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Pharmacists knowledge, perception and practice regarding medication disposal

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ABSTRACT

Background: Medications that are improperly disposed contribute to environmental contamination with proven negative impacts on biological ecosystems. The role of the pharmacist in providing medication disposal advice is paramount to reducing this effect.
Objective: To investigate pharmacists' knowledge, perception and practices regarding medication disposal in Trinidad.
Methods: A cross-sectional study was conducted electronically over 4 months amongst public and private sector pharmacists using a self-administered questionnaire. The questionnaire comprised 32 questions and four sections - demographics, knowledge, perception and practice regarding medication disposal. Ethical approval was obtained from the Ethics Committee, the University of the West Indies, the four Regional Health Authorities in Trinidad, and the Ministry of Health, Government of the Republic of Trinidad and Tobago. Data were analysed using IBM SPSS Statistics Version 24. Chi-squared tests sought to detect significant associations between demographics and responses.
Results: Of 400 pharmacists, (response rate 52.0%) most were female (63.0%), had <5 years experience (47.1%), and worked in a community pharmacy (68.0%). Most (79.3%) believed that improperly disposed medications can negatively affect the environment but only 45.2% thought that improperly disposed antibiotics could lead to antimicrobial resistance. Most returned expired drugs to the pharmaceutical distributor (80.8%), or disposed of through the Drug Inspectorate (63.9%), but 32.3% still disposed of expired medicines in the workplace garbage, with community pharmacies being more likely to carry out this practice ($p = 0.011$). Most pharmacists (36.5%) do not counsel patients on medication disposal and 64.4% would not recommend flushing expired drugs down the toilet. Only 20.7% would recommend flushing narcotics, which is considered the best practice to prevent accidental poisoning.
Conclusions: Continuing education for pharmacists is needed to increase awareness of the best practices of medication disposal, along with an awareness campaign on medication disposal.

Introduction

The United Nations has a sustainable development goal to ensure medicine access for all.[1–3] In the Republic of Trinidad and Tobago, medication is freely available at all state-run health institutions such as General Hospitals, District Health Facilities and Public Health Centres. To improve access to medications, the state has made 47 essential medicines freely available to all citizens at privately owned community pharmacies via the Chronic Disease Assistance Programme (CDAP).[4] Though medicines are readily accessible, not all medications dispensed will be consumed. The World Health Organization (WHO) has stated that 50% of patients are guilty of non-adherence, which leads to the accumulation of unused, often expired pharmaceuticals.[5] Most unused/expired medications returned to the pharmacy often fall into the category of chronic disease medications,[6] but may also include over the counter preparations and schedule 0 items. Additional reasons for an increase in unused and expired medications included irrational prescribing and dispensing, therapeutic failure, drug interactions, adverse effects and changes in prescribed medicines.[5] The United States Food and Drug Administration (USFDA) recommended a drug disposal program, such as Drug Take Back programs, in communities for patients to return unused or expired medications.[7] A Drug Take Back program represents a system that allows patients an opportunity to return their unused/expired medications so that they can be properly disposed of by incineration. If patients cannot access a Drug Take Back facility, then the USFDA provides further guidelines on the disposal of unused/expired drugs.[8] It further advises flushing medications down the toilet if they possess a high risk of being abused, or if the drug can cause death after a single dose.[9] For other classes of medications, incineration was branded as the best method for disposing of pharmaceutical waste.[5,6,10]

With no medication take back programme available in Trinidad, it was observed that a large proportion (88%) of the Trinidadian public disposed

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of expired/unused medications in household trash.[11] Pharmacies can also contribute to the increase in pharmaceutical waste by disposing of expired medication in the workplace garbage or dissolving the drugs in water and pouring them down the sink. This can cause health hazards to life and the environment if disposed is this manner as environmental contamination will inevitably occur.[5,6,10] The consequences of inappropriate disposal of pharmaceutical waste were observed in vultures who experienced renal failure after they fed on the cadaver of cattle treated with diclofenac; whilst high levels of ethinyl estradiol in rivers and streams impaired the reproductive system in fish.[12] The threat of antibiotic resistance is being fuelled by improper disposal of antibiotics with its detected presence in wastewater.[5,6] Though the USFDA guidelines may suggest disposing medication in household trash, this method is only recommended when there is no drug takeback program available. These guidelines recommend mixing the drug with unpalatable substances and placing in a sealed plastic container but there is always a chance that they may eventually escape this confinement and contaminate the environment.

Apart from their many responsibilities, pharmacists have been identified to play a significant role in medication takeback programs; hence, their knowledge of how to properly dispose of medications is required to assist patients and other healthcare professionals. It is crucial for pharmacists to be informed of updated protocols on the best methods for drug disposal. Studies have supported the idea that pharmacy students should be educated on the management of pharmaceutical waste.[5,6] Other strategies suggested to help decrease drug wastage and pharmaceutical waste include the implementation and enforcement of national policies and performing awareness programs. Due to the environmental impact of improperly disposed prescription medications, Schedule 0 and OTC drugs, these should be disposed of through incineration. As per the USFDA guidelines, controlled and narcotic drugs that pose severe risks if accidentally ingested should be disposed of via flushing down the toilet. This study aimed to investigate pharmacists' knowledge, perception and practices regarding medication disposal in Trinidad.

Design and methods

The study was a randomized cross-sectional study conducted amongst pharmacists employed within the public and private sectors in Trinidad. A list of pharmacists was obtained and every other person on the list was contacted and invited to participate in the study. The study was conducted over a period of 16 weeks using a self-administered questionnaire. This study was granted Ethical exemption from the Ethics Committee (CEC1174/06/19), University of the West Indies, St Augustine. Approval to conduct the study at various sites was granted from the ethics Committees of the Ministry of Health (HE: 3/13/441 Vol II), Government of the Republic of Trinidad and Tobago, along with the North West Regional Health Authority (NWRHA), North Central Regional Health Authority (NCRHA), Eastern Regional Health Authority (ERHA) and the South West Regional Health Authority (SWRHA).

The study team developed the questionnaire based on a literature review and modifying survey questions adapted from Tong A et al. (2011)[13] and the drug disposal guidelines of the WHO[10] and United States Food and Drug Administration (USFDA).[9] The questionnaire was reviewed by 2 Pharmacists with postgraduate degrees in Pharmacology and 2 members of the Pharmacy Practice team. The group developed and revised individual questions to ensure simplicity within the local setting. The questionnaire was pilot-tested amongst 50 pharmacists to ensure clarity. Using a confidence interval of 95%, a margin of error of 5% and a population proportion of 50%, a sample size of 197 would be sufficient for this study. Four hundred pharmacists employed in the public and private sector were approached by a study surveyor, who was a final year student in the BSc Pharmacy program, School of Pharmacy, The University of the West Indies, St Augustine Campus. After obtaining written consent to participate, the study surveyor allowed the participant to complete the questionnaire without interruption. The survey was conducted during the period December 2nd 2019 to March 31st 2020. Statistical analysis was carried out using Statistical Package for the Social Sciences (SPSS) version 24. Cronbach's alpha was employed to estimate the reliability through the measure of internal consistency of each group of questions which related to knowledge, perception and disposal practice regarding medication disposal in Trinidad. Descriptive statistics were utilized including Cross-tabulation and Chi-square test. A p-value <0.05 was considered significant.

Results

Of the respondents, 208/400 responded to the survey for a response rate of 52.0%. The majority of respondents studied in Trinidad (95.7%) and had a BSc. Degree in Pharmacy (89.9%). The remaining respondents obtained a Diploma in Pharmacy before the advent of the BSc programme and its first batch of graduates in 1999. Most respondents were female (63.0%), in the age group 21–30 years old (48.1%), had <5 years working experience as a pharmacist (47.1%), and worked in a community pharmacy (68.8%). The demographics of the respondents are shown in Table 1.

The majority of respondents (79.3%) correctly identified that improper disposal of pharmaceuticals can have negative implications for planetary health due to contamination of soil and water supplies. Less than half of the of participants knew that improper disposal of antibiotics can cause increased bacterial resistance (45.2%), 41.8% incorrectly stated that over-the-counter medications can be disposed of in household trash, and only 28.4% could identify the temperature of incineration as being >1200 °C. Although the facilities of incineration may not be directly accessible to pharmacists, it is still important that they know of the temperature of incineration to provide adequate advice to the relevant stakeholders. Of all these parameters measuring knowledge of pharmacists, there was no difference between age, gender, qualification, years of experience, location of the pharmacy, and type of pharmacy. Less than half of the pharmacists give advice on medication disposal during routine dispensing of medicines (36.5%), and only 38.0% reported patients asking for drug disposal advice. Only 13.5% believed that patients should pay a fee and 69.2% would like their current place of employment to be a medication takeback site. Just 28.4% believed that it is a part of the pharmacist's duty to provide drug disposal information to patients. (Table 2).

Less than half the respondents reported not keeping expired medications at all (40.4%), whilst 36.0% stated that medications that expired in their pharmacies was kept for <3 months. The majority of pharmacists (80.8%) reported returning expired medication to the pharmaceutical distributors whilst 63.9% utilized the state disposal service of incineration through the local Drug Inspectorate, Ministry of Health. The state disposal service is only available to facilities and not to patients, but community

Table 1
Demographics of pharmacists' population in Trinidad.

Type of pharmacy	Community n (%) 143 (68.8)	Public sector n (%) 65 (31.3)	TOTAL n (%)
Gender:			
Male	65 (45.5)	12 (18.5)	77 (37.0)
Female	78 (54.5)	53 (81.5)	131 (63)
Location:			
North West	32 (22.4)	6 (9.2)	38 (18.3)
North Central	50 (35.0)	30 (46.2)	80 (38.5)
Eastern	15 (10.5)	14 (21.5)	29 (13.9)
South West	46 (32.2)	15 (23.1)	61 (29.3)
Age:			
21–30	73 (51.0)	27 (41.5)	100 (48.1)
31–40	45 (31.5)	25 (38.5)	70 (33.7)
41–50	13 (9.1)	8 (12.3)	21 (10.1)
>50	12 (8.4)	5 (7.7)	17 (8.2)
Years' experience:			
0–5	69 (48.3)	29 (44.6)	98 (47.1)
6–10	28 (19.6)	19 (29.2)	47 (22.6)
11–15	18 (12.6)	4 (6.2)	22 (10.6)
16–20	9 (6.3)	6 (9.2)	15 (7.2)
21–25	10 (7.0)	0 (0.0)	10 (4.8)
>25	9 (6.3)	7 (10.8)	16 (7.7)

Table 2
Knowledge and attitudes of Trinidadian pharmacist regarding medication takeback.

Type of pharmacy	Community n (%) 143 (68.8)	Public sector n (%) 65 (31.3)	TOTAL n (%)
Soil and water can be contaminated by improperly disposed drugs	109 (76.2)	56 (86.2)	165 (79.3)
Improper disposal of antibiotics can cause increased bacterial resistance	63(44.1)	31(47.7)	94 (45.2)
OTC medicines can be disposed of in household trash	61(42.7)	26 (40)	87 (41.8)
The temperature of incineration >1200 ˚C	38(26.6)	21 (32.3)	59 (28.4)
Gives advice on medication disposal	29(20.3)	47 (72.3)	76 (36.5)
Have been asked for medication disposal advice	48(33.6)	31 (47.7)	79 (38.0)
My current pharmacy can be a medication take-back site	98(68.5)	46 (70.8)	144 (69.2)
Patients should pay a fee for medication disposal	18(12.6)	10 (15.4)	28 (13.5)
The pharmacist is responsible for providing drug disposal information	34(23.8)	25 (38.5)	59 (28.4)

pharmacies can access the service for a fee whilst it is provided free of charge to state-run facilities. There were no statistically significant differences in demographic variables except the location of the pharmacy where the private community pharmacies were more likely to dispose of expired medicines in the workplace garbage ($p = 0.011$). The most popular source of information for drug disposal practices (52.4%) was the senior pharmacist which was more prevalent within the public sector as opposed to private community pharmacies ($p = 0.038$). This is expected given that the majority of the respondents graduated within 5 years, and there is little formal training on medication disposal. A large portion (79.8%) thoughts that pharmacists should be the source of drug disposal information, although 64.5% believed that the Ministry of Health should be responsible for the mass dissemination of drug disposal information. There was no difference between any of the demographic variables and the perception of where patients should get drug disposal information, except that private community pharmacists believed that the internet could be a source of drug disposal information when compared to public sector pharmacists ($p = 0.017$). (Table 3).

The USFDA guidelines suggest drugs that can cause serious harm if ingestion after a single dose such as narcotics can be disposed of by flushing down the toilet. Pharmacists were asked which classes of drugs they would advise disposing of by flushing down the toilet and less than a quarter of pharmacists would recommend disposal of controlled/narcotics, antibiotics, antidepressants/antipsychotics, hormones and analgesics. There was no difference in this practice based on age, gender, years of experience and location, but pharmacists in the private community were more likely to recommend this disposal practice than those employed in the public sector. (Table 4).

Table 3
The practice of Trinidadian pharmacists regarding medication takeback. (Chi-Square analysis SPSS Version 24; *$p < 0.05$).

Type of pharmacy	Community 143 (68.8)	Public sector 65 (31.3)	TOTAL ($n = 208$)
How long do you keep expired medicines?			
Not at all	64 (44.8)	20 (30.8)	84 (40.4)
<3 months	51 (35.7)	24 (36.9)	75 (36)
3-6 months	12 (8.4)	6 (9.2)	18 (5.83)
6–12 months	2 (1.4)	1 (1.5)	3 (0.02)
>12 months	14 (9.8)	14 (21.5)	28 (13.4)
What do you do with expired medicines?			
Return to Pharmaceutical distributor	120 (83.9)	48 (73.8)	168 (80.8)
Incinerate through drug inspectorate	87 (60.8)	46 (70.8)	133 (63.9)
Dispose in workplace garbage *	54 (37.8)	13 (20)	67 (32.3)
Source of information on drug disposal			
Senior Pharmacist*	68 (47.6)	41 (63.1)	109 (52.4)
School/education	61(42.7)	28 (43.1)	89 (42.8)
Books/Journals	57 (39.9)	25 (38.5)	82 (39.4)
Internet	66 (46.2)	28 (43.1)	94 (45.2)
Medical Representative	12 (8.4)	9 (13.8)	21 (10.0)
None	1 (0.006)	0 (0.0)	1 (0.005)
Where should patients get information on proper medication disposal			
Pharmacists	114 (79.7)	52 (80.0)	166 (79.8)
Doctors	44 (30.8)	16 (24.6)	60 (28.9)
Ministry of Health Media Campaigns	95 (66.4)	39 (60.0)	134 (64.5)
Internet*	36 (25.2)	7 (10.8)	43 (20.7)

Discussion

Pharmaceutical contamination of the environment was identified by the majority of pharmacists as being due to improper disposal practices, but less than half knew that improper disposal of antibiotics can increase bacterial resistance. Most do not give information on proper medication disposal and less than half recall being asked for advice by patients. The majority did not think that the pharmacist's job included providing drug disposal advice but believed that they were the best category of staff to provide this service. Most pharmacists do not keep expired stock and return it to the pharmaceutical distributor or the Drug Inspectorate, Ministry of Health. The senior pharmacist was the major source of information on drug disposal, and most do not recommend disposal of drugs via flushing down the toilet.

Pharmacists should be aware of the guidelines outlined by the World Health Organization,[10] and the United States Food and Drug Administration (USFDA),[7–9] for proper disposal of pharmaceutical waste. Previous work in Trinidad[11] showed that patients disposed of unused/expired medication by throwing it in the household trash. As drug experts, pharmacists must be well equipped to inform the general population on the best ways to dispose of unused/expired medications.

Pharmacists were aware that improperly disposed of medication could contaminate soil and water (79.3%), which was similar to the findings in Kuwait[14] (82%), Delhi, India[15] (84.0%) and Saudi Arabia[16] (78.9%), but more than in Brazil[17] where just 16.8% had knowledge of the environmental harm resulting from the contamination of medicinal waste. Improper disposal of antibiotics is considered an overlooked source of increased antimicrobial resistance,[18] but only 45.2% of Trinidadian pharmacists were aware of this risk. With the spread of antibiotic stewardship programmes in community pharmacies,[19] there is a need to include proper disposal methods of antibiotics to mitigate this effect. Although antibiotics disposed of in the trash may be acceptable if there is no medication take-back programme, it will eventually leech into the environment, which highlights the need for implementation of a drug takeback programme.

Table 4
Medications Trinidadian pharmacists would recommend flushing down the toilet. (Chi-Square analysis SPSS Version 24; *$p < 0.05$).

Type of pharmacy	Community n (%) 143 (68.8)	Public sector n (%) 65 (31.3)	TOTAL n (%) 208 (100)
Controlled/Narcotics	34 (23.8)	9 (13.8)	43 (20.7)
Antibiotics*	25 (17.5)	4 (6.2)	29 (13.9)
Antidepressants/Antipsychotics*	28 (19.6)	4 (6.2)	32 (15.4)
Hormones*	23 (16.1)	3 (4.6)	26 (12.5)
Analgesics*	42 (29.4)	7 (10.8)	49 (23.6)
None*	84 (58.7)	50 (76.7)	134 (64.4)

Almost half of the respondents would recommend the disposal of OTC medications in the household trash, which is in contravention to the guidelines by the WHO and USFDA.[9,10] Only 28.4% of Trinidadian pharmacists correctly identified the temperature of incineration, which although low, was higher than that reported in India[15] (16%), and the minority counselled patients on disposal methods. There is no medication take-back programme implemented in Trinidad and previous work revealed that most patients dispose of medication in the household garbage (88.0%), and the majority do not seek information on proper disposal practise, as determined in this study with only 38% of patients seek disposal advice from their pharmacist.[11] Almost half of the pharmacists were not exposed to proper medication disposal practices while at Pharmacy School and only 28.4% thought that the pharmacist job description includes providing information on medication disposal.

The majority of pharmacists either did not keep expired medication or kept it for a period of less than three months. However, the majority returned expired medication to the pharmaceutical distributor (80.8%) or through the state via the Drug Inspectorate (63.9%). Almost one-third (32.3%) disposed of expired medication in the workplace garbage, a practice more commonly reported in community pharmacies. In Nigeria,[6] only 23.4% of pharmacists complied fully with the national guideline on disposal of expired drugs, whilst 71.4% used the state-run disposal system. Amongst Nigerian community pharmacists, 16.2% used workplace garbage or pouring down the sink as their means of expired drug disposal. This was lower than that observed in Trinidad,[11] although the sample size was smaller in Nigeria. In Saudi Arabia,[16] 75.3% returned expired medication to their pharmaceutical distributors whereas in Kuwait,[14] 73% of pharmacists disposed of medication by pouring it down the sink/flushing in the toilet. In New Zealand,[13] 58% of pharmacists dispose of controlled drugs by pouring down the sink. It appears that bulk packaging medications that can be returned to Pharmaceutical distributors are done is a timely manner, whereas partially used containers may be disposed of in the workplace garbage. This practice was higher in community pharmacies whereas drug disposal by incineration is procured in the public sector pharmacies through the Ministry of Health.

The majority of respondents had minimal training and knowledge in proper medication disposal, therefore it was not surprising that most got their information from the senior pharmacist at their location site, suggesting that the policies of the institution took precedence over their initial training and knowledge. Interestingly, even though pharmacists thought that giving disposal information was not in their job description, more than three-quarters believed that they should provide this information to patients. More than half also believed that there should be campaigns by the Ministry of Health to educate the population on good disposal practices. The lack of knowledge of proper disposal practices highlights the need for training and continuing medical education for pharmacists. This training should include the expanded role of providing adequate disposal information to affirm the position of the pharmacist as a drug expert.

Only one-fifth of pharmacists recommended the disposal of controlled/narcotics by flushing down the toilet. More than half did not think any expired/unused medication should be flushed down the toilet. Even though the recommendation of flushing antibiotics, antidepressants, antipsychotics, hormonal preparations and analgesics was low, it was more prominent amongst community pharmacists than in those employed within the public sector. The WHO[10] and USFDA[9] flush list include “medicines with a high misuse and/or abuse potential and those that can result in death from one dose if inappropriately taken. These include medications which contain drugs such as fentanyl, buprenorphine, oxycodone, methadone and morphine. If children, adults, or pets accidentally or intentionally ingest, touch, misuse, or abuse a medicine on the flush list, they can suffer serious consequences including death”.

The lack of knowledge amongst Trinidadian pharmacists highlight the need for increased education through continuing medical education, and a national awareness campaign. As is being done throughout the country for recyclable items such as plastics, glass and aluminium tins, a national policy for the safe disposal of unused/expired medications should be implemented. Many pharmacists displayed good disposal practises and also suggested their willingness for their workplace to be included as a site for medication takeback.

The study was limited by the sample size as mainly pharmacists who earned their degree in Trinidad comprised the majority of the sample population. The views expressed cannot be generalised throughout the entire population, and the views of non-nationals and those with diplomas in pharmacy were not represented sufficiently.

Conclusions

Even though Trinidadian pharmacists were aware of the environmental impact of improperly disposed medications, there was a lack of knowledge of the dangers of increased antimicrobial resistance. There is a need to improve awareness of best practices for medication disposal whilst highlighting the safety concerns associated with the authorized flush list. Continuing education for pharmacists is recommended along with a national awareness campaign on medication disposal and the implementation of a national medication take-back programme.

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Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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