



Patients' Knowledge, Attitude and Practices on Disposal Methods of Expired and Unused Medicines: Implication for Creation of Drug Take-Back Program

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How to cite this paper: Kampamba, M., Kalambwa, Z., Chabalenge, B., Zulu, J., Mudenda, S., Chimombe, T., Mufwambi, W., Hamachila, A., Ngula, M.I. and Hikaambo, C.N. (2024) Patients' Knowledge, Attitude and Practices on Disposal Methods of Expired and Unused Medicines: Implication for Creation of Drug Take-Back Program. *Pharmacology & Pharmacy*, 15, 113-128.

<https://doi.org/10.4236/pp.2024.154008>

Received: March 18, 2024

Accepted: April 27, 2024

Published: April 30, 2024

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Abstract

Background: Handling of medicines is a day-to-day activity by patients and many health care providers. However, multiple studies have brought to light inappropriate disposal methods for expired and unused medication (EUM). Improper disposal of expired and unused medicines is hazardous both to humans and the environment. **Objective:** This sought to measure patients' knowledge, attitude, and practices on disposal methods of EUM. **Methods:** A cross-sectional study was carried out among 384 patients at three outpatient pharmacies at the University Teaching Hospitals (UTHs). The structured questionnaire was used to collect data and STAT version 15.1 was used to analyse the data. **Results:** 384 respondents participated in this study and, at some point, had EUM. In this study, 356 (92.7%) of the participants reported that they had never heard of a drug take-back system. Most of the participants 285 (74.2%) and 239 (62.2%) kept and donated their unused medicine, respectively. Additionally, 244 (63.5%), 212 (55.2%), and 176 (44.8%) of the participants disposed of expired medicines in the bin or garbage, flushed them in toilets or sinks, or burned them, respectively. Occupation was significantly associated with unsafe disposal of unused medicine [P-value = 0.019]. **Conclusion and Relevance:** Knowledge of safe disposal methods for EUM was good amongst most participants. However, used unsafe disposal methods. The majority of the participants exhibited positive attitude concerning safe disposal methods. This study highlights the need for drug-take-back program creation in Zambia.

Keywords

Attitude, Disposal Methods, Expired Medicines, Knowledge, Practices, Unused Medicines

1. Introduction

Incorrect disposal methods of EUM are a global problem that is occurring in both developing countries like Zambia and developed countries [1] [2]. This mostly leads to problems like unsuccessful treatment, health risks, drug resistance, and overall decreases the quality of care for the population and increases illness and death [3] [4]. Additionally, there is extreme spending on pharmaceuticals and wastage of financial resources by both patients and the healthcare system [5] [6]. Improper disposal of EUM is also usually linked with environmental pollution and health hazards [7] [8]. It pollutes superficial bodies and drinking water, adds to the growth of antimicrobial resistance (AMR), and exposes the population to irritant or mutagenic anticancer medicines [1].

Excessive prescribing by doctors, poor adherence and compliance, discontinuation of medication, adverse effects, and dose changes are factors that have led to the accumulation of EUM in some homes [9]. A study conducted in Ethiopia revealed that 89.1% of medicines obtained by consumers are never used [10]. There is a dearth of knowledge on how to dispose of EUM among the population [11]. Several studies conducted both internationally and nationally have revealed that a significant portion of patients fail to store their medications appropriately at home, posing risks such as incorrect self-medication, accidental overdose, and misuse of prescription medications [12]. Patients retain medications due to concerns about wastage, lack of knowledge regarding expiration date verification, or uncertainty about safe and proper disposal methods [13]. This contributes to the accumulation of EUM [14].

An increase in healthcare activity, demonstrated by a higher number of patients seeking services, prescriptions, medication consumption, and excessive drug manufacturing, can contribute to the accumulation of EUM, thereby escalating the volume of pharmaceutical waste [8]. Many countries face a notable prevalence of unused medications (UM), a trend that has significantly escalated in recent decades due to factors such as poor patient adherence, excessive and irrational prescribing practices, or insufficient oversight in the distribution of prescribed drugs [15]. Despite its importance for public health, environmental concerns, and efficient resource allocation, research on medication waste remains limited [16]. Prescribers' adjustments to drug therapy aimed at benefiting the patient's health may inadvertently lead to the accumulation of medications within the patient's home [16] [17].

Various researches conducted across different regions worldwide regarding

the disposal methods of unused medications (UM) indicated that disposing of them in the trash or flushing them down a toilet or sink were the most commonly employed practices. [18]. In a study undertaken in India, it was found that a predominant number of consumers mentioned discarding medicines in the trash or pouring them down the sink as their preferred disposal methods [19]. A study conducted in the United States of America revealed that over half of the patients kept unused medications (EUM) in their households, with a similar proportion admitting to flushing them down the toilet [13].

Research conducted in Zambia on the disposal practices of unused and expired drugs among both institutions of higher learning and residents of Lusaka indicated that disposing of them in the trash or flushing them down a toilet or sink were commonly employed methods [20] [21] [22].

There are no studies that have been published that detail how unwanted and expired medication is disposed by patients visiting Zambian hospitals. This made it necessary to carry out a study to evaluate patients' knowledge, attitudes, and practices regarding the disposal of EUM.

2. Methodology

2.1. Study Design and Setting

This institution-based cross-sectional investigation took place between September 1st and October 31st, 2022, involving patients who received dispensed medications from three outpatient pharmacies situated within the University Teaching Hospitals (UTHs) in Lusaka, Zambia. These hospitals, namely the Women and Newborn Hospital, the Cancer Disease Hospital, and the Adult Hospital, are located approximately 4 kilometers east of the city center and provide a range of inpatient and outpatient healthcare services, serving as a hub for specialized referrals from across Zambia.

2.2. Study Population

The study was conducted among patients of ≥ 18 years old at the University Teaching Hospitals, Lusaka, Zambia who were from different cultural, religious, educational, and social backgrounds. Without using any particular means of recruitment, participants were chosen at random. Anybody attending one of the designated outpatient pharmacy waiting areas on a weekday between the hours of 8:00 and 17:00 was given the opportunity to take part in the study.

The sample size was calculated using the single proportion formula.

$$n = \frac{Z^2 p(1-p)}{d^2},$$

n = the sample size, Z = Confidence interval level (95% = 1.96), p = estimated population proportion 50%, d = absolute error or precision (0.05), $n = (1.96)^2(0.5)(1 - 0.5)/(0.05)^2$. Therefore, $n = 384$ patients.

2.3. Data Collection and Measurement

The collection of data involved the use of a questionnaire that had been

modified based on previous research studies after obtaining permission [21] [22] [23]. The questionnaires had four sections. The first part of the questionnaire was designed to address the sociodemographic characteristics of the participants. The second part addressed questions about knowledge of the disposal of unused and expired medicines. The third part was about the attitude of participants regarding the disposal of EUM measured using 5-point Likert scale responses (1 “strongly agree,” 2 “agree,” 3 “Neutral,” 4 “disagree” and 5 “strongly disagree”). We then reported the results by converting options 1 and 2 as agree while 4, 5 and 6 were regarded as disagree. Finally, the fourth part of the questionnaire addressed the questions about practices toward disposal of EUM. We further dichotomize disposal methods of UM into safe and unsafe disposal methods. Participants who chose to return the medications to the pharmacy were identified as engaging in safe disposal practices, while others who reported actions such as burning, sharing with relatives, and keeping until expiration, or expressing uncertainty about disposal methods were classified as employing unsafe disposal practices. Following the acquisition of written consent from each participant and ensuring confidentiality, participants were provided with the questionnaire for self-administration.

2.4. Data Analysis

Following data collection, meticulous checks and cleaning were undertaken to ensure data completeness prior to analysis utilizing STATA version 15.1. Microsoft Excel 2016 facilitated the creation of graphical representations. Descriptive statistics, including frequencies and percentages, were computed to summarize sample characteristics. Results were effectively communicated through tables and figures. In evaluating safe versus unsafe disposal methods of unused medicines, the Pearson-Chi-square test was applied, with a significance level established at 0.05.

2.5. Ethical Considerations

The current research project received approval from the institutional review the University of Zambia Health Sciences Research Committee (UNZAHSREC) Protocol ID Number 202112030022 in an approved memo dated 12th August 2021. Participation was voluntary and participants were given a brief explanation of the study’s objectives, and they were free to skip any questions that they were unsure of or felt uncomfortable answering. Furthermore, written consent was also obtained from the participants.

3. Result

3.1. Sociodemographic Characteristics of Participants

Overall, 384 participants were approached, and all responded representing a 100% participants’ response rate. Among the total respondents, the majority 184

(47.9%) were females. Most 173 (45.1%) of participants aged ≥ 36 years old. The majority of the participants were Christians 376 (97.9%) and unemployed 239 (62.2%). Regarding residence, the majority 275 (71.6%) were from the urban areas. 204 (53.1%) of the participants were married and 226 (58.9%) had attained tertiary education. 186 (48.4%) earned a monthly basic salary of less than K1380 (\$68). Occupation was significantly associated with unsafe disposal of unused medicine [P-value= 0.019]. Other sociodemographic variables such as age, employment status, residence, gender, marital status, education level, and income were not statistically significantly associated with disposal methods of UM as presented in **Table 1**.

Table 1. Sociodemographic characteristics of the participants and their disposal methods of unused medicines (n = 384).

Variables	Frequency (%)	Disposal Methods of Unused Medicines		
		Safe n = 19(%)	Unsafe n = 365 (%)	P-value
Gender				
Males	200 (52.1)	6 (3)	194 (97)	0.066
Females	184 (47.9)	13 (7.1)	171 (92.9)	
Age				
18 - 25 years	93 (24.0)	8 (8.6)	85 (91.4)	0.168
26 - 35 years	118 (30.7)	5 (4.2)	113 (95.8)	
≥ 36 years old	173 (45.1)	6 (3.5)	167 (96.5)	
Residence				
Rural	109 (28.4)	3 (2.7)	106 (97.3)	0.212
Urban	275 (71.6)	16 (5.8)	259 (94.2)	
Religion				
Christians	376 (97.9)	19 (5.0)	357 (95.0)	0.514
Others	8 (2.1)	0 (0.0)	8 (100)	
Marital status				
Married	204 (53.1)	13 (6.4)	191 (93.6)	0.290
Unmarried	125 (32.6)	6 (4.8)	119 (95.2)	
Divorced	25 (6.5)	0 (0.0)	25 (100)	
Widowed	30 (7.8)	0 (0.0)	30 (100)	
Educational background				
Illiterate	29 (7.6)	0 (0.0)	29 (100)	0.288
Primary	19 (5.0)	0 (0.0)	19 (100)	
Secondary	110 (28.7)	8 (7.3)	102 (92.7)	
Tertiary	226(58.9)	11(4.9)	215 (95.1)	
Occupation				
Unemployed	239 (62.2)	7 (2.9)	232 (97.1)	0.019
Employed	145 (37.8)	12 (8.3)	133 (91.7)	
Monthly income				
<K1380	186 (48.4)	11 (5.9)	175 (94.1)	0.628
K1381 - 6900	132 (34.4)	6 (4.5)	126 (95.5)	
K 6901 - 13,800	66 (17.2)	2 (3.0)	64 (97.0)	

3.2. Participants' Knowledge on the Disposal of Unused and Expired Medicines

The majority of survey respondents, encompassing 355 (92.5%) individuals, acknowledged the issue of medication waste, although an equally significant portion, 356 (92.7%) participants, remained uninformed about the drug-take-back system. Regarding the potential dangers associated with improper medicine disposal, a substantial majority of 358 (93.2%) respondents mentioned environmental contamination, while an even larger majority of 362 (94.3%) participants highlighted the risk of accidental ingestion by children. 370 (96.4%) of participants responded that the harmful effects of improperly disposed of medication could be avoided through the provision of guidance on safe disposal of medication to consumers and 360 (93.8%) held pharmacists as being responsible for public awareness (Table 2).

3.3. Assessment of Attitudes toward Disposal Methods for Expired and Unused Medicines

In the evaluation of participant attitudes toward the disposal procedures for EUM, an overwhelming 373 (97.1%) individuals expressed consensus on the necessity for the implementation of outreach and awareness campaigns focused on educating people about appropriate methods of disposing of EUM. Additionally, 357 (93%) of the respondents believe that mandatory take-back programs for EUM should be implemented. When asked if doctors and healthcare professionals should provide advice on the safe disposal of EUM, 376 (98%) respondents agreed to the statement. On the part of children being more vulnerable to the risks associated with EUM, 378 (98.5%) of the respondents agreed that EUM poses a huge risk to children. When asked if there was a lack of adequate information on the safe disposal of UM, 366 (95.3%) respondents agreed. Lastly, 374 (97.4%) strongly agreed that unused and expired medicines present potential risks at home as shown in Figure 1.

3.4. Determination of Disposal Methods for Expired and Unused Medicines

Majority 344 (89.6%) of the respondents still had some purchased or dispensed medicines in their homes. When asked why participants kept the medicines in their homes, majority 263 (68.5%) responded that they kept them due to improvement in their medical conditions and side effects, 251 (65.4%) as shown in Table 3. The most kept medicines were antibiotics 308 (80.2%) followed by analgesia with 282 (73.4 %) Figure 2. When asked what they do with EUM, the majority 285 (74.2%) keptUM at home until expired, and the majority 63.5% (244) through away expired medicines in household garbage (Figure 3).

4. Discussion

The accumulation and inappropriate disposal of EUM pose potential adverse

Table 2. Participants' knowledge on the disposal of unused and expired medicine (n = 384).

Questions/Statement	Frequency	Percentage
Have you ever heard about medicine waste?		
Yes	355	92.5
No	29	7.7
If yes, which one of the following can be considered as medicine waste (multiple answers allowed)? n = (355)		
Expired medicines	341	88.8
Leftover medicines due to some reasons	148	38.5
Damaged medicines that cannot be used	242	63.0
Opened medication and beyond its recommended use date	273	71.1
Do you ever read medicines disposal instructions?		
No	304	79.2
Yes	80	20.8
Do you know about the “drug-take-back system”?		
No	356	92.7
Yes	28	7.3
Do you know that misused/repeated change or failure to complete antibiotics may cause drug resistance?		
No	32	8.3
Yes	352	91.7
Improper disposal of unused and expired medicines can affect the environment and health.		
No	15	3.9
Yes	369	96.1
What do you think is the possible harm associated with inappropriate medicine disposal?		
It can contaminate the environment	358	93.2
It can kill wildlife	151	39.3
Can cause accidental swallowing by children	362	94.3
How can the hazardous effects of unused and expired medicines be minimized or controlled?		
Providing proper guidance to the consumer	370	96.4
Prescribing in quantities and for duration that ensure patient compliance	305	79.4
Lowering the number of prescribed medicines by doctor	70	18.2
Donating or sharing unused medicines	188	49.0
Who do you think is responsible for creating public awareness about the proper disposal of unused and expired medicines (multiple answers allowed)?		
Mass media	275	71.6
Physician	306	79.7
Pharmacists	360	93.8
The pharmaceutical industry	184	48.0

impacts on both the environment and public health due to the increasing manufacturing and utilization of pharmaceuticals. [24]. Through the establishment of policies and protocols for medication disposal and increasing public awareness about correct disposal practices, the incidence of this problem can be minimized.

Table 3. Reason for having unused medication (n = 384)

Statement	Frequency (%)
Did any quantity of purchased or dispensed medicine remain unused at your home?	
Yes	344 (89.6)
No	40 (10.4)
If yes, what is the reason for having unused medication (multiple answers allowed)? n (344)	
Improvement in medical condition	263 (68.5)
Change of medication by prescriber	104 (27.1)
Experiencing side effects	125 (32.6)
Keeping for future use	251 (65.4)
Forgetting	79 (20.6)

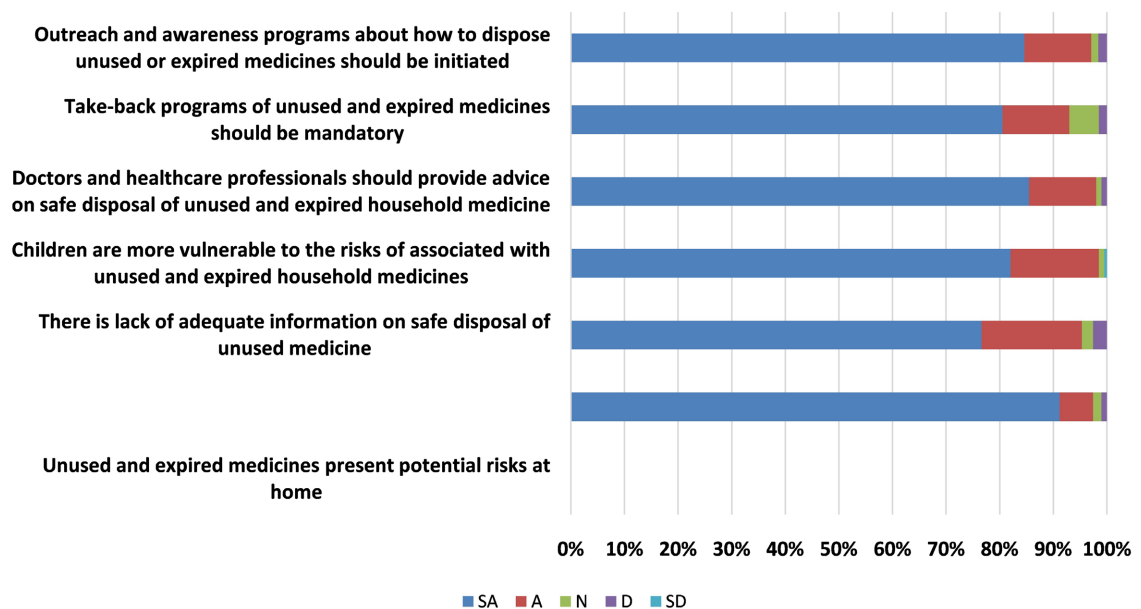


Figure 1. Assessment of attitude on disposal methods of expired and unused medicines (n = 384). SA: Strongly agree, A: Agree, N: Neutral, SD: Strongly disagree, DA: Disagree.

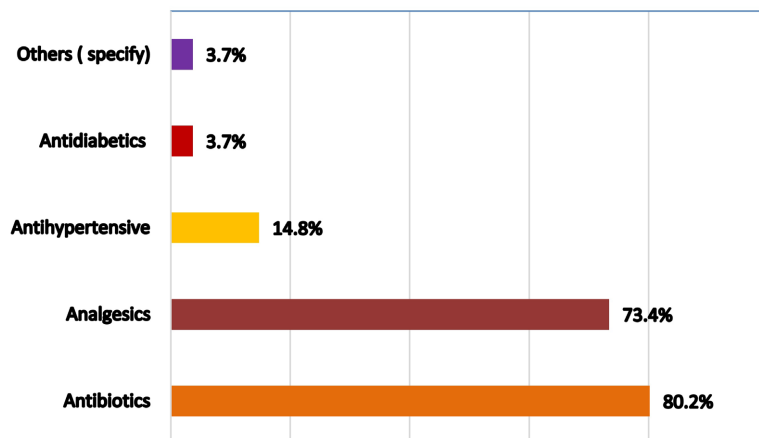


Figure 2. Class of medicines remained unused at home (n = 344).

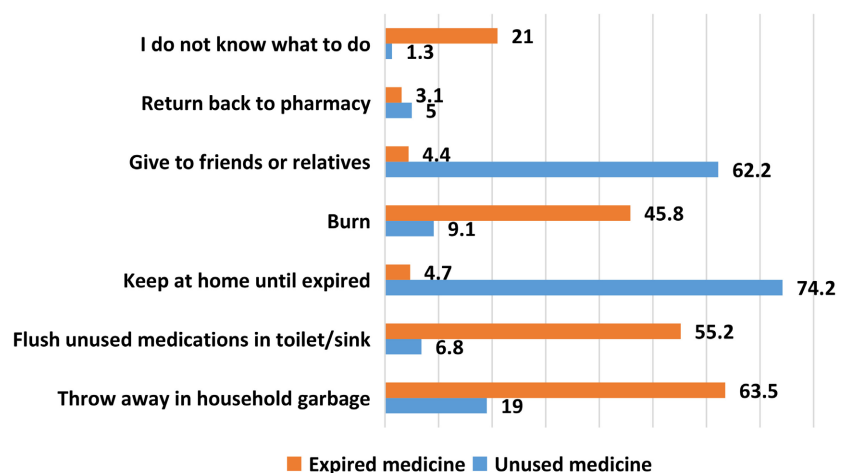


Figure 3. Methods of disposal of unused and expired medicines (n = 344).

[25] [26] [27]. The study aimed to assess the patients' knowledge, attitudes, and practices regarding the disposal of unused and expired medicines at the UTHs.

Most of the participants (92.5%) responded that they understood medication waste, of which expired medicines were mostly considered. This is similar to the findings of other studies [22] [28]. Many respondents in the current study considered damaged medicines that could not be used and once-opened medicines that had passed their recommended use dates to be medicine waste. In the current study, participants may have obtained knowledge about EUM through educational resources provided by local pharmacies, healthcare providers, or government agencies, and by consulting reputable online sources that offer guidance on safe disposal methods. Additionally, community outreach programs, such as workshops or seminars, may also offer valuable information on this topic. However, participants regarded leftover medicines as the least likely to be considered medicine waste. This was alarming as participants in this study considered unused medicines as a danger, especially to children.

A larger portion (92.7%) of the respondents indicated that they did not know about the drug take-back system. This finding is consistent with studies conducted in Adigrat, Ethiopia (82.2%), Bangladesh (96.8%), and Malaysia (93.6%) [13] [29] [30], but higher than in the study conducted in Harar, Ethiopia, where 66.9% of respondents did not know the drug take-back system [23]. The participant's lack of knowledge about the drug take-back system in this study could be due to the non-existence of such a system in Zambia. A drug take-back program can help remove EUM from households and lower the risk of someone else mistakenly taking the medication [31]. Therefore, we argue that countries without drug take-back programs like Zambia need to introduce such a program. If our community has a drug take-back program, the public would be made aware of any unique guidelines about which medications can be returned for proper disposal.

Concerning the UM, most respondents (74.2%) kept them at home until they expired. This is supported by the findings of a study in Mwanza, Tanzania in

which 70.19% of households kept the medicines at their homes [28]. In our study, 68.5% and 65.4% of the participants stated that improvement in the condition and keeping the medicine for future use respectively were the major reasons for storing unused medicines at home. This could have contributed to the high levels of storing unused medicines seen in households in this study. Other studies have found similar reasons to ours as the major contributing factor for storing unused medicine [21] [32] [33]. Having medications in households is alarming and may highlight non-compliance to medicines, sharing of medicines with friends, and self-medication, which are all main drivers of drug resistance [34] [35].

The most common practices for disposal of EUM in this study were throwing them into the garbage, flushing them down the toilet or sink, and burning them. These findings are consistent with findings in Tanzania, Kuwait, Malaysia, Serbia, and the USA [28] [36] [37] [38]. The improper disposal of EUM through sinks, dustbins, and toilets as observed in the current study is environmentally unfriendly and may be linked to deleterious environmental effects [39], harmful effects on aquatic organisms [40], negative effects on public health through drinking contaminated water [41], and antimicrobial resistance [42]. The impact of improperly discarding EUM on the emergence of antimicrobial resistance in Zambia should not be disregarded, as research has linked inappropriate disposal of antibiotics to resistance [43]. In this study, only 4.9% and 3.1% of unused and expired medication were returned to the pharmacy, respectively. This might be due to the lack of a well-established drug take-back system in Zambia, and hence, the need for a robust system in place and awareness programmes.

In the current study, unemployed people used unsafe disposal methods more often than those who were employed (97.1% vs 91.7%). The reason could be that the employed easily access information on the safe disposal practices at their workplaces when pharmaceutical companies/distributors are marketing their products. In a study conducted in Kenya, multivariate logistic regression analysis revealed that respondents who had previous information on safe medicine disposal were more probably to dispose of unused medicines rather than have them for future use [44]. Therefore, cooperation between pharmaceutical companies, governments, and medical professionals is necessary to promote awareness about the good disposal practices of EUM.

Generally, more than 90% of the participants in the current study displayed a high level of positive attitude towards all the statements about disposal methods for expired and unused medicines. These findings are similar to what has been reported by other studies in which participants had agreed to most of the statements [20] [29] [45] [46]. This is very encouraging, especially in the current study where participants advocated for the initiation of outreach and awareness programs about how to dispose of the EUM through health professionals and the media. This is in support with other studies conducted in Malaysia and Ethiopia where participants viewed health workers and media as a tool to promote appropriate disposal of EUM [23] [47]. Excitingly, 93% of the participants

in the current study stated that drug take-back programs EUM should be mandatory. This is consistent with earlier research done elsewhere [48] [49] [50]. The body of knowledge has shown that collaborative drug take-back programs are a successful way to get rid of EUM from the communities [51] [52]. Therefore, we urge the policymakers in Zambia to seriously consider initiating a mandatory drug take-back program.

In this study, antibiotics (80.2%) were the most kept UM in the households followed by analgesics. This is consistent with the findings of other studies, which found antibiotics as the most stored UM in households [33] [53] [54] [55]. This finding in the current study is very alarming because it can be an indication of inappropriate use of antibiotics in the communities, which may result in AMR. Surprisingly, a large proportion of the participants (91.7%) in our study were aware that misusing antibiotics, as well as failing to finish antibiotics, could lead to AMR. Other studies found that analgesics and antihypertensives as the most kept UM in the households [12] [56] [57] [58].

The study faced limitations, notably the likelihood that its findings primarily represent the awareness and perspectives of the public residing in Lusaka, Zambia, thus possibly not being broadly applicable to the entire Zambian population. Moreover, the inclusion criteria, which involved individuals with recent medication exposure in the preceding three months, could introduce recall bias. A more expansive survey encompassing remote areas holds the potential to unveil supplementary valuable insights.

5. Conclusion

This study revealed that many participants had adequate knowledge regarding the proper disposal of unused or expired medicines. Unsafe disposal practices of unused or expired household medicines were observed among the participants. However, most of the participants requested the need to introduce a drug take-back program and outreach to promote the safe disposal of unused or expired household medicines within their homes and communities.

Conflicts of Interest

The authors declare no conflict of interest.

Funding

This research received no external funding.

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