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Management

Assessment of Pharmaceutical Waste Management Systems Used By Selected Hospitals in Western Uganda

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ABSTRACT

Pharmaceutical waste (such as expired and unused drugs, partially used drugs, sharps, syringes, plastics, glass bottles, damaged vials and ampoules, tablet packages) not only poses threat to the environment but also indicates wastage of valuable resources. If not handled, it was result into contamination of ground water, spread of infections, air pollution, and accumulation in the food chain and wastage of valuable resources. Therefore, this study assessed the pharmaceutical waste management systems used by selected hospitals in western Uganda. A quantitative descriptive cross-sectional was carried out using a self-administered data collection questionnaire, among 90 Hospital staffs from 3 selected Hospitals determined by Yamane, (1967)Formula and a simple random sampling method. The data coded and analyzed using SPSS, results in Frequency and percentage tables and charts. According to the study findings, majority 53(58.9%) were females and 37(41.1%) were males, majority with experience of 0-5 years mostly 62(68.9%), and only 3(3.3%) had worked for about 21 years and above. More than a half 51(56.7%) were singles and 39(43.3%) were married. Mostly 49(54.4%) Nurses, 23(25.6%) were laboratory technicians, pharmacy technicians were 9(10%) and only 4(4.4%) were causal workers. mostly 20(22.2%) used and /or expired drugs, minority being syringes and lastly were broken glasses and plastics each with 4(4.4%). Cans are used to sort the wastes according to type 84(93.3%), and majority 80(88.9%) reported to be using a combination of red bin, black bin and yellow bin as well as a safety box for the sharps and transported mostly 50(55.6%) by manual handling; and the minority, 11(12.2%) use a wheeled cart. While methods used included majorly 75(85.2%) by incineration; and /or incineration in combination with autoclave method 7(8%). The rest were disinfection, landfills of a combination, each being reported to be used by 2(2.3%). Bad Smell during waste Burning 51.35%, followed by Unskilled staff in Equipment operation (autoclave) 21.62%, Bottles not completed 10.81% and the others reported late communications concerning wastes, delay to pick the bins from the collection points to disposal areas and less personal protective equipment for those responsible to collect the bins to the disposal site, each with 5.401%. However, 58.9% of the study participants could not mention or report any challenge associated with waste disposal and/or management. The incinerators used as reported by 85.2% of the study participants thus the main means of pharmaceutical waste disposal, they are not suitably located in that they are surrounded either by plantations or by residential (66.7%). Similarly, 66.7% (2/3) lack a temperature monitor and 1/3 (33.3%) is located <500 meters while 2/3 (66.7%) were located \geq 500 meters. Nonetheless, all the hospitals had their incinerator chimneys installed >3 meters high. In conclusion, Pharmaceutical waste disposal at the selected sites is mainly by incineration but owing to unskilled staff in waste management/waste machinery operation, unsuitability of the machine location and lack of enough personal protection equipment, thus; incomplete burning of some wastes, bad smell associated with the nearly situated residents and/or agro-farms.

Keywords: Pharmaceutical waste, management systems, hospitals, Western Uganda

INTRODUCTION

Pharmaceutical waste is a form of medical waste that includes unused medications, over-the counter personal care products, and sometimes accessories such as sharps, used test strips, and other supplies. Because of the dangers, pharmaceutical waste cannot be disposed of like conventional waste and requires special handling, whether it comes

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from a hospital, clinic, pharmacy, or private $\lceil 1 \rceil$. Pharmaceuticals are an indispensable part of life today since they are used on a daily basis in the treatment, prevention, cure or diagnosis of diseases or to otherwise enhance people's physical or mental well-being [2]. However these drugs have positive as well as negative consequences on different environmental components including biota in different ways [3]. Pharmaceuticals comprise an extensive group of compounds whose release into the environment has potential adverse impacts directly or indirectly on the staff, patients and the environment [4, 5]. Pharmaceutical waste disposal is an alarming issue today and it's the role of Pharmacists to educate the public about safe drug disposal [6]. Pharmaceutical waste management encompasses identifying, managing, collecting, transporting, processing, recycling and disposing pharmaceutical wastes [7-9] and these wastes include; expired and unused drugs, partially used drugs, sharps, syringes, plastics, glass bottles, damaged vials and ampoules, tablet packages etc $\lceil 10 \rceil$. There are mainly three types of disposal technology; landfill, incineration and recycling in the world [11]. Due to their high toxicity and radioactive nature and the ability to cause diseases, these wastes should be given a special attention. Creation of healthcare waste management committee can help to monitor pharmaceutical waste disposal but in most of the health facilities the committees do not exist more so in private hospitals [12]. The availability of material for waste segregation at point of generation, compliance of healthcare workers to healthcare waste management guidelines and the existence of infection control committee in both hospitals is generally low and unsatisfactory [12]. Hospitals are equipped with incinerators but most of them have operational problems with the incinerators and in addition the staff and support staff do not undergo any training courses about hospital waste management and the hazards associated with them further more the training courses that are provided are either ineffective or unsuitable [13]. Effective pharmaceutical waste management depends on active support of hospital administration and staff training [14]. Lack of sufficient knowledge of the associated risks may be a strong factor contributing to inadequate disposal practices 15. In the study done in Libya Out of eight hospitals visited, 25% were segregating sharps, pathological waste, chemical, infectious, pharmaceutical and pressurized containers at the source. For handling potentially dangerous waste, 25% of the hospitals provided essential protective gears to its waste handlers, 12.5% of the hospitals arranged training sessions for its waste handling staff regularly, 62.5% of the hospitals had storage areas but mostly it was not protected from access of scavengers, 62.5% of the hospitals disposed off their hazardous waste by burning in incinerators, 25% disposed off by municipal landfills and 12.5% was burning waste in open air without any specific treatment. No record of waste was generally maintained, 25% of the hospitals had well documented guidelines for waste management and a proper waste management team $\lceil 1 \rceil$.

Medical wastes have entered our ecosystem owing to improper disposal practice which exploited as pollutants and posed huge threat to the public health, economy and eco-system ("Improper Management of Pharmaceutical Waste in South and South-East Asian Regions," 2017). Many health care facilities have faced financial difficulties and thus they have attempted to find cost-effective treatment and disposal methods of their medical wastes [16]. The practice of use and disposal of waste from pharmaceuticals compromises the safety of the environment as well as representing a serious health risk as they may accumulate and stay active for a long time in the aquatic environment [17]. In many developing countries, little information is available regarding generation, handling and disposal of hospital waste [18]. This fact hinders the development and implementation of hospital waste management schemes [18]. Burning, burial, land fill and small scale incineration are the most common methods of hospital waste disposal [12]. Incineration is the major method of waste disposal applied by Health centers but their usage have faced wide objections due to emission of hazardous gases such as carbon monoxide and carbon dioxide as well as Carcinogenic gases such as Dioxins and Furans which are generated as a result of incomplete combustion. Alternatively autoclave is one the newest methods of medical wastes treatment which works based on wet disinfection [19].

METHODOLOGY

Study Design

This was a cross sectional Study and it was both qualitative and quantitative [20]. Cross-section survey was used for this study because it employed a single point of data collection for each participant.

Study Area

The study was carried out in three hospitals in western Uganda that is Mbarara Regional Referral hospital, Kampala international university teaching hospital and Ishaka Adventist Hospital.

Study Population

All medical staff in the department of pharmacy, nursing, Lab., non-medical staff in waste management department. Inclusion criteria

All medical staff in the department of pharmacy, nursing, lab and non-medical staff in the waste management department who was consent.

Exclusion criteria

All clients who were ill during the period of data collection. All clients being encountered for the second time during the study period.

All the clients who did not consent.

Data collection techniques/tools

The study used; Structured questionnaire and a checklist

- The validity of the questionnaire was tested using content validity index (CVI),
- CVI = <u>number of items regarded relevant by the judges</u>
 - Total number of items
- The value obtained should be greater than 0.7 for the questionnaire to be valid.
- The questionnaire was pretested on 8clients at Bushenyi HCIV, which was excluded during data analysis.

Data Analysis

Data was organized and analyzed using social package for social sciences (SPSS)

Ethical consideration

The research report was presented to the research and ethics committee for Kampala International University for approval. Letter of introduction from the Dean School of Pharmacy, Kampala International University-Western Campus was obtained. Also, participants' consent was requested. Confidentiality was maintained throughout the study. Informed consent, the researcher was make sure that the participants/respondents are aware of the purpose of the study.

Parameter		Frequency (n=90)	Percentage (%)	
GENDER	Male	37	41.1	
	Female	53	58.9	
DURATION OF	0-5yrs	62	68.9	
PRACTICE	6-10yrs	19	21.1	
	11-15yrs	4	4.4	
	21 and above	3	3.3	
MARITAL STATUS	Married	39	43.3	
	Single	51	56.7	
PROFESSION	Nurse	49	54.4	
	Pharmacy technician	9	10.0	
	Lab technician	23	25.6	
	Causal workers	4	4.4	

RESULTS Table 1: Socio-demographic Characteristics of the Study Participants

According to the study findings, majority 53(58.9%) of the 90(100%) respondents were females whereas the 37(41.1%) were males. These had a practice experience of 0-5 years mostly 62(68.9%), followed by the 19(21.1%) who had practiced for 6-11 years, 11-15 years being 4(4.4%) and only 3(3.3%) had worked for about 21 years and above. More than a half 51(56.7%) were singles and their counterparts 39(43.3%) were married. Mostly 49(54.4%) Nurses, 23(25.6%) were laboratory technicians, pharmacy technicians were 9(10%) and only 4(4.4%) were causal workers. *See table 1 above*

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Figure 1: Age of the Respondents

According to this study findings, majority 13(14.4%) of the hospital staff who participated in this study at the selected hospitals were aged 25 years, followed by those of 18 years being 11(12.2%), 27 and 30 years being 10(11.1%) each and minority were those of 32, 35, and 48 years being 2(2.2%) each. See fig. 1 above



What kind of pharmaceutical wastes are generated by your health facility

Figure 2: Pharmaceutical wastes at the selected Hospitals

According to our study findings as shown in fig. 2 above, majority 25(27.8%) of this study participants reported these selected hospital to be generating a combination of pharmaceutical wastes which singly included but not limited to; mostly 20(22.2%) used and /or expired drugs, followed by gloves and papers each with 10(11.1%), then 8(8.9%) being syringes and lastly were broken glasses and plastics each with 4(4.4%)



*1, 2&3=Heavy-duty gloves, Gumboots and masks use.

Figure 3: Equipment used in the Pharmaceutical waste handling

As illustrated in figure 3 above, the pharmaceutical wastes are handled using Heavy-duty gloves, Gumboots and masks either independently or in a combination.

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	Parameter	Frequency (n=90)	Percentage (%)		
Cans are used to sort the	Colour coding at point of collection				
wastes to appropriate	Black bin	2	2.2		
cans by 84(93.3%)	Yellow bin	3	3.3		
N=90	Box for sharps	3	3.3		
	All the above and a red bin	80	88.9		
	Not sure	6	6.7		
Transportation to	Manually	50	55.6		
disposal sites from point	Use wheeled cart	11	12.2		
of collection	Use wheeled trolley	23	25.6		
	Not sure	6	6.7		
Methods used at the	Disinfection	2	2.2		
facility to dispose off the	Autoclaving	2	2.3		
wastes	Inertization				
	Immobilization				
	Encapsulization				
	Disinfection				
	Incineration	75	85.2		
	Landfills	2	2.3		
	Recycling				
	Electron baem technology				
	Bioconversion				
	Xenobiotics				
	Denaturisation				
	Autoclaving and incineration	7	8.0		
	A combination of the above but not all	2	2.3	7	

Table 2: The identified pharmaceutical waste disposal methods

Regarding waste pharmaceutical waste management at the selected study sites, Cans are used to sort the wastes to appropriate cans by 84(93.3%) according to type, which corresponds to the reported colour coding used. These included but not limited to; majority 80(88.9%) who reported to be using a combination of red bin, black bin and yellow bin as well as a safety box for the sharps at the collection points of the pharmaceutical waste generation point. They then transport these wastes to the final disposal points mostly 50(55.6%) by manual handling; 23(25.6%) use a wheeled trolley and the minority, 11(12.2%) use a wheeled cart. While at the disposal destinations, the methods used for pharmaceutical disposal included but not limited to; majorly 75(85.2%) by incineration; and /or incineration in combination with autoclave method 7(8%). The rest were disinfection, landfills of a combination, each being reported to be used by 2(2.3%).





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What challenges are associated with the method(s) used?

Figure 4: Challenges associated with Pharmaceutical wastes

According to the study findings, the challenges associated with pharmaceutical wastes disposal include; Bad Smell during waste Burning 51.35%, followed by Unskilled staff in Equipment operation (autoclave) 21.62%, Bottles not completed 10.81% and the others reported late communications concerning wastes, delay to pick the bins from the collection points to disposal areas and less personal protective equipment for those responsible to collect the bins to the disposal site, each with 5.401%. However, 58.9% of the study participants could not mention or report any challenge associated with waste disposal and/or management. As shown in the *fig. 4 above*

https://www.eejournals.org Table 3: The challenges associated with pharmaceutical waste disposal

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	Paramete	r Estimates	5			
What kind of pharmaceutical wastes are generated by your health facility		P-Value	Odds Ratios	95% Confidence Interval for Exp(B)		
55				Lower Bound	Upper Bound	
		Challen	ge Associat	ed		
	Unskilled staff	0.787	0.000	1.026E-028	1.562E+21	
	Incomplete Bottles	0.946	0.001	2.496E-091	4.012E+08 4	
SYRINGES	Late Communications	0.956	0.001	1.998E-110	5.013E+10 3	
	Bins pick delay	0.961	0.001	3.742E-125	2.677E+11 8	
	Less PPEs	1.000	0.001	.000	.b	
	Pollution	Ref	1	1	1	
		Challen	ge Associat	ed	•	
	Unskilled staff	0.803	8.76E-8	2.441E-063	3.148E+04 8	
	Incomplete Bottles	0.951	0.001	2.069E-107	1.743E+10 0	
BROKEN GLASSES	Late Communications	0.960	0.001	1.846 E- 130	1.953E+12 3	
	Bins pick delay	0.965	0.001	3.462E-148	1.041E+14 1	
	Less PPEs	< 0.001	0.001	0.001	0.001	
	Pollution	Ref	1	1	1	
	Challenge Associated					
	Unskilled staff	0.902	.000	2.634E-065	8.091E+05 6	
	Incomplete Bottles	1.000	1.000	4.583 E- 107	2.182E+10 6	
PLASTICS	Late Communications	1.000	1.000	1.334E-129	7.497E+12 8	
	Bins pick delay	1.000	1.000	4.831 E- 147	2.070E+14 6	
	Less PPEs	0.998	4.85E+9	0.000	. ^b	
	Pollution	Ref	1	1	1	
		Challen	ge Associat	ed		
	Unskilled staff	1.000	1.000	1.737E-035	5.755E+35	
	Incomplete Bottles	1.000	1.000	4.583 E- 107	2.182E+10 6	
PAPERS	Late Communications	1.000	1.000	1.334E-129	7.497E+12 8	
	Bins pick delay	1.000	1.000	4.831E-147	2.070E+14 6	
	Less PPEs	< 0.001	1.000	1.000	1.000	
	Pollution	Ref	1	1	1	
		Challen	ge Associat	ed		
	Unskilled staff	0.966	0.250	8.179E-029	7.6414E+2 7	
GLOVES	Incomplete Bottles	0.921	6967.42	4.486E-073	1.082E+08 0	
	Late Communications	1.000	1.000	1.305E-102	7.666E+10 1	

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https://www.eejournals.o	rg				Open Access
	Bins pick delay	0.942	6967.42	4.502E-101	1.078E+10 8
	Less PPEs	1.000	1.000	0.000	. ^b
	Pollution	Ref	1	1	1
		Challen	ge Associat	ed	
	Unskilled staff	0.689	1.12E-7	1.136E-041	111826E+2 8
USED AND/OR	Incomplete Bottles	0.941	0.001	3.707E-086	1.608E+07 9
EXPIRED DRUGS	Late Communications	0.990	3.645	2.697E-091	4.927E+09 1
	Bins pick delay	0.957	0.001	1.244E-117	4.791E+11 0
	Less PPEs	1.000	0.001	0.000	.b
	Pollution	Ref	1	1	1

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a. The reference category is: A combination.

b. Floating point overflow occurred while computing this statistic. Its value is therefore set to system missing.

c. This parameter is set to zero because it is redundant.

*Statistically significant

Ref=Reference

From the table above, personal protective equipment were statistically and significantly associated challenges within the disposal of broken glasses and papers.

Table 4: Incinerator associated Challenges

Parameter		Frequency (n=90)	Percentage (%)		
Incinerator properties/suitability	Location				
N = g(chocklist)	Yes	1	33.3		
N=5(checkhst)	No	2	66.7		
		Temperature monitor			
	Present				
	Absent	3	100.0		
Incinerator distance from the Hospital (meters) N=3(checklist)	<500	1	33.33		
	≥500	2	66.7		
Incinerator chimney height (meters)	1				
N=5(checkhst)	2-3				
	>3	3	100.0		

According to the study findings, the incinerators used as reported by 85.2% of the study participants thus the main means of pharmaceutical waste disposal, they are not suitably located in that they are surrounded either by plantations or by residential (66.7%). Similarly, 66.7% (2/3) lack a temperature monitor and 1/3 (33.3%) is located <500 meters while 2/3(66.7%) were located ≥ 500 meters. Nonetheless, all the hospitals had their incinerator chimneys installed >3 meters high.

DISCUSSION

According to our study findings, majority 25(27.8%) of the participants reported a combination of pharmaceutical wastes which singly included but not limited to; mostly 20(22.2%) used and /or expired drugs, followed by gloves and papers each with 10(11.1%), then 8(8.9%) being syringes and lastly were broken glasses and plastics each with 4(4.4%). They are sorted to appropriate cans using colour codes which included but not limited to; majority 80(88.9%) a combination of red bin, black bin and yellow bin as well as a safety box for the sharps at the collection points of the pharmaceutical waste generation point. As this complements [21] in sorting/isolation was reported. Unlike [22] that; Waste collected from wards, in 25\%, 50\% and 25\% of hospitals was done manually, from a wheeled cart and on centers wheeled trolley respectively. The wastes collected at the hospitals are collected and transported

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to the final disposal points mostly 50(55.6%), 23(25.6%) and 11(12.2%) by manual handling; wheeled trolley and a wheeled cart respectively.

In disagreement with [23-26]; who reported Varying configurations of anaerobic and aerobic reactors to have been used for pharmaceutical wastewater treatment, disposal and management as a whole including incineration, autoclaving, land filling, inertization, immobilization, encapsulation, disinfection, recycling, electron beam technology, bioconversion xenobiotics, several bioremediation measures are being currently investigated and proposed for removal of pharmaceutical contaminants from the environment. The methods used for pharmaceutical disposal at the selected study sites included but not limited to; majorly 75(85.2%) by incineration; and /or incineration in combination with autoclave method 7(8%). The rest were disinfection, landfills or a combination, each being reported to be used by 2(2.3%).

According to the study findings, majority 53(58.9%) of the 90(100%) respondents were females whereas the 37(41.1%) were males; with a practice experience of 0-5 years mostly 62(68.9%). This could be the reason for the reported lack of skill in machine operation as majority lack experience/starters. Regarding waste management, this study found lack of enough personal protective equipment a significant challenge specially to do with broken glasses and papers' disposal, which was delayed in the collection bins. Also, Bottles not completely burnt (10.81%); a study in developing countries in which it was found out that unsegregated waste is illegally recycled, leading to further safety risks and several other challenges. In this study, it could be poor sorting and the delay in the disposal that exaggerates the reported bad smell during burning of these wastes thus affecting the nearly situated the residential (33.3%) as well as the hospital facility itself. Thus, according to the study findings, the challenges associated with pharmaceutical wastes disposal include; Bad Smell during waste Burning 51.35%, followed by unskilled staff in Equipment operation (autoclave) 21.62%.

Majority of those responsible for pharmaceutical wastes at the study sites were 49(54.4%) Nurses, 23(25.6%) were laboratory technicians, pharmacy technicians were 9(10%) and only 4(4.4%) were causal workers. Unlike $\lfloor 22, 27-30 \rfloor$ where only cleaning workers and nursing assistants were responsible for collecting, storing and transporting medical waste generated for external storage. This could be probably due to other professionals such as Doctors and Pharmacists having a lot of responsibility including overseeing the worker done by the lower cadres including the nurses and those in the laboratory as regards the general management of patients. The casual workers were many at the facility but could possibly be only responsible for cleaning but not disposal. Similarly, the casual/cleaning workers were very limited yet they should be the majority responsible for the general maintenance of the facilities as it was reported by $\lfloor 22 \rfloor$ that; at Tehran hospitals, where 15% were management. Lastly but not least, landfills are also used as one of the disposal methods employed in the process. This in congruency with $\lfloor 21 \rfloor$ where landfills were used but reported to be dangerous since it allows- leaching of the medicine in the landfill. Since some of the disposal sites of these hospitals are surrounded by residential and cultivated lands within less than the recommended distance by WHO (<500meters), many end up; not only affecting their crops in the garden but also the health.

CONCLUSION

The Pharmaceutical waste disposal at the selected sites is mainly by incineration but owing to unskilled staff in waste management/waste machinery operation, unsuitability of the machine location and lack of enough personal protection equipment, thus; incomplete burning of some wastes, bad smell associated with the nearly situated residents and/or agro-farms.

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