

**Pharmaceutical waste management among community pharmacists in Lagos metropolis,  
South-western Nigeria- a cross-sectional study**

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**ABSTRACT**

**Background:** Pharmaceutical waste is an emerging public health concern. Unsafe disposal of unused, expired, or unwanted pharmaceuticals can adversely affect our communities. Of particular concern is that exposure to pharmaceutical waste may cause cancer as well as physiological changes in humans and animals.

**Objectives:** To determine the knowledge, attitude and practices of pharmaceutical waste management among community pharmacists in Lagos metropolis.

**Methods:** A descriptive cross-sectional study was carried out among community pharmacists selected by multistage sampling technique. Pre-tested, structured, self-administered questionnaire and an observer checklist were used for data collection. Data were analysed using Epi-Info Version 7.1.1.4 statistical software. Respondents' knowledge, attitudes and practices were scored and graded as poor (<50%) and good ( $\geq 50\%$ ). Univariate and bivariate analysis were carried out. P value  $\leq 0.05$  was considered statistically significant.

**Results:** Mean age of the respondents was  $44.5 \pm 9.2$  years. Only 12.6% of the respondents identified 'Drug Take-back' as a method of pharmaceutical waste disposal for consumers. Majority (86.6%) of the respondents agreed that it is the responsibility of a community pharmacist to ensure proper management of pharmaceutical waste. Most reported method of disposal of pharmaceutical waste was throwing into trash bin (56.9%). Few (38.1%) of the respondents were observed to have secured container for pharmaceutical waste. Respondents' mean  $\pm$ SD (in percentage) and proportion of respondents with good grades were: Knowledge [ $56.7 \pm 26.1$  & 187 (78.2%)]; attitude [ $88.5 \pm 6.4$  & 235 (98.3%)]; reported practice [ $59.2 \pm 28.7$  & 216 (90.4%)] and observed practice [ $26.5 \pm 18.2$  & 79 (33.1%)].

**Conclusion:** Underlying problem of pharmaceutical waste management among community pharmacists is inherent in the observed practice component. Routine training of community pharmacists on pharmaceutical waste management is recommended.

**Keywords:** Pharmaceutical waste management, knowledge, attitude, practice, drug take-back

## Gestion des déchets pharmaceutiques chez les pharmaciens communautaires de la métropole de Lagos, dans le sud-ouest du Nigeria- une étude transversale

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### RESUME

**Contexte:** Les déchets pharmaceutiques constituent un problème de santé publique émergent. L'élimination dangereuse de produits pharmaceutiques non utilisés, périmés ou non désirés peut nuire à nos collectivités. Il est particulièrement préoccupant de constater que l'exposition aux déchets pharmaceutiques peut causer le cancer ainsi que des changements physiologiques chez l'homme et les animaux.

**Objectifs:** Déterminer les connaissances, l'attitude et les pratiques de gestion des déchets pharmaceutiques chez les pharmaciens communautaires de la métropole de Lagos.

**Méthodes:** Une étude descriptive transversale a été menée auprès de pharmaciens communautaires sélectionnés par une technique d'échantillonnage à plusieurs degrés. Un questionnaire pré-testé, structuré et auto-administré et une liste de contrôle des observateurs ont été utilisés pour la collecte des données. Les données ont été analysées à l'aide du logiciel statistique Epi-Info version 7.1.1.4. Les connaissances, attitudes et pratiques des répondants ont été notées et classées comme médiocres (<50%) et bonnes (≥ 50%). Une analyse uni-variée et bi-variée a été réalisée. La valeur  $p \leq 0,05$  a été considérée comme statistiquement significative.

**Résultats:** L'âge moyen des répondants était de  $44,5 \pm 9,2$  ans. Seuls 12,6% des répondants ont indiqué que le « retrait des médicaments » était une méthode d'élimination des déchets pharmaceutiques pour les consommateurs. La majorité (86,6%) des répondants sont d'avis qu'il incombe à un pharmacien communautaire d'assurer une bonne gestion des déchets pharmaceutiques. La plupart des méthodes d'élimination des déchets pharmaceutiques signalées étaient jetées dans des poubelles (56,9%). On a observé que peu (38,1%) des répondants avaient sécurisé le conteneur pour les déchets pharmaceutiques. La moyenne  $\pm$  ET des répondants (en pourcentage) et la proportion de répondants ayant de bonnes notes étaient : connaissances [56,7 $\pm$ 26,1 & 187 (78,2%)]; attitude [88,5 $\pm$ 6,4 et 235 (98,3%)]; pratique rapportée [59,2 $\pm$ 28,7 & 216 (90,4%)] et pratique observée [26,5 $\pm$ 18,2 & 79 (33,1%)].

**Conclusion:** Le problème sous-jacent de la gestion des déchets pharmaceutiques chez les pharmaciens communautaires est inhérent à la composante pratique observée. Une formation de routine des pharmaciens communautaires sur la gestion des déchets pharmaceutiques est recommandée.

**Mots-clés:** gestion des déchets pharmaceutiques, connaissances, attitude, pratique, reprise des médicaments

## INTRODUCTION

Pharmaceutical waste is an emerging public health concern. Unsafe disposal of pharmaceutical waste can adversely affect our communities in four distinct areas: environmental impacts, financial impact, poisoning, and abuse issues (misuse, diversion, and abuse).<sup>1</sup>

Improper disposal of unused pharmaceuticals is estimated to contribute up to one-third of the total load of pharmaceuticals in the environment.<sup>2</sup> Environmental contamination due to pharmaceutical wastes, adversely affect aquatic life and terrestrial species.<sup>3,4</sup> Of particular concern is that exposure to emerging pollutants may cause cancer as well as physiological changes in humans and animals.<sup>3,5</sup>

Another important public health implication of pharmaceutical waste is financial aspect. There is monetary cost of wasted drugs, and programmes designed to collect unwanted medications. Any unused pharmaceutical indicate wasted healthcare resources and it adds to the total cost of the healthcare system.<sup>6,7</sup>

Unintentional poisoning caused by improper disposal of pharmaceuticals has been documented. Between 2001 and 2008, more than 43,000 children under 5 years were seen in Emergency departments in USA due to poisonings from self-ingested prescription and over-the-counter medications.<sup>6</sup>

Stored unused medication can also be diverted to those for whom they were not intended or abused.<sup>1,8</sup> Abuse of pharmaceuticals is increasing.<sup>1</sup> A survey of teens in the U.S found that 62% who abused prescription pain relievers said they were easily accessible through parents' medicine cabinets.<sup>6</sup>

The best form of preventing unintentional poisonings, avoiding the temptation to abuse substances, or minimizing the possibility of environmental contamination due to unused medications is to remove the risk by practicing proper disposal of unused drugs. With the lack of federal and state regulations governing the proper disposal of pharmaceuticals, grassroots community drug take-back programmes are emerging.<sup>1</sup>

In the United States, pharmaceuticals are increasingly being detected in the nation's water. The U.S Geographical Survey (USGS) of 1999 - 2000 revealed that 80% of the U.S's streams and nearly a quarter of the nation's groundwater sampled have been found to be contaminated with a variety of pharmaceuticals.<sup>9,10</sup>

Meanwhile, in Nigeria, there is no apparent indication that pharmaceutical waste is monitored, and there is little or no awareness that pharmaceutical waste is an emerging contaminant with growing concern.<sup>11</sup>

Community pharmacists are health professionals most accessible to the public. They supply medicines in

accordance with prescription or, when legally permitted, sell them without a prescription.<sup>12</sup> In addition to ensuring an accurate supply of appropriate products, their professional activities also cover counseling of patients at the time of dispensing of prescription and non-prescription drugs. They maintain links with other health professionals in primary health care.<sup>12</sup>

The joint International Pharmaceutical Federation (FIP) and World Health Organization (WHO) guidelines on good pharmacy practice stipulates that: Pharmacists should ensure that regular monitoring of the medicines inventory is conducted and should always include medicines samples in the process of periodic inspection for expiration dates and removal of outdated stock.<sup>13</sup> Pharmacists should ensure that recalled medical products, including medicines samples, are immediately stored separately for subsequent disposal and prevented from being available for further dispensing or distribution. Pharmacists should establish a safe way of medicines waste disposal at the community pharmacy and or hospital so that patients and the public can be encouraged to return their expired or unwanted medicines and medical devices. Alternatively, pharmacists should provide appropriate information to patients on how to safely dispose of expired or unwanted medicines.<sup>13</sup>

Pharmacists have the greatest interaction with consumers and prescription and over-the-counter medications and are therefore, in an excellent position to influence the use of medications and, by extension, drug disposal.<sup>8</sup> However, pharmacists are not routinely educated on proper disposal of pharmaceutical waste or environmental regulations, but it is their professional responsibility to learn how to protect the environment and future generations.<sup>14</sup> In addition, pharmacists have the potential to be in the forefront of pharmaceutical waste management, but it is essential that their knowledge of proper pharmaceutical disposal is current, complete, and accurate.<sup>15</sup>

Although, many studies have been carried out on pharmaceutical waste management among Community Pharmacists in other parts of the world, very few or none has carried out in Lagos state. Lagos is the biggest city in Nigeria and many community pharmacies are located in it. This study was therefore carried out to assess the knowledge, attitudes and practices of pharmaceutical waste management among Community Pharmacists in Lagos metropolis.

## METHODS

**Study location:** This study was conducted in Lagos State in south western Nigeria. Lagos State is divided into 20

Local Government Areas (LGAs). Sixteen of the 20 LGAs are in Lagos metropolis. At the time of the study, there were 975 registered community pharmacies (retail outlets=712 and wholesale outlets=263) in Lagos State according to the lists obtained from Pharmacist Council of Nigeria (PCN). Most (96%) of the community pharmacies in Lagos State were located in the Lagos metropolis. There were 20 Community pharmacist zones in Lagos State at the time of the study. The Community pharmacist zones were created to ensure the ease of administration and prevention of the operation of illegal premises. The 20 zones in Lagos State were recognized by both the Pharmaceutical Society of Nigeria (PSN) and Lagos State Chapter of the Association of Community Pharmacists of Nigeria (ACPN).

**Study design:** The study design was a descriptive cross-sectional study

**Study population and sample size estimation:** The study population comprised the registered pharmacists working in community pharmacies in different parts of Lagos metropolis in South-western Nigeria. With confidence interval of 95%, prevalence of 82% of adequate knowledge of pharmaceutical waste management,<sup>8</sup> degree of accuracy desired of 5%, and anticipated response rate of 90%; the required minimum sample size of 204 was estimated using the formula for descriptive cross-sectional study when target population is less than 10,000. However, in order to increase precision of the study, 250 respondents were selected for the study.

**Sampling technique:** Multistage sampling technique was used for the selection of the study subjects as follows: In stage one, the community pharmacists were stratified by zone and 15 out of the 20 zones were selected by simple random sampling technique using balloting procedure. In stage two, the list of all the registered pharmacists in each selected zone constituted the sampling frame. Proportionate selection of the required number of study subjects was done from the 15 selected zones by simple random sampling technique using balloting procedure.

**Data collection:** Interviews were conducted at the community pharmacies. A pre-tested, structured, self-administered questionnaire with open- and close-ended questions and an observer checklist were used for data collection. The questionnaire was divided into four sections: Socio-demographic characteristics, knowledge of pharmaceutical waste management, attitudes toward pharmaceutical waste management and reported practices of pharmaceutical waste management.

The observer checklist was used to record the observed practices of pharmaceutical waste management at the community pharmacies.

Pre-testing of the questionnaire was done among 30 community pharmacists, in zones that were not selected for the study. The aim of the pre-test was to test the clarity and time required to answer the questionnaire. The 30 community pharmacists, who were involved in the pre-test, were excluded from the survey due to major changes that were incorporated in the final version of the questionnaire.

**Data analysis:** The obtained data were entered into Microsoft excel sheet and analyzed with Epi-Info version 7. Respondents' knowledge, attitudes and practices were scored. Each correct response to the knowledge and practice questions was scored one mark while each incorrect and non-response was scored zero. The responses to the attitude questions were scored with a 3-point Likert scale as follows: positive attitude-3, indifferent attitude-2, and negative attitude-1. The total knowledge, attitude and practice scores for each respondent were converted to percentages and graded as poor (<50%) and good ( $\geq 50\%$ ). The mean  $\pm$  standard deviations (SD) (in percentages) of knowledge, attitude and practice scores for all the respondents were also computed. Results were presented in form of frequency tables showing the frequencies, percentages, arithmetic mean and standard deviations. Chi-square test and Fisher Exact test were used for comparison of differences between proportions while t-test was used for comparison of differences between means. P-value  $\leq 0.05$  was considered statistically significant.

Ethical approval was obtained from Health Research and Ethics Committee of Lagos University Teaching Hospital. Verbal informed consent was obtained from each respondent. All the respondents were informed that the survey was voluntary, confidential and assured that there was no risk in the study about information supplied. Only number was assigned to each questionnaire and no name was required.

## RESULTS

Two hundred and thirty nine out of the 250 administered questionnaires were retrieved and analysed giving a response rate of 95.6%. The ages of the respondents ranged from 20-74 years with a mean age of  $44.5 \pm 9.2$  years. The modal age group was 40-59 years 160 (66.9%). One hundred and thirty six (56.9%) of the respondents were males. Highest qualification of majority 195 (81.6%) of the respondents was B.Pharm. Majority 183

(76.6%) of the respondents had practiced for less than 20 years. High proportion 176 (73.6%) of the respondents

**Table 1: Socio-demographic characteristics of the respondents**

Variables, n=239	Frequency (%)
<b>Age (Years)</b>	
20 -39	70 (29.3)
40 -59	160 (66.9)
60 -79	9 (3.8)
Mean $\pm$ SD = 44.5 $\pm$ 9.2	
<b>Gender</b>	
Male	136 (56.9)
Female	103 (43.1)
<b>Highest Qualification</b>	
B. Pharm	195 (81.6)
M. Pharm	28 (11.7)
Pharm. D	12 (5)
FPC Pharm	4 (1.7)
<b>Years of Experience</b>	
<20	183 (76.6)
$\geq$ 20	56 (23.4)
Mean $\pm$ SD = 13.8 $\pm$ 9.1	
<b>Ownership Status</b>	
Owner	176 (73.6)
Employee	63 (26.4)

#### **Knowledge of pharmaceutical waste management**

Among the respondents, 118(49.4%) were of the view that pharmaceutical waste is not all wastes generated from all activities in the pharmacy, 195(81.6%) affirmed that expired pharmaceuticals are pharmaceutical waste, 102 (42.7%) affirmed that unused pharmaceuticals are pharmaceutical waste, 184 (77%) affirmed that contaminated pharmaceuticals are pharmaceutical waste. Majority 213 (89.1%) of the respondents were aware that poorly managed pharmaceutical waste have harmful impact on the environment and human health.

One hundred and fifty five (64.9%) of the respondents were aware that there are regulatory guidelines for pharmaceutical waste management in Nigeria. Eighty-seven (36.4%) of the respondents identified National Agency for Food and Drug Administration and Control (NAFDAC) as the agency responsible for disposal of pharmaceutical waste generated from community pharmacy. Few 30 (12.6%) of the respondents identified 'Drug Take-Back' as a method of pharmaceutical waste disposal for consumers (Table 2).

**Table 2: Knowledge of pharmaceutical waste management**

Variables, n=239	Frequency (%)
Drug Take - back is	
A method that allow public to bring back unused, expired and unwanted medications to a central location for proper disposal	30(12.6)*
A method of pharmaceutical waste disposal for nurses	55 (23)
Return pharmaceuticals to supplier when sales are low	43 (18)
I don't know	111 (46.4)
Pharmaceutical waste include all wastes generated from all the activities in the pharmacy	
Yes	92(38.3)
No	118(49.4)*
I don't know	29 (12.1)
Pharmaceutical waste include expired pharmaceuticals	
Yes	195(81.6)*
No	30(12.6)
I don't know	14(5.9)
Pharmaceutical waste include unused pharmaceuticals	
Yes	102(42.7)*
No	109(45.6)
I don't know	28(11.7)
Pharmaceutical waste include contaminated pharmaceuticals	
Yes	184 (77)*
No	35(14.6)
I don't know	20(8.4)
Poorly managed pharmaceutical waste have harmful impact on the environment and human health.	
Yes	213(89.1)*
No	12(5)
I don't know	14(5.9)
There are guidelines for pharmaceutical waste management in Nigeria.	
Yes	155(64.9)*
No	84(35.1)
I don't know	0(0)
Who is responsible for disposal of pharmaceutical waste generated from the community pharmacy?	
PCN	17 (7.1)
Community Pharmacists	55 (23)
NAFDAC	87 (36.4)*
Pharmaceutical manufacturers/distributors	5 (2.1)
I don't know	75 (31.4)

\* Correct response

The mean  $\pm$ SD knowledge of pharmaceutical waste management score (in percentage) was  $56.7 \pm 26.1$ . The level of knowledge of pharmaceutical waste management was poor among 52 (21.8%) and good

among 187 (78.2%) of the respondents. There was statistically significant association ( $p < 0.05$ ) between the respondents' ownership status and level of knowledge of pharmaceutical waste management (Table 3).

**Table 3: Association between socio-demographic characteristics and knowledge of pharmaceutical waste management**

Variables	Level of Knowledge		Statistics and p values
	Poor, n=52	Good, n=187	
	Frequency (%)	Frequency (%)	
Gender			
Male	29 (21.3)	107 (78.7)	$\chi^2=0.001, df=1, p=0.977$
Female	23 (22.3)	80 (77.7)	
Highest Qualification			
B. Pharm	40 (20.5)	55 (79.5)	*p=0.166
M. Pharm	7 (25)	21 (75)	
FPC Pharm	0 (0)	4 (100)	
Pharm. D	5 (41.7)	7 (58.3)	
Ownership Status			
Owner	30(17.0)	146(83.0)	$\chi^2=7.689, df=1, p=0.006$
Employee	22(34.9)	41(65.1)	
	Mean $\pm$ SD	Mean $\pm$ SD	
Age ( Years)	45.2 $\pm$ 12.6	44.3 $\pm$ 8.1	t=0.62; df=237; p=0.536
Years of Experience	15.4 $\pm$ 11.8	13.3 $\pm$ 8.2	t=1.47, df=237, p=0.142

· Fisher's exact

**Attitudes toward pharmaceutical waste management**  
Among the respondents, 207 (86.6%) agreed that it is the responsibility of a community pharmacist to ensure proper management of pharmaceutical waste, 155 (64.9%) agreed that it is the responsibility of a community pharmacist to protect the environment, 173 (72.4%) agreed that consumers/patients should return

their un-used/expired pharmaceuticals to community pharmacies for proper disposal, 179 (74.9%) agreed that community pharmacist should be willing to accept returned un-used pharmaceuticals from consumers/patients, and 217 (90.8%) agreed that community pharmacist should have formal training on pharmaceutical waste management (Table 4).

**Table 4: Respondents' attitude to pharmaceutical waste management**

Attitude, n=239	Frequency (%)	
It is the responsibility of a community pharmacist to ensure proper management of Pharmaceutical Waste.	Agree	207 (86.6)
	Undecided	17 (7.1)
	Disagree	15 (6.3)
It is the responsibility of a community pharmacist to protect the environment	Agree	155 (64.9)
	Undecided	20 (8.4)
	Disagree	64 (26.8)
Consumers/patients should return their un-used/expired pharmaceuticals to community pharmacies for proper disposal	Agree	173 (72.4)
	Undecided	35 (14.6)
	Disagree	31 (13)
Community Pharmacist should be willing to accept returned un-used pharmaceuticals from consumers/patients	Agree	179 (74.9)
	Undecided	29 (12.1)
	Disagree	31 (13)
Community Pharmacist should have formal training on pharmaceutical waste and its management	Agree	217 (90.8)
	Undecided	13 (5.4)
	Disagree	9 (3.8)

The mean±SD attitude towards pharmaceutical waste management score (in percentage) was 88.5±6.4. The attitude grade of the respondents was poor among 4(1.7%) and good among 235(98.3%) of the respondents. There was no statistically significant relationship ( $p > 0.05$ ) between respondents' socio-demographic characteristics and attitude to pharmaceutical waste management.

#### **Reported practices of pharmaceutical waste management**

Among the respondents, 24(10%) had attended pharmaceutical waste management training, 92 (38.5%) document pharmaceutical waste generated in the pharmacy, 71 (29.7%) segregate/sort generated

pharmaceutical waste into hazardous and non-hazardous waste and 72 (30.1%) collect returned expired/un-used pharmaceuticals from consumers/patients.

Most common pharmaceutical waste in respondents' pharmacy was expired or obsolete stock 212 (88.7%). Most reported storage method of pharmaceutical waste prior to disposal was storage in a secured container with cover 193 (80.8%). The most reported method of disposal of pharmaceutical waste was throwing into trash bin 136 (56.9%). Only few 70 (29.3%) of the respondents reported that they dispose of the pharmaceutical waste in the pharmacy by taking it to NAFDAC. Most reported challenge encountered during disposal of pharmaceutical waste was the cost of disposal 156 (65.3%) (Table 5).

**Table 5: Respondents' reported practices of pharmaceutical waste management**

Reported Practices, n=239	Frequency (%)
Attended pharmaceutical waste management training or certification	24 (10.0)*
Document pharmaceutical waste generated in the pharmacy	92 (38.5)*
Segregate generated pharmaceutical waste into hazardous and non-hazardous	71 (29.7)*
Collect returned expired/unused pharmaceuticals from consumers/patients	72 (30.1)*
Pharmaceutical waste in respondents' pharmacy	
Expired or obsolete stock	212(88.7)
Waste arising from diagnostic testing such as blood glucose monitoring	92(38.5)
Pharmaceutical products returned from consumers	46(19.2)
Pharmaceutical products returned from other health care facilities	20(8.4)
Storage of pharmaceutical waste prior to disposal	
In a secure container with cover/lid	193 (80.8)*
Direct into the trash	89 (37.2)
Open display shelf	12(5)
Method of disposal of pharmaceutical waste	
Throw it in the trash bin	136 (56.9)
Return it to Pharmaceutical companies/distributors	94 (39.3)
Take it to NAFDAC	70 (29.3)*
Open burning	63 (26.4)
Flushing it down the toilet	29 (12.1)
Draining it in the sink	29 (12.1)
Send it to PCN	21 (8.8)
Challenges encountered during disposal of pharmaceutical waste	
Cost of disposal is an additional financial burden on the pharmacy	156 (65.3)
Lack of knowledge or misunderstanding of regulatory requirements	116 (48.5)
Manual sorting of pharmaceutical waste is time consuming	107 (44.8)

\* Correct response

The mean  $\pm$ SD reported practice of pharmaceutical waste management score (in percentage) was 59.2  $\pm$  28.7. The reported practice grade was poor among 23 (9.6%) and good among 216 (90.4%) of the respondents.

There was a statistically significant association ( $p < 0.05$ ) between respondents' years of experience and reported practice grade of pharmaceutical waste management (Table 6).

**Table 6: Association between socio-demographic characteristics and reported practices of the respondents**

Socio-demographic characteristics	Practice		Statistics and Pvalues
	Good, n=216 Frequency (%)	Poor, n=23 Frequency (%)	
Gender			
Male	123 (90.4)	13 (9.6)	* $p=1.000$
Female	93 (90.3)	10 (9.7)	
Highest Qualification			
B. Pharm	175 (89.7)	20 (10.3)	* $p=0.380$
M. Pharm	27 (96.4)	1 (3.6)	
FPC Pharm	3 (75)	1 (25)	
Pharm. D	11 (91.7)	1 (8.3)	
OwnershipStatus			
Owner	158 (89.8)	18 (10.2)	* $p=0.804$
Employee	58 (92.1)	5 (7.9)	
	Mean $\pm$ SD	Mean $\pm$ SD	
Age (Years)	44.4 $\pm$ 9.4	44.7 $\pm$ 7.8	$t=0.148, df=237, p=0.883$
Years of Experience	14.2 $\pm$ 9.3	10.3 $\pm$ 4.5	$t=1.98, df=237, p=0.048$

\* Fisher's Exact

**Observed practices of pharmaceutical waste management**

Among the respondents, 91(38.1%) had secured container for pharmaceutical waste; only 3(1.3%) had

secured bin for hazardous waste, 60(25.1%) documented pharmaceutical waste generation, and 140(58.6%) dispose mix of pharmaceutical waste and general wastes in the general disposal bin (Table 7).

**Table 7: Observed pharmaceutical waste management practices**

Variables, n=239	Frequency (%)
Availability of secured container for pharmaceutical waste	91 (38.1)*
Availability of secured bin for hazardous waste	3 (1.3)*
Availability of documented pharmaceutical waste generation	60 (25.1)*
A mix of pharmaceutical wastes and general wastes in the general disposal bin	140 (58.6)

\*Correct practice

The mean ± SD observed practice of pharmaceutical waste management score (in percentage) was 26.5±18.2. The observed practice grade of pharmaceutical waste management was poor among 160 (66.9%) and good among 79 (33.1%) of the respondents. There was no statistically significant association (p>0.05) between the respondents' sociodemographic characteristics and observed practice grade of pharmaceutical waste

management.

Grades of knowledge, attitudes and practices of pharmaceutical waste management  
Majority of the respondents had good knowledge grade, good attitude grade, good reported practice grade but poor observed practice grade of pharmaceutical waste management (Table 8).

**Table 8: Grades and scores of knowledge, attitudes and practices of pharmaceutical waste management**

Variable	Knowledge	Attitude	Reported Practice	Observed Practice
Grade	Frequency (%)			
Poor	52 (21.8)	4 (1.7)	23 (9.6)	160 (66.9)
Good	187 (78.2)	235 (98.3)	216 (90.4)	79 (33.1)
Total	239 (100)	239 (100)	239 (100)	239 (100)
Score				
Mean score (%)	56.7±26.1	88.5±6.4	59.2±28.7	26.5±18.2

**DISCUSSION**

This present study sheds light on the knowledge, attitude and practice of pharmaceutical waste management among community pharmacists in Lagos metropolis.

**Knowledge of pharmaceutical waste management**

Pharmaceutical waste is a category of health care waste and includes expired, unused, spilt and contaminated pharmaceutical products, drugs and vaccines. It also includes discarded items used in the handling of pharmaceuticals like bottles or boxes with residues, gloves, masks, drug vials, and connecting tubing.<sup>13,17,9</sup> Unsafe disposal of pharmaceutical waste can adversely affect our environment and human health.<sup>1</sup> An encouraging finding in this study is that a great majority of the community pharmacists were aware that poorly

managed pharmaceutical waste have harmful impact on the environment and human health.

Although, regulatory authorities and ministries of environment have been set up, there are no indications that the regulatory bodies are fully equipped to function effectively. Awareness of any national policy on waste is lacking and some available guidelines are not specific on how to manage and dispose pharmaceutical waste. In fact, it appeared that Nigeria does not have a healthcare waste management policy and plan.<sup>11</sup> However, in this study, majority of the pharmacists claimed they are aware of the guidelines for pharmaceutical waste management in Nigeria. A study done among Nigerian based drug manufacturers and importers (these people included superintendent pharmacists, quality

control/assurance managers, regulatory officers, and environmental officers) also reported that majority of the respondents were aware of the regulatory requirement for pharmaceutical waste management in Nigeria.<sup>11</sup>

In Nigeria, NAFDAC is the agency responsible for handling and disposal of unwholesome medicines and NAFDAC regulated products (food, medicines, medical devices, cosmetics etc.).<sup>18</sup> However in this study, less than two-fifth of the community pharmacists knew that NAFDAC is the agency responsible for the disposal of pharmaceutical waste generated from the community pharmacy. If only a few of the surveyed community pharmacists knew the agency responsible for disposal of pharmaceutical waste in Nigeria, it implies that majority of the community pharmacists were managing pharmaceutical waste improperly.

'Drug-take-back' programmes are community-based systematic initiatives that allow public to bring back unused, expired and unwanted drugs to a central location for proper disposal.<sup>1,19</sup> The programmes can involve permanent collection boxes set up in the pharmacy, or one-day events sponsored by the local law enforcement agency. 'Drug-take-back' is an emerging method of disposal of pharmaceutical waste though not common in many countries.<sup>2</sup> Majority of the community pharmacists in this study did not know about drug-take-back system. Studies conducted in India<sup>19</sup> and Malaysia<sup>20</sup> among students, and among the general population in Malta,<sup>21</sup> reported that majority of the participants lacked awareness about drug-take-back program.

#### **Attitudes to pharmaceutical waste management**

Majority of the community pharmacists in this study agreed that it is the responsibility of a community pharmacist to ensure proper management of pharmaceutical waste. Similar result was obtained in the study carried out among pharmacists in Kuwait.<sup>8</sup>

Majority of the community pharmacists in this study agreed that consumers/patients should return their un-used/expired pharmaceuticals to community pharmacies for proper disposal. Similar result was reported in the study conducted among pharmacists in Kuwait where majority of the pharmacists were willing to have their pharmacies designated as collection site for future drug-take-back programs.<sup>8</sup>

A large proportion of the community pharmacists in this study agreed that community pharmacists should be willing to accept returned un-used pharmaceuticals from consumers/patients. This willingness is an indication that 'drug-take-back' system should be put in place as a method of pharmaceutical waste disposal in Nigeria.

Furthermore, this study revealed that majority of the community pharmacists agreed that community pharmacists should have formal training on pharmaceutical waste management. Training and re-training of pharmacists on standards for disposal of pharmaceuticals will allow for the continued use of safe and effective medicine, while also protecting the environment from unnecessary harm.

#### **Reported practices of pharmaceutical waste management**

The finding that few of the community pharmacists in this study had attended pharmaceutical waste management related training is similar to the report from a study conducted in South Africa among health care professionals (doctors, pharmacists and nurses) employed in the hospital.<sup>22</sup>

Less than half of the community pharmacists in this study reported they documented pharmaceutical waste generated in their pharmacies. This poor reported documentation of generated pharmaceutical waste is not in line with the pharmaceutical waste disposal guidelines that requires documentation of all generated pharmaceutical waste.<sup>23,24</sup>

In this study, about 3 in 10 of the community pharmacists reported that they collected returned expired/un-used pharmaceuticals from patients or consumers; this is lower than what was reported from the study that was conducted among pharmacists in Kuwait.<sup>8</sup> The difference can be attributed to the fact that the Kuwait study was carried out among pharmacists in government hospitals and specialized polyclinics where guidelines on pharmaceutical waste management are enforced.<sup>8</sup>

In this study, the most common pharmaceutical waste was expired or obsolete stock, followed by waste arising from diagnostic testing such as blood-glucose monitoring, pharmaceutical products returned from consumers, and pharmaceutical products returned from other health care facilities. This finding underscores the need for community pharmacists to utilize some methods such as periodic review of inventory, having a purchasing policy that includes insisting on the longest expiry dates of the pharmaceuticals and reverse distribution to minimize expiry of pharmaceutical products.

The community pharmacist in this study store pharmaceutical waste prior to disposal mostly in a secure container with cover; this practice conforms with the general pharmaceutical waste disposal guidelines.<sup>23,24</sup>

The community pharmacists in this study disposed

pharmaceutical waste mostly in trash followed by return to pharmaceutical companies/distributors, taking it to NAFDAC, open burning, flushing down the toilet, draining in sink and lastly sending to PCN. A study conducted among pharmacists in Kuwait reported that the pharmacists disposed pharmaceutical waste mostly in trash followed by sink and toilet.<sup>8</sup> A study conducted among households in United Kingdom reported that households dispose pharmaceuticals mostly in household waste followed by emptying them in the sink or toilet and taking them to municipal waste sites that sometimes have special waste facilities.<sup>25</sup> A survey carried out among under-graduate students in India reported that the students disposed of medications mostly in trash followed by draining in the sink and flushing down the toilet.<sup>19</sup> Comparing these studies revealed that disposing of pharmaceutical waste via throwing in the trash was common in Southern England, Kuwait, India, and the present study. Disposal of pharmaceutical waste via throwing in the trash can lead to drug diversion whereby expired pharmaceuticals may come into the hands of scavengers and maybe diverted for resale to the general public.<sup>26</sup> Furthermore, accidental poisoning in human and pets can occur.<sup>1,2,19</sup> Also bearing in mind other consequences of improper disposal, pharmaceutical waste can find its way to municipal wastewater.<sup>27</sup> This has become a growing environmental concern, as wastewater treatment facilities are not equipped to remove toxic pharmaceutical compounds.<sup>4</sup>

This study found that the most common challenges encountered by community pharmacist during disposal of pharmaceutical waste was cost of disposal as an additional financial burden on the pharmacy, followed by lack of knowledge or misunderstanding of regulatory requirements and manual sorting of pharmaceutical waste is time consuming. It costs at least N20,000 (twenty thousand naira) to dispose of a carton of pharmaceutical waste.<sup>28</sup> This financial burden on the pharmacy may be one of the reasons respondents who actually knew about existing guidelines and the agency responsible for pharmaceutical waste management did not adhere to the pharmaceutical waste disposal guidelines.

#### **Observed practices of pharmaceutical waste**

Observed practices of pharmaceutical waste management among the community pharmacists in this showed that minority 91 (38.1%) of the pharmacists had secure container for pharmaceutical waste. This observed practice contradicts the results obtained from the reported practices which showed that 193 (80.8%) of

the respondents' had secure container. This is an indication that majority of the pharmacists surveyed who reported storing pharmaceutical waste in a secure container prior to disposal did not actually have such facility. Very few 3 (1.3%) of the community pharmacists had secure bin for hazardous waste, and 140 (58.6%) of the community pharmacists had a mix of pharmaceutical wastes and general wastes in the general disposal bin. Clearly defining pharmaceutical waste streams is the first step toward effective management.<sup>14</sup> In order to properly manage pharmaceutical waste, the facility needs to identify the types of materials on site, in compliance with the laws regulating each waste type.<sup>29</sup> Observed practice showed that 60 (25.1%) of the community pharmacists documented pharmaceutical waste generated. This result is lower than the reported practice of documentation of generated pharmaceutical waste generated by 92 (38.5%) of the respondents in this study. In the course of the study, it was observed that, some of the study participants were reluctant to fill the questionnaires because of their daily busy schedules. Although, data collection was anonymous, the responses of some of the surveyed community pharmacists might have been given to conform to the right practices given that their inappropriate actual practices implied unethical and un-professional conducts.

#### **CONCLUSION**

The knowledge, attitudes, and reported practices of pharmaceutical waste management among community pharmacists in this study are optimal while the observed practices of pharmaceutical waste management among the community pharmacists are not optimal. To make the most out of community pharmacists' knowledge and positive attitudes toward pharmaceutical waste management, guidelines on pharmaceutical waste management should be forced by NAFDAC, PCN and other relevant government agencies.

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