out solely the sale of drugs. There was a statistically significant difference in pharmaceutical waste management practices between pharmacies and medicine stores.

Unique contribution to policy: Incentives in the form of financial reimbursements, tax cuts or tax holidays could be offered by the state to licensed drug dispensers who comply with national guidelines on sale of drug and pharmaceutical waste management.

Keywords: *Pharmaceutical waste, management, pharmacy, medicine store and Bamenda.*

1.0 INTRODUCTION

Pharmaceuticals are an important part of a health framework of which sufficient stocks are required consistently (Pharmacy and Poisons Board, 2018). Steep growth in the pharmaceutical industry over the last several decades has led not only to more medications in markets, but also to significant environmental and public health hazards when these drugs are not properly disposed (Bruno *et al.*, 2016). It should be noted that Pharmaceutical waste management is an important component in pharmaceutical industries (Jaseem *et al.*, 2017). “Those who have greatest influence over a product (usually manufacturers) should have a role in dealing responsibly with a product at the end of its life.” (Lubick, 2010). Antibiotics are some of the most commonly prescribed pharmaceutical agents in the world. During manufacturing, antibiotics can seep or be discharged into the environment but a significant amount can enter the environment through improper disposal practices (in sinks, toilets, and household garbage) and natural human excretion (National Collaborating Centre for Infectious Diseases, 2021).

Pharmaceutical waste can be generated from many activities and locations in healthcare facilities such as pharmacies, distribution centers, and hospitals. Generally it may include; expired drugs; patients’ discarded personal medications; waste materials containing excess drugs (syringes, IV bags, tubing, vials, etc.); waste materials containing chemotherapy drug residues; open containers of drugs that cannot be used; containers that held acute hazardous waste drugs; drugs that are discarded; contaminated garments, absorbents and spill cleanup material. Pharmaceutical waste is further classified in 3 categories: Hazardous waste, Non-hazardous waste, and Chemo waste (Jaseem *et al.*, 2017; WHO, 2018). The major pharmaceuticals utilized in the fight against Covid-19 include but not limited to: test kits, surgical masks, gloves, scrubs, hospital gowns, headgears, thermometers, swab sticks, hand sanitizers and disinfectants, face shields, drugs; syringes, intravenous bags, protective suits, tubing and vials (Ejeromedoghene, 2021). A number of these pharmaceuticals can only be used once on a patient and consequently have to be disposed of after its first use.

2.0 LITERATURE REVIEW

More than 3,000 active pharmaceutical substances are being administered worldwide in prescription medicines, over-the-counter therapeutic and veterinary drugs. Their active ingredients comprise a variety of synthetic chemicals produced by pharmaceutical companies in both the industrialized and the developing world at a rate of 100,000 tons per year (WHO 2014). Over 23 million people have been tested with the aid of swab sticks for the novel virus in many parts of the world. This paints a gloomy picture on the quantum of pharmaceuticals that would have been used and eventually disposed in the course of testing more citizens (Center for Disease Control and Prevention, 2020). In total, environmental analyses were performed on 713 different active substances, including 142 transformation products of which, 631 inclusive of 127 transformation products were detected in concentrations over the detection limit. In addition, 16 active substances were found in surface, ground and drinking waters in all regions of the world (Beek *et al.*, 2016).

The painkiller diclofenac was the pharmaceutical most commonly found in the environment, being present in around 50 countries. In at least 45 countries, carbamazepine, ibuprofen, sulfamethoxazole and naproxen were found. Alongside these antiepileptics, painkillers and antibiotics, hormones and antilipemics were also detected in all United Nation regions. The accumulation of antibiotics and other antimicrobial agents in the environment can contribute to Antimicrobial Resistance (AMR) which is the constant evolutionary modification in

viruses, bacteria, fungi, and other pathogens against naturally occurring and synthetic antibiotics, antivirals, and antifungals (WHO, 2011 by National Collaborating Centre for Infectious Diseases 2021). According to United Nations Environment, growing AMR linked to the discharge of drugs and particular chemicals into the environment is one of the most worrying health threats of today. AMR accounts for an estimated 700,000 deaths per year worldwide and by 2030 will represent up to US\$ 3.4 trillion in gross domestic product (GDP) loss (WHO Expert Committee on Specifications for Pharmaceutical Preparations Fifty-fourth report, 2020). The adverse harmful effects of pharmaceuticals in the environment range from the spreading of AMR and species survival, to the interference with reproduction and increased cancer incidence in humans (Freitas & Radis-Baptista, 2021).

The occurrence of pharmaceutical wastes in the environment is an everyday recognized global concern (Costel *et al.*, 2021). Medication disposal is an alarming issue today and gaining more and more awareness from healthcare professionals as well as consumers (Kadam *et al.*, 2016). The strategic attention to grapple with Covid-19 cases will lead to multiple waste generation problems, posing another health risk if not properly handled and disposed (Alrawi *et al.*, 2021; Ejeromedoghene, 2021). Pharmaceutical waste disposal being a critical step in the supply chain, low and high-income countries struggle to implement a disposal system that is affordable, efficient and safe (Kamba *et al.*, 2017). The central challenge is to determine how to dispose of pharmaceutical waste in a manner that is safe for the environment and for public health while still being affordable and effective (Costel *et al.*, 2021). Methods of pharmaceutical waste management and disposal include; incineration, secure landfilling, waste immobilization-encapsulation, waste immobilization-inertization, sewer (Jaseem *et al.*, 2017). Pharmaceuticals are generally disposed of by incineration at high temperatures (above 1200 ° C) (Nyagah *et al.*, 2020). Pharmaceuticals flushed into septic systems may pose even more of a threat to waterways than those put into municipal systems (Lubick, 2010). Disposal methods for pharmaceuticals in developing countries are largely inappropriate and unsafe (Oladimeji-Salami *et al.* 2017) as many low and middle-income countries do not have 'established' systems for pharmaceutical disposal (Bataduwaarachchi & Chamari, 2016 by Iosue, 2020). It is pertinent therefore, for developing countries to be equipped with adequate technologies for appropriate disposal of their pharmaceutical wastes to prevent potential hazards (Jason *et al.*, 2016).

Indiscriminate waste disposal also raises the opportunity that medicines will be returned to the community, as it may profit from unused or partially used prescription medicines including painkillers (Ruhoy & Daughton, 2008 by Jade *et al.*, 2021). The mainstream of the disposed pharmaceuticals in developing nations ends up in open dumps with most being non-biodegradable (Babanyara *et al.* 2013). Developing nations are enjoined to upgrade their open dump waste disposal sites to engineered sanitary landfills (Ferronato & Torretta, 2019). Sultan & Mohammed (2021) noted that community pharmacists' potential toward drugs disposal directions and practice are not emphasized enough. However, there is an urgent need to have newer techniques and methods to dispose of unused and unwanted medications Swaroop *et al.*, 2015. Good medicine disposal practice is an essential aspect of public health preventive services carried out by community pharmacists, due to their proximity and accessibility to health seekers in our communities (Michael *et al.*, 2019). As healthcare professionals pharmacists have the potential to be at the forefront of this movement in their admirable position to educate patients about safe drug disposal. The principle of shared responsibility for waste management applies at all levels of the Health Supply Chain including industries (manufacturers, donors and importers), community facilities (hospitals, healthcare facilities,

etc.) and households (Iosue, 2020).As pharmaceutical waste management reform has been increasing globally, many organizations have undertaken the task of assessing and improving disposal practices in their own countries (Jason *et al.*, 2016).

In Cameroon, regulations dealing with the management of healthcare wastes fall within the domain of laws protecting public health and the environment under the jurisdiction of the Ministry of Public Health (Manga *et al.*, 2011). According to Manga *et al.*, (2008), the plethora of waste management related statutory instruments and regulations are often either incomplete or not enforced. Non-enforcement here is a reflection of a lack of supportive accompanying ‘*text of implementation*’ for the statutory instrument like technical prescriptions and special rules for dump disposal. Cameroon like other African countries has a weak healthcare system (Ojong, 2020). Although resources have been allocated for healthcare by the Ministry of Public Health in Cameroon, medical waste management has not received adequate attention. Order N^o 003/MINEPDED of 15th October 2012 laid down conditions for managing medical and pharmaceutical waste. In Article 3 of this order, it was specified that medical and pharmaceutical waste shall be classified according to their characteristics and nature. Literature on pharmaceutical waste management in Cameroon is very limited. The disposal methods for pharmaceuticals in Cameroon have been observed to be inappropriate and unsafe. This study therefore seeks to explore and describe pharmaceutical waste management practices by pharmacies and medicine stores operating in the Bamenda Health District of the North West Region of Cameroon.

3.0 METHODOLOGY

Study setting

Cameroon is a country in Central Africa (Cameroon Health Sector Strategy 2016-2027), administratively divided into 10 Regions, 58 Divisions, 360 Sub-Divisions, and 360 municipalities ([https://www.worldbank.org/en/country/cameroon /overview](https://www.worldbank.org/en/country/cameroon/overview)). Bamenda Health District (BHD) is one of the 19 Health Districts of the North West Region (NWR). It is located at the heart of the North West Regional head quarter Bamenda, with a population of about 429,419 as of 2020 (Bamenda Health District, 2020). The health district is comprised of 18 health areas located in Bamenda I, II, and III Sub-divisions with a total of 35 health facilities. These health facilities comprise 18 public, 12 private and 5 confessional. There are 16 pharmacies (licensed drug dispensers) operating in BHD (Regional Delegation of Public Health, 2019). The map of BHD is shown in Figure 1.

Inclusion and Exclusion criteria: All drug dispensers operating pharmacies or medicine stores located in BHD who gave consent to participate in the study, were included in the study. All drug dispensers who did not operate pharmacies or medicine stores yet were located in BHD were not included for the study. Pharmacies operating within hospital, health centers and clinics were excluded. Respondents were orally informed that all responses would be confidential and treated as aggregates. To ensure anonymity and confidentiality, questionnaires carried no personal information with respect to a respondent's name or telephone number. Respondents were equally informed that the information obtained was intended for improvement in pharmaceutical waste management practices by drug dispensers.

4.0 RESULTS

Socio demographic characteristics of respondents

Results revealed that all 200 facilities; 13(6.5%) pharmacies and 187 (93.5%) medicine stores were privately owned. The distribution of facilities by Sub-division showed 13 (6.5%) facilities from Bamenda I, 93 (46.5%) from Bamenda II, and 94 (47.0%) from Bamenda III. Also, 71 (35.5%) of these facilities had existed for a short- term duration, 87 (43.5%) for a mid-term duration, and 42 (21.0%) for a long term duration. A total of 106 (53.0%) proprietors, 79 (39.5%) employees and 15 (7.5%) managers participated in the study. Also, 154 (77.0%) of respondents were holders of a Diploma in Nursing.

Type of facility by years of existence is presented in Figure 2.

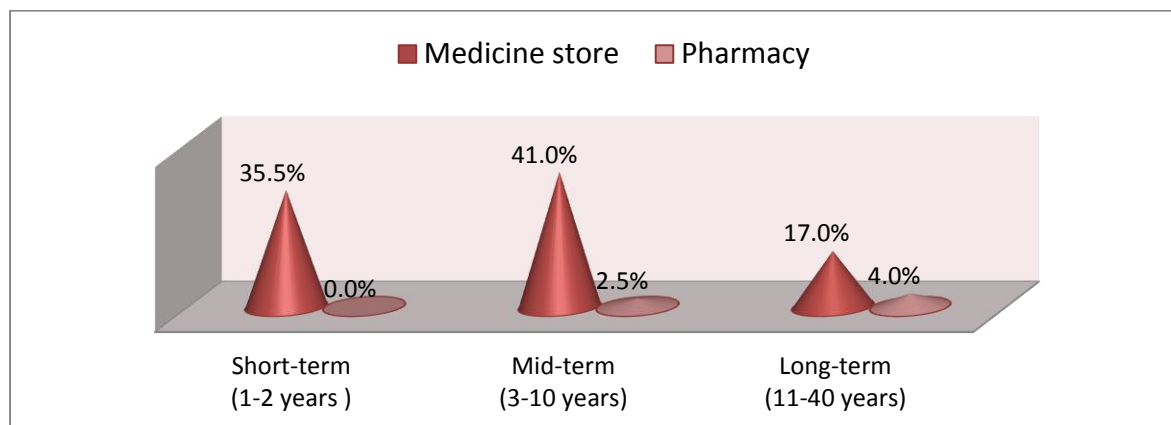


Figure 2: Type of facility by years of existence

In Figure 2, 17.0% of medicine stores compared to 4.0% of pharmacies had existed for a long- term duration whereas 41.0% of medicine stores compared to 2.5% of pharmacies had existed for a mid-term duration. Also, 35.5% of medicine stores compared to 0.0% of pharmacies, had existed for a short-term period. There was a statistically significant difference between years of existence and type of facility ($\chi^2 = 15.897$, p-value = .000). That is, p-value < 0.001. There was thus an association between type of facility and years of existence.

Services offered to the public by pharmacies and medicine stores in the BHD are presented in Figure 3.

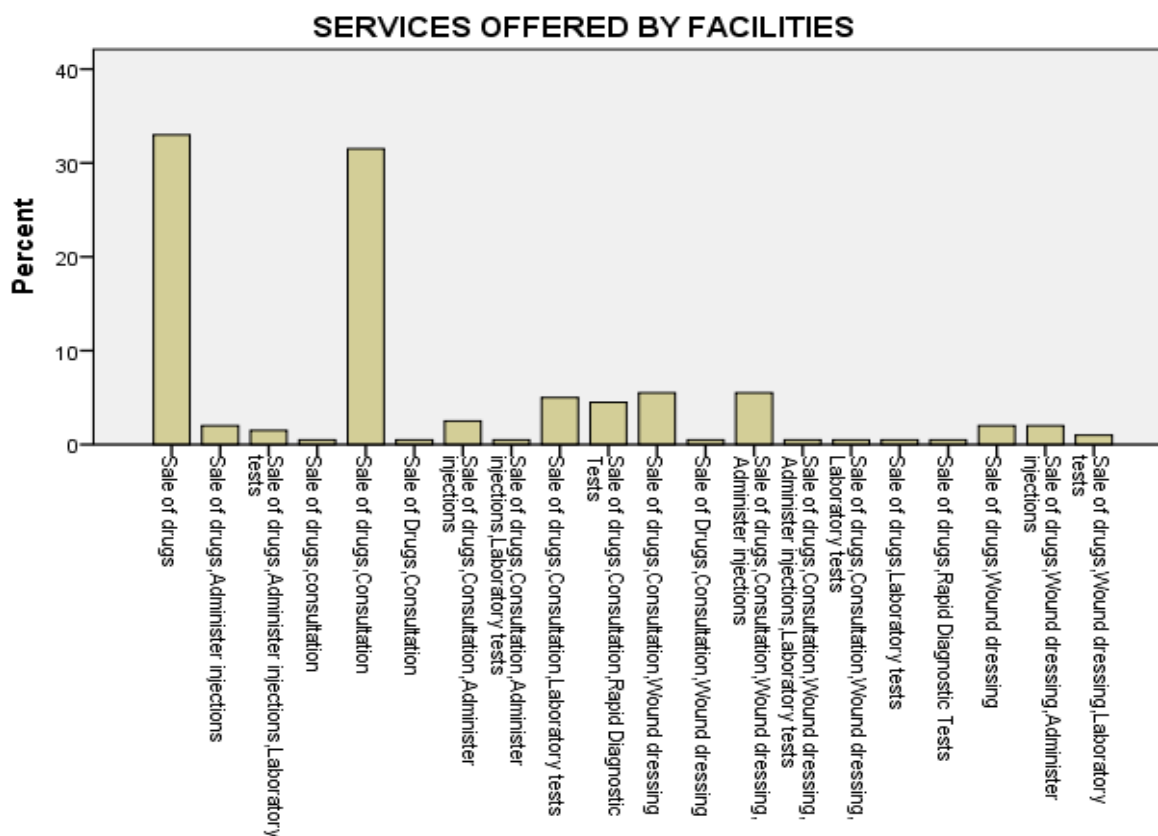


Figure 3: Services offered by pharmacies and medicine stores in the Bamenda Health District

It is demonstrated in figure 3 that 33.0% of the facilities were solely engaged in the sale of drugs followed by 31.5% that carried out sale of drugs and consultation services. Again, 5.5% carried out sale of drugs, consultation and wound dressing and 5.5% carried out sale of drugs, consultation, wound dressing, administered injections, and carried out laboratory tests.

Management of general waste by pharmacies and medicine stores in BHD is presented in Table 1.

Table 1: Management of general waste by medicine stores and pharmacies in the Bamenda Health District

Variable	TYPE OF FACILITY		
	MEDICINE STORES	PHARMACIES	TOTAL
GENERAL WASTE			
GENERATION	187(93.5%)	13(6.5%)	200 (100.0%)
STORAGE			
Carton	64(32.0%)	9(4.5%)	73(36.5%)
Drum	2(1.0%)	0(0.0%)	2(1.0%)
Plastic bag	34(17.0%)	1(0.5%)	35(17.5%)
Plastic bucket	18(9.0%)	1(0.5%)	19(9.5%)
Plastic basket	69(34.5%)	2(1.0%)	71(35.5%)
P- Chi-square (χ^2)	6.617^a		0.158
PLACE OF STORAGE			
Onsite	141(70.5%)	13(6.5%)	154(77.0%)
Offsite	46(23.0%)	0(0.0%)	46(23.0%)
P- Chi-square (χ^2)	4.153^a		0.132
DISPOSAL METHOD			
Open burning	74(37.0%)	1(0.5%)	75(37.5%)
Open dump	109(54.5%)	12(6.0%)	121(60.5%)
Open shallow pit	3(1.5%)	0(0.0%)	3(1.5%)
Throw in stream	1(0.5%)	0(0.0%)	1(0.5%)
P- Chi-square (χ^2)	5.897^a		0.117
PERSONS			
DISPOSING WASTE			
Employee	47(23.5%)	13(6.5%)	60(30.0%)
Manager	3(1.5%)	0(0.0%)	3(1.5%)
Proprietor	82(41.5%)	0(0.0%)	82(41.0%)
Waste disposer	55(27.5%)	0(0.0%)	55(27.5%)
P- Chi-square (χ^2)	32.442^a		0.000

Source: Primary data

General waste was generated by both pharmacies and medicine stores (100.0%). Most of the drug dispensing facilities (36.5%) used cartons for storage, while 35.5% used plastic buckets and 17.5% plastic bags. A cross section of facilities (77.0%) stored their general waste onsite, compared to 23.0% who chose offsite storage. Concerning disposal, 60.8% disposed the waste in open dumps while 37.5% carried out open burning. Also, 41.0% had the waste disposed by proprietors, 30.0% had theirs done by employees and 27.5% had it done by a waste disposer (an individual who disposes waste but is not an employee of the facility). Again, 77.0% of participants involved in general waste disposal were holders of a Diploma in Nursing. There was no statistical significant difference in the management of general waste between pharmacies and medicine stores. However, a statistically significant difference existed with respect to persons disposing general waste between pharmacies and medicine stores (p-value < 0.001). This means there was an association between persons disposing general waste and the type of facility. Infectious waste management by medicine stores in the Bamenda Health District is shown in Table 2

Table 2: Infectious waste management by medicine stores in the Bamenda Health District

Variable	TYPE OF FACILITY		
	MEDICINE STORES	PHARMACIES	TOTAL
INFECTIOUS WASTE			
GENERATION	105(52.5%)	0(0.0%)	105 (52.5%)
N/A (Not Applicable)	82(41.0%)	13(6.5%)	95(47.5%)
STORAGE			
Carton	45(22.5%)	0(0.0%)	45(22.5%)
Drum	4(2.0%)	0(0.0%)	4(2.0%)
Plastic bag	25(12.5%)	0(0.0%)	25(12.5%)
Plastic bucket	31(15.5%)	0(0.0%)	31(15.5%)
N/A	82(41.0%)	13(6.5%)	95(47.5%)
PLACE OF STORAGE			
Onsite	91(45.5%)	0(0.0%)	91(45.5%)
Offsite	14(7.0%)	0(0.0%)	14(7.0%)
N/A	82(41.0%)	13(6.5%)	95(47.5%)
DISPOSAL METHOD			
Open burning	50(25.0%)	0(0.0%)	50(25.0%)
Open dump	35(17.5%)	0(0.0%)	35(17.5%)
Open shallow pit	6(3.0%)	0(0.0%)	6(3.0%)
Pit toilet	4(2.0%)	0(0.0%)	4(2.0%)
Shallow burial	10(5.0%)	0(0.0%)	10(5.0%)
N/A	82(41.0%)	13(6.5%)	95(47.5%)
PERSONS DISPOSING WASTE			
Employee	25(12.5%)	0(0.0%)	25(12.5%)
Manager	1(0.5%)	0(0.0%)	1(0.5%)
Proprietor	67(33.5%)	0(0.0%)	67(33.5%)
Waste disposer	12(6.0%)	0(0.0%)	12(6.0%)
N/A	82(41.0%)	13(6.5%)	95(47.5%)

Source: Primary data

From table 2, 52.5% of facilities medicine stores generated infectious waste. Most (22.5%) used cartons for storage, 15.5% used plastic buckets and 12.5% used plastic bags. This category of waste was mostly stored onsite by 45.5% of medicine stores while 17.0% stored it offsite. Moreover, 25.0% disposed of the waste by open burning, 17.5% openly dumped and 5.0% buried in shallow pits. In addition, 33.5% of medicine stores had their infectious waste disposed by proprietors, 12.5% by employees and 6.0% by a waste disposer. Most (34.5%) had their waste disposed by holders of a Diploma in Nursing and 6.6% by holders of a degree in Nursing.

Sharps waste management by medicine stores in the Bamenda Health District is presented in Table 3.

Table 3: Sharps waste management by medicine stores in the Bamenda Health District

Variable	TYPE OF FACILITY		
	MEDICINE STORES	PHARMACIES	TOTAL
SHARPS WASTE			
Generation	109(54.5%)	0(0.0%)	109(54.5%)
N/A (Not Applicable)	78(39.0%)	13(6.5%)	91(45.5%)
STORAGE			
Bottle	11(5.5%)	0(0.0%)	11(5.5%)
Carton	16(8.0%)	0(0.0%)	16(8.0%)
Drum	4(2.0%)	0(0.0%)	4(2.0%)
Plastic bag	11(5.5%)	0(0.0%)	11(5.5%)
Plastic bucket	37(18.5%)	0(0.0%)	37(18.5%)
Safety box	30(15.0%)	0(0.0%)	30(15.0%)
N/A	78(39.0%)	13(6.5%)	91(45.5%)
PLACE OF STORAGE			
Onsite	95(47.5%)	0(0.0%)	95(47.5%)
Offsite	14(7.0%)	0(0.0%)	14(7.0%)
N/A	78(39.0%)	13(6.5%)	91(45.5%)
DISPOSAL METHOD			
Open burning	31(15.5%)	0(0.0%)	31(15.5%)
Open dump	32(16.0%)	0(0.0%)	32(16.0%)
Open shallow pit	31(15.5%)	0(0.0%)	31(15.5%)
Pit toilet	10(5.0%)	0(0.0%)	10(5.0%)
Take to hospital for incineration	5(2.5%)	0(0.0%)	5(2.5%)
N/A	78(39.0%)	13(6.5%)	91(45.5%)
PERSONS DISPOSING WASTE			
Employee	27(13.5%)	0(0.0%)	27(13.5%)
Proprietor	67(33.5%)	0(0.0%)	67(33.5%)
Waste disposer	15(7.5%)	0(0.0%)	15(7.5%)
N/A	78(39.0%)	13(6.5%)	91(45.5%)

Source: Primary data

It can be observed in Table 3 that 54.5% of medicine stores generated sharps wastes. Most of them (18.5%) used plastic buckets for storage, 15.0% used safety boxes while 8.0% used cartons. Onsite storage of sharps waste was done by 47.5% of medicine stores while 7.0% stored it offsite. In terms of disposal, 16.0% openly dumped the waste while 15.5% carried out open burning. Few (15.5%) dumped in an open shallow pit while 5.0% disposed in a pit toilet. Again, 33.5% had their waste disposed by proprietors and 13.5% by employees. Most medicine stores (36.0%) had this category of waste disposed by holders of a Diploma in Nursing

Pathological waste management by medicine stores in the Bamenda Health District is shown in Table 4

Table 4: Pathological waste management by medicine stores in the Bamenda Health District

Variable	TYPE OF FACILITY		
	MEDICINE STORES	PHARMACIES	TOTAL
PATHOLOGICAL WASTE			
Generation	9(4.5%)	0(0.0%)	9(4.5%)
N/A (Not Applicable)	178(89.0%)	13(6.5%)	191(95.5%)
STORAGE			
Drum	1(0.5%)	0(0.0%)	1(0.5%)
Plastic bucket	8(4.0%)	0(0.0%)	8(4.0%)
N/A	178(89.0%)	13(6.5%)	191(95.5%)
PLACE OF STORAGE			
Onsite	8(4.0%)	0(0.0%)	8(4.0%)
Offsite	1(0.5%)	0(0.0%)	1(0.5%)
N/A	178(89.0%)	13(6.5%)	191(95.5%)
DISPOSAL METHOD			
Open dump	3(1.5%)	0(0.0%)	3(1.5%)
Open shallow pit	6 (3.0%)	0(0.0%)	6 (3.0%)
N/A	178(39.0%)	13(6.5%)	191(95.5%)
PERSONS DISPOSING WASTE			
Employee	5(2.5%)	0(0.0%)	5(2.5%)
Proprietor	3(1.5%)	0(0.0%)	3(1.5%)
Waste disposer	1(0.5%)	0(0.0%)	1(0.5%)
N/A	178(89.0%)	13(6.5%)	191(95.5%)

Source: Primary data

In table 4, 4.5% of medicine stores generated pathological waste. The waste was stored in plastic buckets by 4.0% of them and 4.0 % stored it onsite. Out 4.5% of medicine stores that generated pathological waste, 3.0% disposed of it in an open shallow pit, while 1.5% disposed in an open dump. Again, 2.5% of the medicine stores had this category of waste disposed by holders of a Diploma in Nursing.

Chemical waste management by medicine stores in the Bamenda Health District is shown in Table 5

Table 5: Chemical waste management by medicine stores in the Bamenda Health

Variable	TYPE OF FACILITY		
	MEDICINE STORES	PHARMACIES	TOTAL
CHEMICAL WASTE			
Generation			
Applicable	19(9.5%)	0(0.0%)	19(9.5%)
N/A (Not Applicable)	168(84.0%)	13(6.5%)	181(90.5%)
STORAGE			
Plastic bucket	19(9.5%)	0(0.0%)	19(9.5%)
N/A	168(84.0%)	13(6.5%)	181(90.5%)
PLACE OF STORAGE			
Onsite	17(8.5%)	0(0.0%)	17(8.5%)
Offsite	2(1.0%)	0(0.0%)	2(1.0%)
N/A	168(84.0%)	13(6.5%)	181(90.5%)
DISPOSAL METHOD			
Open dump	16(8.0%)	0(0.0%)	16(8.0%)
Open shallow pit	3 (1.5%)	0(0.0%)	3(1.5%)
N/A	168(39.0%)	13(6.5%)	181(90.5%)
PERSONS			
DISPOSING WASTE			
Employee	11(5.5%)	0(0.0%)	11(5.5%)
Proprietor	1(0.5%)	0(0.0%)	1(0.5%)
Waste disposer	7(3.5%)	0(0.0%)	7(3.5%)
N/A	168(84.0%)	13(6.5%)	181(90.5%)

District

Source: Primary data

In table 5, Chemical waste was generated by 9.5% of medicine stores, all of which stored the waste in plastic buckets. Majority of them (8.5%) placed these buckets onsite. In addition, 8.0% disposed the waste in an open dump while 1.5% disposed in an open shallow pit. Most of the facilities (5.5%) had the waste disposed by employees and 3.5% had it disposed by a waste disposer. In terms of qualification, 5.5% of facilities had the waste disposed by holders of a Diploma in Nursing.

Pharmaceutical waste management by medicine stores and pharmacies in the Bamenda Health District is shown in Table 6.

Table 6: Pharmaceutical waste management by medicine stores and pharmacies in the Bamenda Health District

Variable	TYPE OF FACILITY		
	MEDICINE STORES	PHARMACIES	TOTAL
PHARMACEUTICAL WASTE			
Generation	134(67.0%)	13(6.5%)	147(73.5%)
(N/R) Non Response	53(26.5%)	0(0.0%)	53(26.5%)
P- Chi-square (χ^2)	5.013^a		0.025
STORAGE			
Carton	89(44.5%)	13(6.5%)	102(51.0%)
Drum	3(1.5%)	0(0.0%)	3(1.5%)
Plastic bag	11(5.5%)	0(0.0%)	11(5.5%)
Plastic basket	8(4.0%)	0(0.0%)	8(4.0%)
Plastic bucket	23(11.5%)	0(0.0%)	23(11.5%)
N/R	53(26.5%)	0(0.0%)	53(26.5%)
P- Chi-square (χ^2)	13.358^a		0.020
PLACE OF STORAGE			
Onsite	120(60.0%)	13(6.5%)	133(66.5%)
Offsite	14(7.0%)	0(0.0%)	14(7.0%)
N/R (Non Response)	53(26.5%)	0(0.0%)	53(26.5%)
P- Chi-square (χ^2)	7.004^a		0.030
DISPOSAL METHOD			
Open burning	53(26.5%)	0(0.0%)	53(26.5%)
Open dump	45(22.5%)	0(0.0%)	45(22.5%)
Open shallow pit	3(1.5%)	0(0.0%)	3(1.5%)
Return to supplier	33 (1.5%)	13(6.5%)	46(23.0%)
N/R (Non Response)	53(26.5%)	0(0.0%)	53(26.5%)
P- Chi-square (χ^2)	46.547^a		0.000
PERSONS DISPOSING WASTE			
Employee	20 (10.0%)	0(0.0%)	20 (10.0%)
NWRFHP, PIG	0(0.0%)	13(6.5%)	13(6.5%)
Proprietor	50(25.0%)	0(0.0%)	50(25.0%)
Supplier	34(17.0%)	0(0.0%)	34(17.0%)
Waste disposer	30(15.0%)	0(0.0%)	30(15.0%)
N/R (Non Response)	53(26.5%)	0(0.0%)	53(26.5%)
P- Chi-square (χ^2)	200.000^a		0.000

Source: Primary data

According to table 6, pharmaceutical waste was generated by 73.5% of facilities (pharmacies and medicine stores). Cartons were used by 51.0% of them to store the waste, while 11.5% used plastic buckets. Also, 66.5% stored the waste onsite while 7.0% stored offsite. In terms of disposal, 26.5% practiced open burning, 23.0% of medicine stores returned expired pharmaceuticals to suppliers, and 22.5% disposed in open dumps. It should be noted that all pharmacies 6.5% returned their pharmaceutical waste to the NWRFHP, PIG for disposal.

Again, 25.0% of medicine stores had their pharmaceutical waste disposed by proprietors, 17.0% by their suppliers and 15.0% by waste disposers. In 25.5% of these facilities, waste was disposed by holders of a Diploma in Nursing. There was a statistical significant difference in pharmaceutical waste management practices by pharmacies and medicine stores. This means pharmaceutical waste management practices by facilities was associated to the type of facility. This is seen in pharmaceutical waste generation (p-value = 0.025), storage (p-value = 0.020), place of storage (p-value = 0.030), disposal method (p-value < 0.001) and persons who disposed the waste (p-value < 0.001).

Suggestions to improve medical waste management practices in Bamenda Health District by respondents is shown in Figure 4

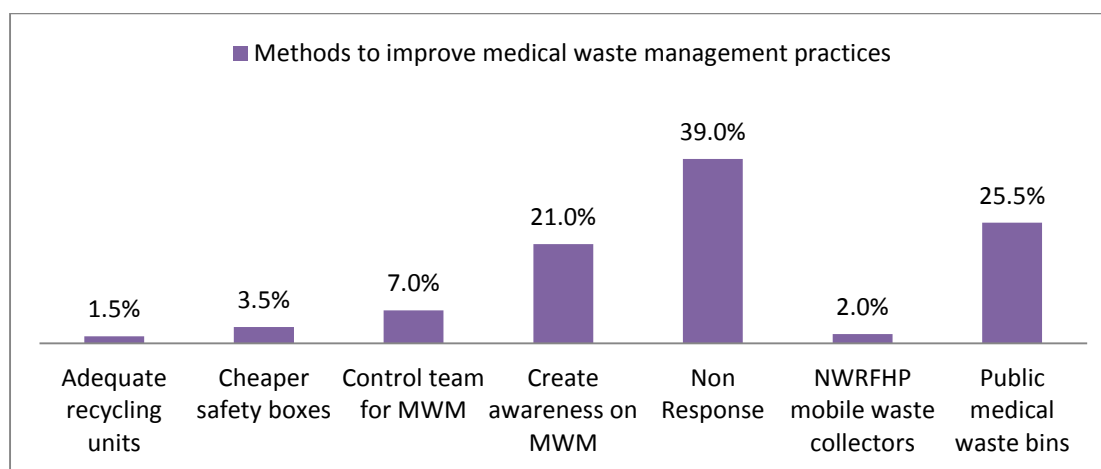


Figure 4: Suggestions to improve medical waste management practices in Bamenda Health District by respondents

From figure 4, a cross section of respondents (25.5%) suggested that public medical waste bins be provided followed by 21.0% who suggested that awareness creation on medical waste management should be intensified. Also 7.0% suggested that a control team be set up to supervise medical waste management practices of drug dispensers.

DISCUSSION

Private facilities that sell drugs in Cameroon, the North West Region and BHD have been in existence for a long-term duration. Results of this study confirm this assertion, as the mean years of existence of drug dispensing facilities in BHD was 7.46 years. However, research in the area of pharmaceutical waste management is very limited in Cameroon. This creates a dare need for increased surveys in this area as was noted by Manga *et al.*, (2011) that, current approaches adopted in the handling and management of healthcare waste in Cameroon is not well documented, despite the fact that it is the basis for formulating appropriate and sustainable waste and resource management strategies. This study therefore, seeks to describe pharmaceutical waste management practices of pharmacies and medicine stores in the BHD. In the process, baseline data generated will contribute in solving the challenge of limited supply of valuable data on medical waste management practices in this domain. This will facilitate the formulation of sustainable evidence-based policies. Results of the study will create public awareness, especially among stakeholders of pharmaceutical waste management. Gupta *et al.*, (2019) pointed out in their study that the general public lacked

knowledge and awareness regarding safe disposal of unused and expired medicines, a remark which is true in the context of BHD.

In this study, all pharmacies and medicine stores were privately owned. This confirms the complementary role of private and public drug dispensers in the provision of healthcare as remarked by Ntembe (2009). The existence of so many private drug dispensers in our study could be explained by the conclusion of GEEST(1983) that, public health institutions which distribute drugs freely often face drug shortages. Private health institutions on the other hand, have a continuous supply of drugs and as a result, patients frequently preferred the private health services over the public facilities although in the former, they had to pay higher prices for their drugs. Results showed that pharmacies and medicine stores all generated general wastes, which fall under non-hazardous waste according to the classification presented by Jaseem *et al.*, (2017) and WHO (2018). As a result, there was no statistically significant difference in general waste management practices between pharmacies and medicine stores because this waste stream was considered non-hazardous and thus, could be disposed in the same manner as regular solid municipal waste by both facilities.

It should be recalled that this study set out to investigate pharmaceutical waste management by pharmacies and medicines stores of BHD. However, in the course of the study, it was realized that due to other services beyond the sale of drugs offered by medicine stores, they generated not only general and pharmaceutical wastes but other hazardous medical wastes such as infectious waste, sharps waste, pathological waste and chemical waste. These services included injection administration, wound dressing, running rapid diagnostic tests (RDTs), and other laboratory tests. The report of Hughes *et al.*, (2021) identified similar services offered by medicine sellers of the NWR of Cameroon. The difference between their study and ours is that although participants were equally informal medicine sellers as in our study, they operated out of fixed premises. It was deduced by authors in this study that the provision of additional services by medicine stores was accounted for by the unregulated nature of their activities.

Results revealed that pharmaceutical waste was stored in cartons, drums, plastic bags, plastic buckets and plastic baskets. WHO (2017) recommend that chemical and pharmaceutical waste be stored in a brown container, labeled with appropriate hazard symbol wherein the container should be a plastic bag or rigid container and the collection frequency on demand. According to WHO (2018), pharmaceutical waste such as syrups and intravenous fluids can be diluted with a proportionate amount of water and flushed into sewers. However, it is advised that they should be flushed in smaller quantities over a longer period. Results showed a statistically significant difference in pharmaceutical waste management practices between pharmacies and medicine stores. This is because the disposal of pharmaceutical waste by pharmacies followed an official protocol prescribed by the Regional Delegation of Public Health through the NWRFP, PIG. They return their hazardous pharmaceutical waste to the NWRFP, PIG for appropriate disposal when the call was made.

However, some pharmacies acknowledged that they sometimes did not return the waste at regular intervals, but kept them until the required quantity for return was attained. This is in line with the results of Alghadeer & Al-Arifi (2021) who reported that the majority of community pharmacists (73.3 - 75.3%) reported that the pharmaceutical supplier was the main route for solid or semi-solid as well as liquid unused medications disposal. It should be recalled that the methods of pharmaceutical waste management and disposal reported by Chartier *et al.*, (2014) and Jaseem *et al.*, (2017) are incineration, secure land filling, waste

immobilization: encapsulation, waste immobilization: Inertization, and sewer. Findings in our study reported that disposal methods of pharmaceutical waste by medicine stores in BHD were open burning, open dump, dumping in open shallow pit, and return to supplier. Methods of waste disposal such as return of pharmaceutical wastes to suppliers and burning were also reported by Michael *et al.*, (2019). These methods of disposing pharmaceutical waste were considered inadequate. The incineration of waste from pharmacies that was carried out by the NWRFPH PIG as recommended in literature. Disposal methods for infectious wastes, sharps wastes, pathological wastes and chemical wastes used by medicine stores included open burning, open dump, pit toilet, shallow burial, and taking sharps to hospital for incineration.

The results of this study confirm the report made by Bruno *et al.*, (2016) that most respondents had no idea whether a national policy on pharmaceutical waste management existed or not. This apparently, made compliance difficult. It is important for national policies to be made public in order to improve community awareness and compliance regarding pharmaceutical and medical waste management in general. This is in line with the conclusion of Begum *et al.*, (2021) that, the absence of mass awareness together with standard laws and policies may explain existing aberrant practices. Kadam *et al.*, (2016) suggested that all pharmacists should familiarize themselves with their region's drug disposal activities and be able to recommend them to their patients.

As was concluded by Swaroop *et al.*, (2015), if medical professionals become aware and educated about safe disposal of medication or have the right attitude regarding the same and agree to adhere to practice guidelines, they can educate the patients and community about this. Kadam *et al.*, (2016) proposed that pharmacists ought to benefit from information in a simple and clear format, including current laws regarding pharmaceutical waste disposal, contact information and explanation of the environmental impact of improper disposal. Cameroon's regulation on medical and pharmaceutical waste ensures that she meets internationally required standards for management. This study agrees with the conclusion of Michael *et al.*, (2019) that poor compliance with the national guideline for medication disposal increased the potential risk of contamination of our environment and increases the possibility of ingesting toxic pharmaceutical wastes by humans and animals. It is evident that compliance with national guideline on pharmaceutical waste disposal reduces the adverse effects of pharmaceuticals in the environment.

Conclusion

There was a statistically significant difference in pharmaceutical waste management practices between pharmacies and medicine stores. Compliance with national guideline on pharmaceutical waste management and disposal reduces the adverse effects of pharmaceuticals in the environment. Pharmaceutical waste management is a serious environmental concern that requires strict and urgent attention, especially within the context of the Covid-19 pandemic as waste management methods were inconsistent.

Recommendations

Incentives in the form of financial reimbursements, tax cuts or tax holidays could be offered by the state to licensed drug dispensers who comply with national guidelines on sale of drug and pharmaceutical waste management.

Research on pharmaceutical waste management in Cameroon should be encouraged if sustainable evidence-based policies in this domain must be formulated.

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