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Comprehensive Assessment of Pharmaceutical Waste Disposal Practices in Ishaka-Bushenyi Municipality: Implications for Public Health and Environmental Sustainability

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ABSTRACT

Proper management of pharmaceutical waste is crucial for safeguarding public health and the environment. This study aimed to comprehensively assess pharmaceutical waste management practices in hospitals, pharmacies, and households within Bushenyi-Ishaka Municipality, Uganda. The study employed a qualitative case study design, gathering data through observations, interviews, and questionnaires administered to five pharmacies, two hospitals, and 100 households. The results revealed that the mean amount of pharmaceutical waste generated by pharmacies and hospitals in Ishaka was $40.5 \text{ kg} \pm 32.39 \text{ kg}$ per month, of which $26.83 \text{ kg} \pm 29.10 \text{ kg}$ were disposed of safely. However, 60% of the waste was categorized as hazardous. The study found that while most facilities used labeled or color-coded containers for waste segregation, the practice of segregation was inconsistent, with 71.43% of the facilities not segregating their waste. Incineration (42.86%) and dilution followed by flushing in protected soak pits (42.86%) were the primary disposal methods employed by the facilities. Concerningly, only 4% of households returned unused or expired medications to pharmacies, with the majority disposing of them in dustbins (46%) or flushing them down toilets (41%). The findings also highlighted gaps in awareness and training, with 50% of pharmacy staff not receiving any training on proper pharmaceutical waste disposal, and only 14.29% of the facilities having established waste management guidelines. These deficiencies in knowledge and practices contribute to the suboptimal management of pharmaceutical waste, posing significant risks to public health and the environment. The study underscores the urgent need for comprehensive policies, targeted training programs, and community-based initiatives to enhance pharmaceutical waste management practices in Bushenyi-Ishaka Municipality and similar settings. Addressing these challenges is crucial for mitigating the adverse impacts of improper pharmaceutical waste disposal and promoting sustainable healthcare waste management.

Keywords: Pharmaceutical waste, Waste management, Disposal practices, Awareness, Hazardous waste

INTRODUCTION

Pharmaceutical waste management has emerged as a critical public health and environmental concern globally. Improper disposal of expired, unused, or contaminated pharmaceuticals can have serious consequences, including contamination of water sources, soil, and air, as well as posing direct health risks to healthcare workers, waste handlers, and the general public [1, 2]. Pharmaceutical waste can contain a wide range of hazardous substances, such as cytotoxic drugs, controlled substances, and antimicrobial agents, which require specialized handling and disposal methods to mitigate their harmful effects [3]. In Uganda, the National Drug Authority (NDA) is mandated to oversee the management of expired and substandard pharmaceutical products, yet concerns persist regarding the effective implementation of proper disposal practices [4]. Inadequate waste segregation, inappropriate storage, and the indiscriminate dumping of pharmaceutical waste can lead to the contamination of the local environment, potentially contributing to the transmission of diseases and the proliferation of vectors like insects and rodents [5]. The Bushenyi-Ishaka Municipality, situated in western Uganda, is not immune to these challenges. As a rapidly urbanizing area, Bushenyi-Ishaka is home to a growing number of healthcare facilities, including hospitals and community pharmacies, all of which generate significant quantities of pharmaceutical waste. However, the extent of pharmaceutical waste generation, the methods employed for handling and disposing of this waste, and the awareness levels among healthcare workers and the general public regarding proper

disposal practices remain largely undocumented in this context. Understanding the current state of pharmaceutical waste management in Bushenyi-Ishaka Municipality is crucial for developing effective strategies to mitigate the associated public health and environmental risks. Strengthening the capacity of healthcare facilities and the community to manage pharmaceutical waste in a safe and sustainable manner can have far-reaching implications for the region's overall environmental well-being and the health of its residents.

This study, therefore, aims to conduct a comprehensive assessment of pharmaceutical waste management practices in hospitals, pharmacies, and households within Bushenyi-Ishaka Municipality. The importance of this study lies in its potential to inform policymakers, healthcare administrators, and the community about the current state of pharmaceutical waste management in the region. By identifying the gaps and challenges in existing practices, the study can provide valuable insights to guide the development of targeted interventions and policy recommendations, ultimately contributing to the establishment of a more effective and sustainable pharmaceutical waste management system in Bushenyi-Ishaka Municipality and potentially serving as a model for other regions facing similar challenges [6]. Furthermore, the findings of this study may have broader implications for the understanding and management of pharmaceutical waste across Uganda and the East African region, where limited research has been conducted on this critical issue [7]. By addressing the knowledge gaps and providing empirical evidence on the current practices and perceptions surrounding pharmaceutical waste management, this study can inform future research, policy formulation, and the implementation of targeted interventions to promote environmentally responsible and health-conscious disposal of pharmaceutical waste [8]. The assessment of pharmaceutical waste management practices in Bushenyi-Ishaka Municipality is a timely and essential undertaking. The study's comprehensive approach, which encompasses hospitals, pharmacies, and households, will shed light on the multifaceted challenges and opportunities for improving pharmaceutical waste management in the region. The findings and recommendations from this research can contribute to the development of evidence-based strategies to safeguard public health, protect the environment, and foster sustainable waste management practices in Bushenyi-Ishaka Municipality and beyond.

METHODOLOGY

Research Design

This was an exploratory qualitative case study. The researcher chose this design which allowed an intensive, descriptive holistic analysis of pharmaceutical waste disposal practices in Ishaka-Bushenyi. This design is justified as useful for this study since it required a smaller sample, in-depth analysis, and multinomial, contextual, and concrete evaluation of the issue at hand [9].

Study Population and Sampling

The study considered five pharmacies and hospitals located within Ishaka – Bushenyi Municipality which have been operational for at least one year.

Target Population

The study was conducted in Bushenyi-Ishaka municipality. The study considered five pharmacies, households, and two hospitals; Kampala International Teaching Hospital and Ishaka Adventist Hospital. These study units were chosen by the researcher since they were few and accessible in terms of distance and time.

Study Sample

The study consisted of five pharmacies and two hospitals, selected from the pharmacies and hospitals within Ishaka-Bushenyi. This number was chosen according to the stratification of Ishaka into divisions and one pharmacy was chosen from each division.

Sampling Techniques and Justification

Two sampling techniques were used in this study: A stratified sampling method was chosen for the selection of pharmacies located within Ishaka municipality. This method was used to ensure that there was equitable representation of all the geographical divisions of Ishaka in the study unit. This method is justified for this study to ensure that all regions are proportionally represented in the study [9]. Purposive Sampling Techniques were used to choose the two hospitals included in this study. This method of sampling was used to ensure focused data collection. This is justified because it ensures only typical and useful study units (in this case, Ishaka and KIUTH) are selected and also saves time and money [9].

Sample Size Determination

Two methods of sample size determination were employed in this study;

1. Convenience sampling methods were employed to determine the two hospitals and five pharmacies within Ishaka at the discretion of the researcher for the key informant and focus group discussion participants.
2. The sample size for the households was calculated using Kish and Leslie's Formula (1 Q65), given by:

$$n = \frac{z^2 Pq}{d^2}$$

Equation 1: Kish and Leslie's Formula

Where; n= sample size

Z= confidence interval

P= total population of the target population (We do not know the exact number of people who are attending pharmacies, and thus we shall assume 50% according to WHO standards [10]).

When: p = 50% (0.5), q = 1-p (0.5), and d = 0.098, z = 1.96(constant at 96% Confidence Interval)

$$n = \frac{1.96^2 * p * q}{0.098^2}$$

n= 100

Therefore: n= 100 households' respondents were considered in this study.

Data Collection

Two instruments were employed to gather data for this study: observation, interviews, and questionnaires.

Observation: The researcher employed their senses (sight and smell) to perceive and comprehend waste disposal practices within each unit. This method allowed direct observation of actual practices compared to reported activities.

Interviews: Respondent interviews were conducted to obtain opinions and information regarding pharmaceutical waste management. This method was chosen to gather insights not observable through direct observation.

Questionnaires: Self-administered questionnaires were distributed to specific respondents in English to efficiently collect a substantial amount of information within a short period. This method ensured documented information gathering.

Research Procedures

Data collection commenced three weeks after approval from the supervisor and the school of pharmacy. Data was collected from two hospitals and five pharmacies by the researcher to ensure comprehensive coverage of key concepts and issues. This approach also facilitated adjustments to investigative questions during data collection.

Data Analysis

Data collected was analyzed using Statistical Product for Social Scientist (SPSS) version 21, IBM ®. The analysis involved both inferential and descriptive statistics. Details of the techniques were chosen after collecting the data which ensured that correct methods were used to analyze specific types of data. The analyzed data was presented in the form of tables, graphs, charts, and statistical outputs.

Quality Control

The data collection tools were pretested outside the study area before being used to collect data at selected pharmacies. This allowed for the modification of the reliability and validity of the instruments to at least 0.70. Items with a validity and reliability coefficient of 0.70 are considered valid and reliable in research [11].

Validity

Validity is the extent to which research results can be accurately interpreted and generalized to other populations. It's the extent to which research instruments measure what they are intended to measure [12]. To establish validity, the instruments were given to two evaluators which established the relevance of each item in the instruments to the objectives and rated each item on the instrument as very relevant (4), quite relevant (3), somewhat relevant (2), and not relevant (1). Validity was calculated using the Content Validity Index (C.V.I).

C.V.I = items rated 3 and 4 by both evaluators against the total number of items given by:

$CVI = n3 / N$

Equation 2: Content Validity Index for Validity Test

Assumption and Limitation

The following extra venous factors (social expectations, political aspects, technical capability, and ownership of the pharmacy {Private or government}) were expected to influence the dependent variables (waste management practices); whose construct include: segregation, disposal, and recycling of pharmaceutical waste. These variables were controlled through a random selection of participating pharmacies.

Ethical Consideration

The major ethical dilemma in this study was related to privacy and confidentiality. Two participating hospitals were purposefully selected. This meant that confidential information might have been leaked from the pharmaceutical units in these centres. However, the researcher ensured that the participants from these units remained anonymous and their identities were kept out of disclosure. Secondly, the researcher ensured that

respondents signed an informed consent form that ensured that they consented to participate in this study; this form ensured that the researcher understood the benefits and risks of participating in this study.

RESULTS

Socio-demographic Characteristics of Respondents who participated in drug disposal
Table 1: Demographic Characteristics of Respondents who participated in drugs disposal

| Variables | Participated | Not Participated | Odds Ratios | P values |
|-------------------|--------------|------------------|-------------------|----------|
| Gender | | | 0.53(0.22- 1.23) | 0.139 |
| 1. Male | 30 | 24 | | |
| 2. Female | 35 | 13 | | |
| Marital Status | | | 1.21(0.51- v2.86) | .66 |
| 1. Single | 43 | 21 | | |
| 2. Married | 22 | 13 | | |
| Employment Status | | | 0.81 (0.35- 1.86) | .61 |
| 1. Employed | 31 | 18 | | |
| 2. Unemployed | 34 | 16 | | |
| Age | | | 1.61 (.56-4.95) | .35 |
| 1. 18-37 | 58 | 27 | | |
| 2. 38- 60 | 9 | 7 | | |

Participation in pharmaceutical waste management was higher among females, accounting for 53.8% of participants, while males comprised 46.2%. The majority of participants, 86.5%, belonged to the 18-37 age group, with 66.15% being single and 46.7% employed.

Quantity and Quality of Pharmaceutical Waste Generated
Table 2: Amount of pharmaceutical waste generated by community Pharmacies and Hospitals per month

| | Mean weight | Std. Deviation | 95% Confidence Interval of the Difference | | P value(2 tailed) |
|--------------------------------------|-------------|----------------|---|-------|-------------------|
| | | | Lower | Upper | |
| Amount of waste in Kilogram disposed | 40.50 kg | 32.39 | 6.50 | 74.49 | 0.028 |

The mean amount of pharmaceutical waste generated was 40.5kgs ± 32.39kgs. The table shows that the volume was significant at p value .028 (2 tailed).

Table 3: Amount of waste disposed by community Pharmacies and Hospitals

| | Mean | Std. Deviation | 95% Confidence Interval of the Difference | | P value (2 tailed) |
|---------------------------|-------|----------------|---|-------|--------------------|
| | | | Lower | Upper | |
| Amount of waste generated | 26.83 | 29.11 | -3.72 | 57.38 | .074 |

The mean amount of pharmaceutical waste disposed by pharmacies in Ishaka averages 26.83 kgs ± 29.10 kgs as shown above.

Table 4: Quality of Pharmaceutical Waste disposed by pharmacies

| Quality of Waste | Frequency | Percentage |
|----------------------|-----------|------------|
| Hazardous Waste | 60 | 60% |
| Non- Hazardous Waste | 40 | 40% |

Most of the waste generated in Ishaka is hazardous, 80(80%) and 20(20%) of the waste generated were non-hazardous.

Table 5: Drugs commonly disposed from households

| | | Responses | | Percent of Cases |
|-----------------------------|-----------------------------|------------|---------------|------------------|
| | | N | Percent | |
| Drugs commonly disposed off | Analgesics | 41 | 28.5% | 52.6% |
| | Antibiotics | 44 | 30.6% | 56.4% |
| | Anti-inflammatory | 10 | 6.9% | 12.8% |
| | Antacid | 13 | 9.0% | 16.7% |
| | Anti-histamine | 7 | 4.9% | 9.0% |
| | Respiratory Infection Drugs | 29 | 20.1% | 37.2% |
| Total | | 144 | 100.0% | 184.6% |

The majority of respondents reported leftover antibiotics (56.4%) and other drugs (30.6%). Additionally, 52.6% reported leftover analgesics along with other drugs, while 28.5% reported leftover analgesics only. A smaller percentage (4.9%) reported leftover anti-histamines exclusively, with 9.0% reporting anti-histamines along with other drugs.

Methods of Handling Pharmaceutical Waste

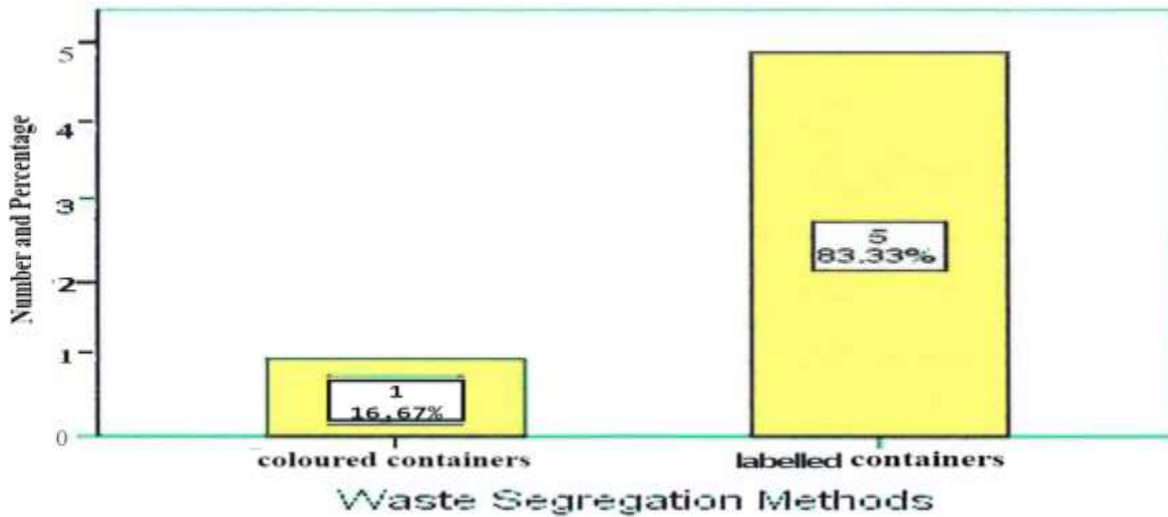


Figure 1: Methods of Waste Segregation

Most of the waste segregation methods were using labeled containers, 5(83.33%) followed by those who used colored containers, 1(16.67%).

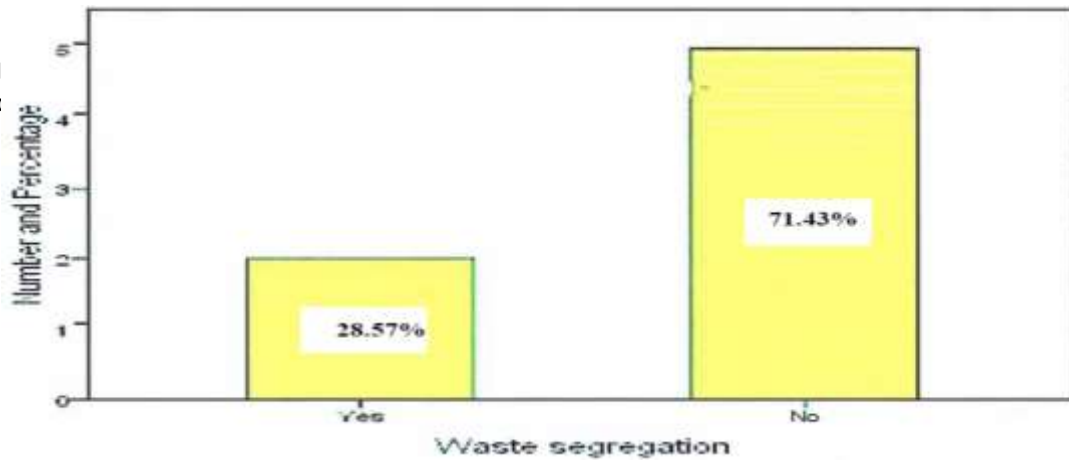


Figure 2: Pharmaceutical waste Segregation

Only 28.57% are doing segregation, the rest are not doing segregation, 71.43%.

Methods of disposing Pharmaceutical Waste in pharmacies and hospitals

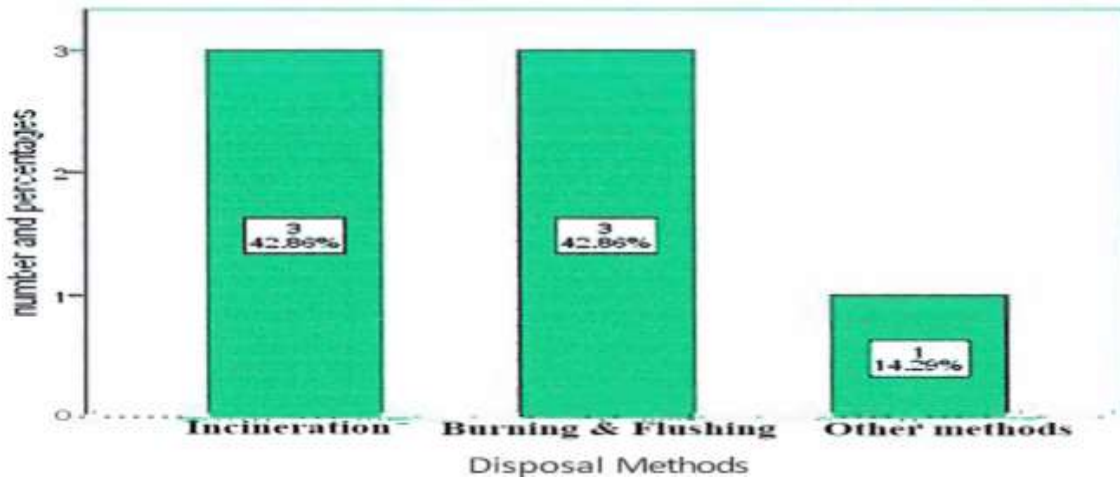


Figure 3: pharmaceutical waste disposal methods

Only 42.86% are using incineration also dilution and flushing while 14.29% are using other methods including burning.

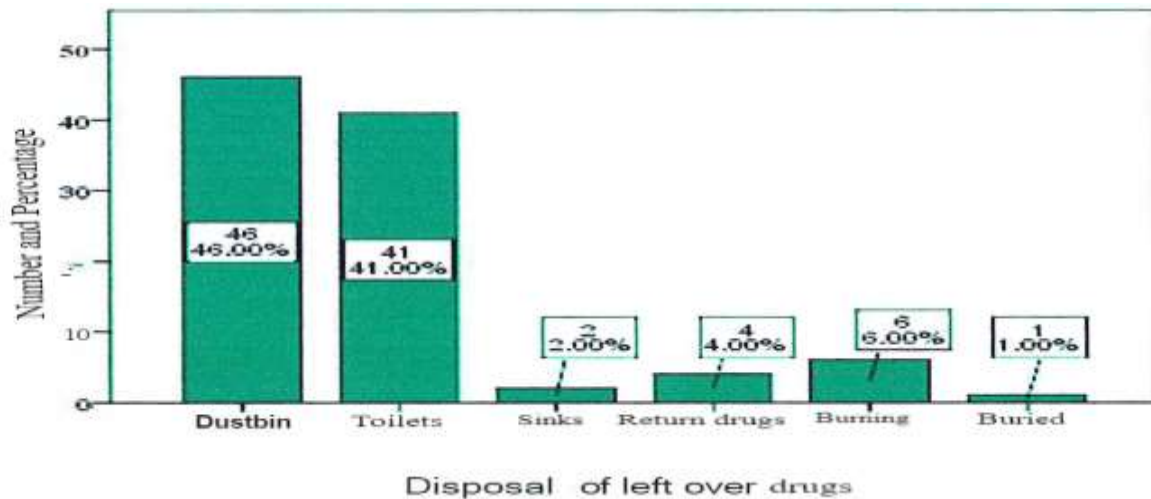


Figure 4: Household methods of pharmaceutical waste disposal.

The methods used by households to dispose of pharmaceutical waste varied: 46% used dustbins, 41% used toilets, 6% burned the waste, 2% flushed it into sinks, and 1% buried it. Only 4% of households returned unused or expired drugs to community pharmacies.

Awareness of the Proper Methods of Drug Disposal
Table 6: Proportion of pharmacy staff trained in pharmaceutical waste disposal

| | Pharmacy staff trained in pharmaceutical waste disposal | | Total |
|----------------------------|---|--------|-------|
| | Yes | | |
| Trainers on waste disposal | | | |
| MOH | 2(50%) | | 2 |
| Not trained | | 2(50%) | 2 |
| Total | | 4 | 4 |

The staff of the community pharmacy were divided into two groups: 50% were trained by the Ministry of Health (MOH), while the remaining 50% were not trained.

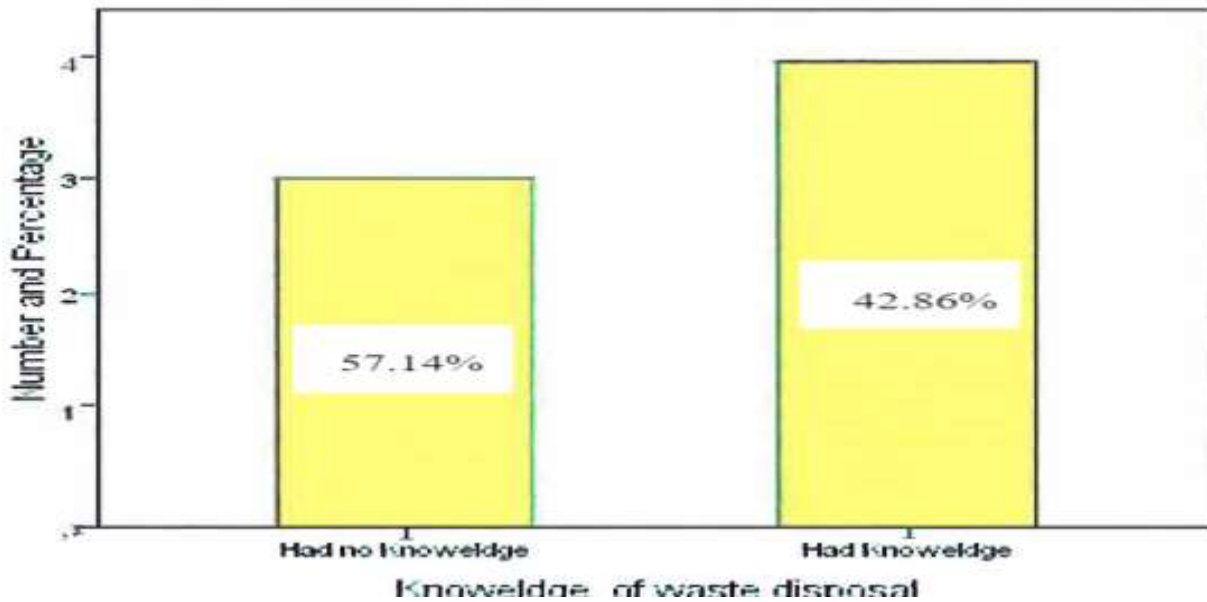


Figure 5: Knowledge on proper disposal of pharmaceutical waste employees

Most of the respondents interviewed (57.14%) had knowledge about proper methods of pharmaceutical waste disposal, while 42.86% had no knowledge of proper disposal methods.



Figure 6: Presence of pharmaceutical waste management guidelines

The figure above shows that only one hospital pharmacy (14.29%) had the guideline, the other hospital and the remaining community pharmacies didn't have any guidelines on management of pharmaceutical waste.

Table 7: Reasons why the households have unused or expired drugs

| | | why did you have left - over drugs | | | | | Total | |
|----------|-------|------------------------------------|--------------|-------------------|---------------|--------|-------|--------|
| | | Recovered and stopped medication | Side Effects | changed treatment | Forgetfulness | Others | | |
| leftover | Yes | Count | 36 | 9 | 6 | 2 | 13 | 66 |
| | | % within leftover | 54.5% | 13.6% | 9.1% | 3.0% | 19.7% | 100.0% |
| No | Count | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| | | % within leftover | .0% | 0% | .0% | .0% | .0% | 100.0% |
| Total | | Count | 36 | 10 | 6 | 2 | 13 | 67 |

Many individuals have unused or expired drugs due to recovery from illness and discontinuation of medication. Side effects also contribute to the accumulation of expired or unused medications, followed by changes in treatment (9.1%).

Table 8: professionals consulted by the community on how to dispose pharmaceutical waste disposal

| | | | Who did you ask? | | | | Total |
|--|-----|-------|------------------|------------|-------|--------|-------|
| | | | Doctor | Pharmacist | Nurse | Others | |
| Have you ever asked about the proper methods of disposing pharmaceutical waste | Yes | Count | 13 | 12 | 26 | 4 | 55 |
| | | % | 23.6% | 21.8% | 47.3% | 7.3% | 55.0% |
| | No | Count | 0 | 0 | 0 | 0 | 45 |
| | | % | .0% | .0% | .0% | 100.0% | 45.0% |
| Total | | Count | 13 | 12 | 26 | 4 | 45 |
| | | % | 20.6% | 19.0% | 41.3% | 19.0% | 45.0% |

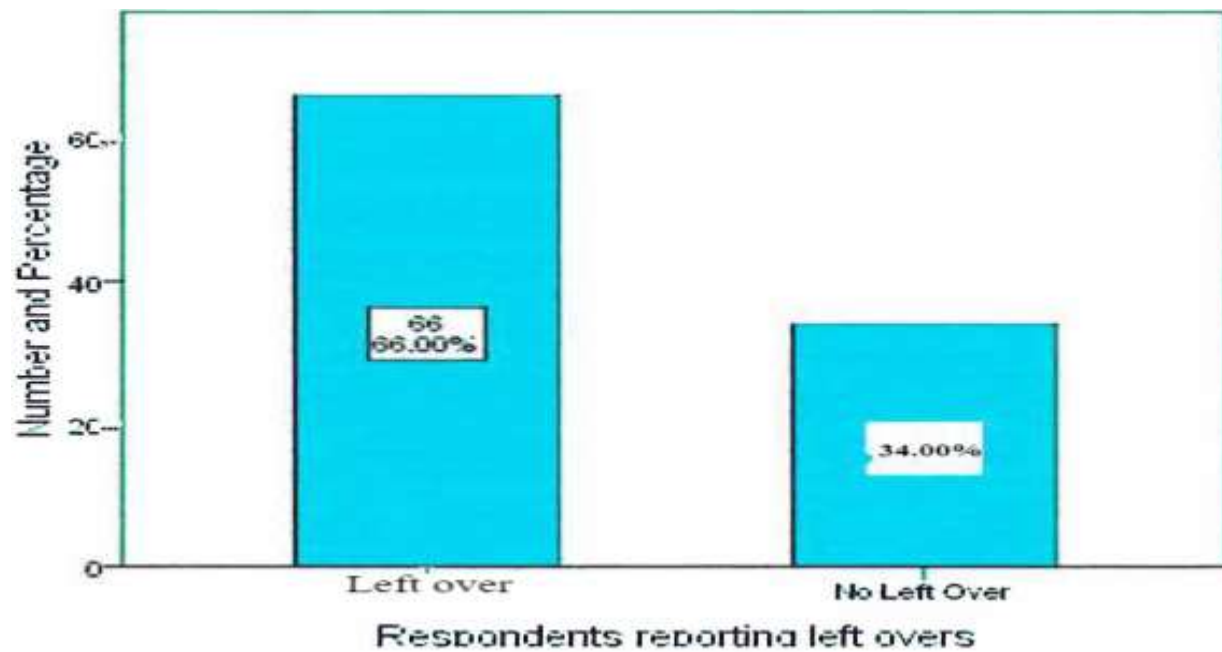


Figure 7: Respondent's reporting households

The figure above shows, 66.0% had unused medication or expired drugs, while 34.0% had no left-over of drugs.

DISCUSSION

Proper management of pharmaceutical waste is a critical public health and environmental concern that requires a comprehensive understanding of the current practices and challenges within a given region. The study found out that the mean amount of pharmaceutical waste generated by pharmacies in Ishaka averages $40.5\text{kgs} \pm 32.39\text{ kgs}$, of which $26.83\text{kgs} \pm 29.10\text{ kgs/month}$ were disposed. This was less than the value obtained from a similar study by [7] that found that Bangladesh hospitals generated a total of 5562 kg/day of waste. The study revealed that the majority (60%) of waste generated in Ishaka was hazardous. This finding contrasts with a study by [7], which reported a mean waste disposal rate of about 77.4% consisting mainly of non-hazardous waste. These findings indicate a lower amount of waste disposal in Ishaka compared to other areas. This could be attributed to undocumented waste disposal or underestimated waste volumes by respondents. Additionally, varied disposal methods employed by pharmacies might contribute to underestimations in waste volume. Studies conducted in India showed that indiscriminate disposal of waste led to a reduced volume of waste disposed as well as having dangerous consequences on the environment (soil, air, water) [13]. Given this, management of hazardous wastes including their disposal in environment-friendly and economically viable ways is very important and therefore suggestions are made for developing better strategies. The study revealed that most waste segregation methods involved using labeled containers, with some also using colored containers. This aligns with a study that emphasized sorting pharmaceutical waste based on drug form at the point of generation and packing it into containers according to its properties [14]. Studies relying on this method of waste segregation have shown that the availability and rules on waste disposal affected the practices of waste disposal in local pharmacies and together with the "availability of containers for sharp items", "disposal frequency", "disposal volume", "disposal method", "vehicles meeting the regulations", and "declaration of 'three lists'" [15]. In this study, leftover drugs were primarily disposed of in dustbins, toilets, and sinks. Pharmaceutical waste was often disposed of through incineration, dilution, and flushing in protected areas. The study also revealed that expired or unused drugs were not returned to pharmacies, indicating that households typically destroy these drugs themselves.

These findings align with a study on waste disposal by [16], which revealed that over half of the surveyed patients stored unused and expired medications at home, and a similar proportion had flushed them down toilets. Only 22.9% returned medication to pharmacies for disposal, and less than 20% received advice on medication disposal from healthcare providers. According to this study, the challenge of pharmaceutical products contaminating groundwater, lakes, rivers, and drinking water will continue to worsen with population growth and increased medication dispensing [17]. In this study, 46% of homes used disposal methods involving dustbins, while 2% flushed pharmaceutical waste into sinks. Only 4% of households returned unused or expired drugs to community pharmacies. These findings align with previous studies by [18-19], which reported that a majority of patients stored unused or expired medications at home, with many flushing them down toilets. Only 22.9% reported returning medication to a pharmacy for disposal. Less than 20% had ever been advised about medication disposal by a healthcare provider. Previous counseling was highly associated with returning medications to a pharmacy (45.8% vs 17.1%, $P < .001$) and was the variable most associated with returning medications to a provider (28.8% vs. 10.0%, $P < .001$).

CONCLUSION

Despite the knowledge of waste disposal, the practice of waste segregation and safe disposal is still a challenge among community pharmacies and hospitals in Ishaka.

RECOMMENDATIONS

To improve waste disposal practices, several actions can be taken: First, the government, through the Ministry of Health, should develop and enforce policies that promote safe disposal methods. Second, programs can be introduced to encourage people to return unused or expired drugs to pharmacies. Third, patients should receive information on the importance of returning unused or expired medicines. Finally, further studies can be conducted to assess the effectiveness of regulatory bodies like the National Drug Authority (NDA) in managing pharmaceutical waste. This preliminary study highlights the need for comprehensive actions to address pharmaceutical waste disposal challenges.

REFERENCES

1. Smith C. and McCauley J. (2006). Pharmaceutical hazardous waste identification and management system: *Google Patents*.
2. Singh V, Biswas G., and Shaima J. (2012). Biomedical Waste Management - An Emerging Concern in Indian Hospitals Indian. *Journal of Forensic Medicine & Toxicology*, 1(1).

3. World Health Organization. (1985). Management of waste from hospitals and other health care establishments: report on a WHO meeting, Bergen 28 June-1 July 1983. In *Management of waste from hospitals and other health care establishments: report on a WHO meeting, Bergen 28 June-1 July 1983*.
4. National Drug Authority. (2000). Guidelines for disposal of pharmaceutical waste supervised by National Drug Authority. Kampala: *National Drug Authority*.
5. Praven M., Sanagret P., and Ananda S. (2015). Need of Biomedical Waste Management System in Hospitals - An Emerging issue - A Review. *Current World Environment*, 17(1), 1-5.
6. Ngwuluka C.N., Ocheke A.N., and Odumosu O.P. (2011). An assessment of pharmaceutical waste management in some Nigerian pharmaceutical industries. *African Journal of Biotechnology*, 10(54), 11269-11264.
7. Hassan M., Ahmed A., Rahman K. and Biswas T. (2008). Pattern of Medical Waste Management: Existing Scenario in Dhaka City, Bangladesh. *BMC Public Health*, 8, 36.
8. Zarook M. (2012). Medical Waste Management and Control. *Journal of Environmental Protection*, 3, 1625-1628.
9. Willis Yuko OsoDO (2009). A general guide to writing research reports and reports. Nairobi Kenya: *JomoKenyata Foundation*.
10. Lwanga, S. K., Lemeshow, S., & World Health Organization. (1991). Sample size determination in health studies: a practical manual. *World Health Organization*.
11. Kathuri N., and Pals A. (1993). Introduction to Education Research Ergerton: *Ergerton University Book Series*.
12. Oso Y., and Onen D. (2009). Writing Research Report and Report (3 ed. Vol. 3). Nairobi Kenya: *Jomo Kenyatta Foundation*.
13. Misra V., and Pandey S.D. (2005). Hazardous waste, impact on health and environment for the development of better waste management strategies in future in India. *Environment International*.
14. Marinković, N., Vitale, K., Holcer, N. J., Džakula, A., & Pavić, T. (2008). Management of hazardous medical waste in Croatia. *Waste Management*, 28(6), 1049-1056.
15. Liao C.J., and Ho C.C. (2014). Risk management for outsourcing biomedical waste disposal using the failure mode and effects analysis. *Waste Management*, 34(7), 1324-1329.
16. Seehusen, D. A., & Edwards, J. (2006). Patient practices and beliefs concerning disposal of medications. *The Journal of the American Board of Family Medicine*, 19(6), 542-547.
17. Glassmeyer S. T, Hinchey E. K, Boehme S. E, Daughton C. G, Ruhoy T. S, Conerly O. (2009). Disposal practices for unwanted residential medications in the United States. *Environment International*, 35(3), 566-572.
18. Mazzanti M. and Zoboli R. (2008). Waste generation, waste disposal and policy effectiveness. *Resources, Conservation and Recycling*.
19. Mutungirehi Faisal, Mustafa M. Mundu and Stephen N. Nnamchi (2023). Analysis and Characterization of the Solid Waste from Kabagarama Dumping site in Bushenyi District, Uganda. *IDOSR Journal of Applied Sciences*, 8(2) 87-107. <https://doi.org/10.59298/IDOSR/2023/10.1.7007>

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