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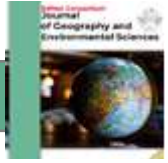

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# Factors Influencing Household Pharmaceutical Waste Disposal Practices in Nakuru City, Kenya

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**Abstract**
This study assessed factors influencing pharmaceutical waste disposal among households in Nakuru City. Although pharmaceutical products play an essential role in promoting public health and enhancing the quality of life for many Kenyans, they are considered waste once they expire and become contaminated. The study utilised a cross-sectional survey design, with 384 households from Nakuru City participating. Information was obtained through structured questionnaires incorporating both open- and closed-ended questions, while descriptive statistical analysis was conducted using SPSS and Microsoft Excel. The findings revealed that 58.36 per cent had no knowledge of pharmaceutical waste handling. Of those who had knowledge, 40.31 per cent had advanced knowledge of risks associated with storing unwanted pharmaceuticals in the house, 25.20 per cent had moderate knowledge, 16.49 per cent had low knowledge, and 18.00 per cent had no knowledge. The study further established that 80 per cent of respondents had never received any information on how to dispose of unwanted pharmaceuticals. There were also statistically significant associations observed for knowledge on pharmaceutical waste, distance to the medical facility and family income, all of which indicated $p < 0.05$. The study concludes that lack of knowledge, limited information, and socio-economic and accessibility factors significantly influence pharmaceutical waste disposal among households in Nakuru City. It recommends the establishment of public awareness and educational programs on pharmaceutical waste management among households, highlighting effects on human health and the environment if poorly disposed.

**Key words**: Household practices, medication disposal, pharmaceutical waste disposal, socio-economic factors, waste management.

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## INTRODUCTION

This study assessed factors influencing pharmaceutical waste disposal among households in Nakuru City. In the last few decades, studies in other countries have shown the presence of pharmaceuticals in drinking water. This is evident in a 2002 study from the U.S. Geological Survey. Studies carried out in Kenya have shown that improperly disposed of pharmaceuticals end up in garbage sites and wastewater treatment systems which are not sufficiently equipped to manage this form of waste (Kahenda &Wagema, 2016). Pharmaceuticals have immense effects on non-target organisms such as aquatic life and humans, and improper disposal might be the cause of dysfunction of sewage treatment facilities since they have been shown to be toxic to beneficial bacteria, especially antibiotics.

There is inadequate information on the handling of pharmaceutical waste at the household level, and knowledge on environmentally-friendly and sustainable disposal methods for pharmaceuticals is lacking. Several studies conducted in other countries have demonstrated that improperly disposed pharmaceuticals can cause adverse effects on humans, such as medicine resistance and accidental poisoning of children and pets. This can also happen in the study area if pharmaceutical waste is not properly disposed of. Therefore, there is a need to assess the disposal practices of pharmaceutical waste among households in the study area.

Nakuru was once dubbed the cleanest town in East Africa, though this has changed due to rapid urbanisation and high population growth. Waste in Nakuru is not segregated, and medical waste has ended up at the dumpsite, both from households and health facilities (Kahenda & Wagema, 2016). This has brought about rising cases of medical waste which have been carelessly disposed of in the Nakuru Gioto dumpsite. From the academic trips made to the dumpsite, it was clearly shown that there was medical waste haphazardly disposed there.

Pharmaceutical waste is a drug that is used to diagnose, cure, treat or prevent diseases. It becomes pharmaceutical waste when it is no longer usable for its intended purpose or is being discarded for reasons such as contamination, already dispensed, and expiration. According to the Environmental Management and Co-ordination Act (1999), waste refers to any matter, whether liquid, solid or gaseous, which is discharged, emitted or deposited in the environment in such volume, composition or manner as likely to cause an alteration of the environment (GOK, 1999). This waste may be hazardous, non-hazardous or a controlled substance (Hoboy, 2011) and includes expired pharmaceuticals, unsealed syrups or eye drops, cold chain damaged pharmaceuticals, bulk or loose tablets and capsules, and unsealed creams and ointments (WHO, 1999).

Pharmaceuticals are critical in maintaining the health of people and improving the quality of life for millions of Kenyans, but not all pharmaceuticals dispensed are consumed. They become waste due to patient non-compliance, change or stoppage of prescription, intolerable effects, ineffectiveness, or expiry before completion of the dose (Bain, 2010a). Unwanted pharmaceuticals are managed in various ways such as keeping them at home, dumping them in the trash, flushing them down sinks or toilets, or returning them to pharmacies for proper disposal (Dharmender et al., 2013). Pharmaceutical waste may also arise from donations during conflicts and disasters when drugs arrive near expiry or in excess quantities (WHO, 1999).

Recently, pharmaceuticals such as antibiotics, hormones and controlled substances have been detected in environmental media. There is evidence that pharmaceuticals harm aquatic life and humans, particularly through contaminated water and food chains. Exposure to endocrine-disrupting compounds has been linked to tumour formation, infertility, genital defects, cancers, and neurological disorders in children (WHO, 1999). Antineoplastic and cytotoxic drugs are also hazardous due to their ability to interfere with cell growth and reproduction.

Therefore, this study assessed the disposal practices of pharmaceutical waste among households in Nakuru City, identifying factors influencing disposal, and feasible safe disposal strategies among households.

## LITERATURE REVIEW

### Sources of Pharmaceutical Waste

Globally, less than half of the patients are treated following the medical guidelines. However, more than half of all patients don't take their medication as prescribed by the physician, hence generating more pharmaceutical waste (Holloway, 2011). There exists a global challenge of poor adherence of patients to their medication as prescribed, with non-adherence of approximately 50 per cent in developed countries and even at a higher rate in developing countries. Many

patients find it difficult to finish their medication as prescribed, making it a big burden of unwanted pharmaceuticals among households (WHO, 2003).

Pharmaceuticals are frequently purchased in excess or are not consumed fully as directed by the physician for a number of reasons such as patients' non-compliance, altered treatment and intolerable effects, which lead to accumulation of unwanted pharmaceuticals. There is a wide spectrum of sources, such as health care facilities, household medicine cabinets, and first aid kits, to less recognised sources such as zoos and cruise ships (Ruhoy & Daughton, 2007).

Drugs accumulate unused for a number of reasons, which presents the need for disposal (Ruhoy & Daughton, 2007). These reasons range from patient non-compliance, which itself has a number of causes, inefficient oversight of the prescribing process by medical practitioners, imprudent dispensing practices by retail pharmacy and the insurance industry and wasteful packaging by manufacturers (Daughton, 2003).

Pharmaceuticals can enter the environment from several sources. The active pharmaceutical ingredients enter the environment in three major ways. This includes: by way of excretion of unmetabolized active pharmaceutical ingredients (as well as bioactive metabolites); release from skin during bathing; this arises from medication applied dermally and from excretion via skin sweat and through disposal to sewerage or trash of unwanted pharmaceuticals (Ruhoy & Daughton, 2007). This particular study focuses on the third origin, which is disposal of unwanted pharmaceuticals from the consumer sector.

**Factors Influencing Disposal of Pharmaceutical Waste**

Improper disposal of unwanted pharmaceuticals is often influenced by confusing and conflicting information given to the public. For instance, poisons control centres have long recommended discarding unwanted pharmaceuticals in sanitary sewer systems, which was perceived to be easily available for protecting humans and pets from accidental and intentional poisonings. Similarly, the White House Office of National Drug Control Policy (NDCP) in the United States of America issued a list of federal guidance that limited 1 specific hazardous drug that should be disposed of directly to the sewer system because of its potential for abuse and acute toxicity (Glassmeyer et al., 2008). Another study carried out in Tanzania showed that (56%) store pharmaceuticals because of frequent illness in the families, followed by distance to the health facility (20%) (Temu et al., 2006).

Disposal practices for unwanted pharmaceuticals are influenced by various factors: most dispose of them improperly because they are not informed about the proper way to dispose of them. Others do so because they don't know whether pharmaceuticals have bad effects on either humans or the environment, and others do so because of the non-existence of systems for unwanted pharmaceuticals among households (Dharmender et al., 2013).

**Research Gap**

Various studies have shown that factors influencing the disposal of pharmaceutical waste have been studied in other countries such as Thailand, Ethiopia and Iraq, but there is inadequate documentation in Kenya. This study was able to identify the factors that influence their disposal in the study area.

**Theoretical Framework**

The Health Belief Model is one of the first theories of health behaviour. It was developed in the 1950s by a group of United States Public Health Service social psychologists (Rosenstock, 1974). HBM is a good model for addressing problem behaviours that evoke health concerns. The model proposes that a person's health-related behaviour depends on the person's perception.

The Health Belief Model (HBM) explains how individuals' beliefs influence their behavioural choices. In the context of this study, the model offers an appropriate theoretical basis for understanding why some households embrace safe pharmaceutical waste disposal practices while others do not. The model assumes that health-related behaviour is influenced by an individual's perceptions of risk, benefits, barriers, cues to action, and confidence in performing the behaviour.

In this study, the dependent variable is household pharmaceutical waste disposal practices, while the independent variables (knowledge, income level, distance from a medical facility, and presence of children under five years) can be mapped onto specific HBM constructs as shown in the following table.

**Table 1. Conceptual Linkages between Health Belief Model Constructs and Household Pharmaceutical Waste Disposal Behaviour**

| HBM Construct | Meaning | Study Variable(s) | How it relates to pharmaceutical waste disposal | Analytical Category |
|---|---|---|---|---|
| Perceived Susceptibility | Belief that one is at risk of harm | Presence of children under five years | Households with children under five years may perceive a higher risk of storing unwanted pharmaceuticals due to accidental poisoning. | Does the presence of children under five influence household pharmaceutical waste disposal handling? |
| Perceived Severity | Belief that the consequences of the problem are serious | Knowledge | Knowledge about proper pharmaceutical handling methods, disposal and risks of unwanted pharmaceutical storage in the house | Does knowledge on pharmaceutical handling methods, disposal and risks of unwanted pharmaceutical storage in the house affect or influence disposal practices? |
| Perceived Benefits | Belief that adopting the recommended behavior will reduce risk | Knowledge | Individuals with knowledge will adhere to the recommended disposal methods like returning them to medical facility for proper disposal | Does knowledge of recommended disposal methods influence safe disposal practices? |
| Perceived Barriers | Factors that make the behavior difficult or costly | Income level; Distance to a medical facility | Long distances to take-back points of unwanted pharmaceuticals attracts costs, those with low income may not afford to return unused medicines for proper disposal. | How do income level and distance to a medical facility influence pharmaceutical waste disposal practices? |
| Cues to Action | Triggers that prompt behavior | Proximity to health facilities (distance); Health education received at facilities | Availability of medical facilities near-by may influence pharmaceutical wastes handling methods. | Does proximity to a medical facility influence disposal services that encourage proper disposal? |
| Self-Efficacy | Confidence in one's ability to perform the behavior correctly | Knowledge | Individuals with knowledge are confident and able to identify proper disposal methods and practicing them. | Does knowledge increase confidence and correct pharmaceutical waste disposal practices? |

This framework identifies knowledge as the strongest enabling factor influencing multiple HBM constructs, while income and distance operate as barriers, and the presence of children under five increases perceived susceptibility to harm. This mapping provides a coherent theoretical basis for explaining how the selected independent variables influence household pharmaceutical waste disposal practices.

**Conceptual Framework**

The model presented in Figure 1 has been borrowed and modified from the theoretical propositions of the Health

Belief Model. The independent variables include types of pharmaceutical waste and disposal practices. These may directly determine the disposal practices of pharmaceutical waste among households. They may also interact with intervening variables such as legal policies and regulations, education level, medical coverage ownership and potential risks to determine the disposal practices of pharmaceutical waste among households.

The independent variables may determine the disposal practice of pharmaceutical wastes in the following ways:- type of pharmaceutical waste that is, if the medicine is in liquid form they are likely to be disposed of by flushing them down the toilet or sink, whereas solid forms are likely to be discarded together with other household waste-: Income level – what one earns will determine ones disposal practice in the sense that if one earns a lot he/she doesn't mind throwing of unused pharmaceutical because he/she will always be able to afford the other dose whenever he/she wants, but if he/he earns little he/she is likely to keep the remaining for future use either for himself or for a member of the family to use.

**Medical cover ownership**: if one owns a medical cover, he/she is likely not to keep pharmaceuticals in the home but can dispose of them because he/she can always get medicine when he/she needs without spending extra cash.

**Distance from the health facility:** will determine pharmaceutical waste disposal practices: the nearer to the medical facility, the more people dispose because, in case of an emergency, they go to the hospital.

**Awareness of potential risks:** when one is aware of the potential risks, he/she is likely to be keen on the methods of disposal he/she uses, which cannot harm the environment and humans.

Availability of legal policies and regulations put in place for disposal of pharmaceutical waste will determine disposal practices of the waste. If they are well implemented, people are likely to dispose of the pharmaceutical waste in a safe and proper manner. The level of awareness of the people will also determine disposal practices of pharmaceutical waste.

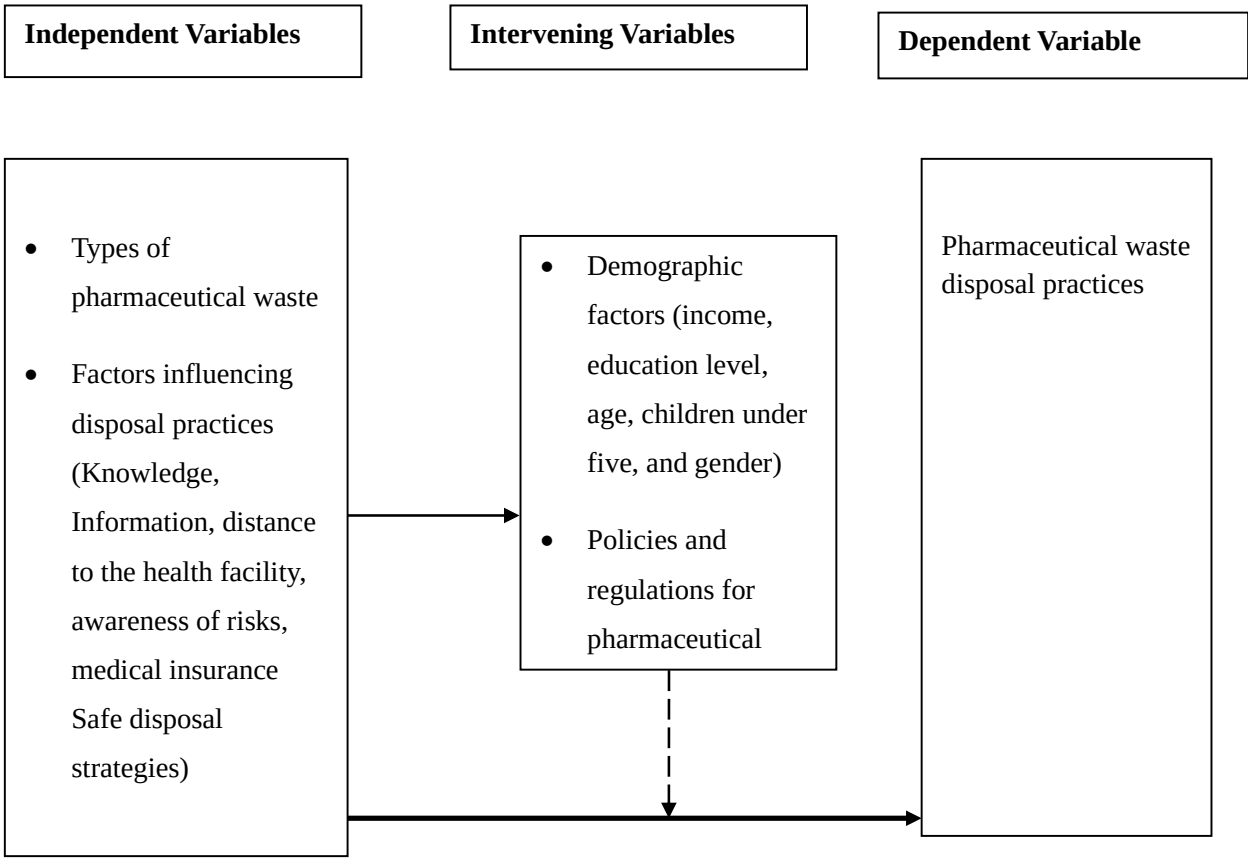


**Figure 1: Conceptual framework**

## METHODOLOGY

The study adopted a cross-sectional research design in which data were collected at a single point in time using a survey method comprising both closed and open-ended questionnaires to examine differences among study subjects. The study was conducted in Nakuru City, located in Nakuru County, and targeted households across Milimani, Kaptembwo, and Free Area administrative units. Cochran's (1977) sample size formula was applied to estimate the study sample, resulting in 384 households at a 95 per cent confidence level, a 5 per cent margin of error, and an assumed population proportion of 0.5.

To ensure representativeness, the population was first stratified by administrative units, and proportionate sampling was applied based on household distribution, followed by simple random sampling with a random start. Additionally, purposive sampling was applied to select key stakeholders, including six nurses, three medical officers, six clinical officers, and five pharmacists.

Data were collected through predetermined questions based on study objectives in order to obtain the required data concerning the research. Close and open-ended questionnaires were used to collect data on socio-economic characteristics of the respondents, the commonly disposed pharmaceutical waste, the current pharmaceutical waste disposal practices, factors that influence pharmaceutical waste disposal and the feasible safe disposal strategies that can be used to manage pharmaceutical waste among households. A total of 384 household questionnaires were administered during fieldwork. The household questionnaires were administered, involving a random start of the first element, and thereafter snowball sampling was applied.

In this study, the instruments were first discussed between the researcher and the supervisors, who provided their expertise and ensured that the instruments measured what they intended to measure, as recommended by Kumar (2005). Before primary data collection started, pilot–testing was carried out in section 58, Rhonda and Naka administrative units in Nakuru City, which were not included in the sample size (Radhakrishna, 2007). The pre-testing of the research tools was done through administration of 20 questionnaires. The results after pilot testing gave a Cronbach's reliability coefficient value of 0.765, which was a good estimate of the reliability of the instruments, as they were above the minimum threshold recommended.

SPSS, Excel spreadsheet software and Inferential statistics were used for the analysis. After obtaining the raw data set, it was sorted and coded. The open- ended questions were manually analysed by grouping responses into similar themes and tallying them. Frequencies were determined using an Excel spreadsheet. Closed-ended questionnaire responses were systematically coded before being entered into the Statistical Package for the Social Sciences (SPSS) for data analysis. The data were then presented using pie charts, bar graphs, percentages and chi-square, among others. Participants in this non-clinical study were not at risk of injury during data collection. The researcher used the introduction letter from Egerton University's Directorate of Research. The researcher received informed consent from respondents to be involved in the study. The researcher was honest with respondents and other participants throughout the study. She remained impartial and kept respondents and their responses confidential.

## FINDINGS AND DISCUSSION

### Socio-Demographic Information of the Study Population

Sixty-four-point eight per cent (64.8%) of the respondents in the study area were female. The study sample comprised respondents aged between 18 and 69 years. The findings on household size revealed that the average household size in the study was 4, with 25.3 per cent having 5 members (Table 2). Approximately 63 per cent of the respondents indicated that their total family income was between 0 and 20,000 Kenyan shillings per month (Table 2).

**Table 2. Distribution of Respondents' Demographic Characteristics in Nakuru City**

| Demographic characteristics | Frequency | Percentage |
|---|---|---|
| **Gender** | | |
| Male | 135 | 35.2 |
| Female | 249 | **64.8** |
| Total | 384 | 100 |
| **Age** | | |
| 18-27 | 133 | 34.6 |
| 28-37 | 189 | **49.2** |
| 38-47 | 40 | 10.4 |
| 48-57 | 21 | 5.5 |
| 58+ | 1 | 0.3 |
| Total | 384 | 100 |
| **Education level** | | |
| None | 12 | 3.1 |
| Primary | 102 | 26.6 |
| Secondary | 167 | **43.5** |
| Tertiary | 103 | 26.8 |
| Total | 384 | 100 |
| **Household size** | | |
| 0-2 | 11 | 2.8 |
| 3-5 | 121 | 31.5 |
| 6-8 | 149 | **38.8** |
| 9-11 | 103 | 26.9 |
| Total | 384 | 100 |
| **Children under five** | | |
| 0 | 165 | **43.1** |
| 1 | 110 | 28.6 |
| 2 | 90 | 23.4 |
| 3 | 19 | 4.9 |
| | 384 | 100 |
| **Household income** | | |
| 0-20,000 | 241 | **62.8** |
| 20,001-80,000 | 113 | 29.4 |
| >80,000 | 30 | 7.8 |
| Total | 384 | 100 |
| Variables | Minimum | Maximum Mean |
| Age | 18 | 69 31.35 |
| Household size | 1 | 9 4 |

Only 3 per cent of the respondents had no formal education, whereas 43.5 per cent had attained secondary level education (Table 2). These figures are considerably different compared with those contained in the KNBS (2019) report for Nakuru County, where 17.3 per cent of the population had no formal education, 54.9 per cent had primary education, and 27.9 per cent had secondary education and above. When the county's level of education is compared to that of the study population, it is found that the level of education in the study population is higher than the county's. Illiteracy can affect disposal practices of unwanted pharmaceuticals among households. Those with education are likely to have some knowledge of safe disposal practices of unused pharmaceuticals.

**Factors that Influence Pharmaceutical Waste Disposal**

Regarding factors influencing pharmaceutical waste disposal, various factors were tested, including knowledge, distance to the medical facility (hospitals, pharmacies, and manufacturers), total family income, and families with children under five years and medical cover ownership.

**Knowledge**

Knowledge on pharmaceutical waste, which included awareness of pharmaceutical waste and risks associated with storing unwanted pharmaceuticals in the house in the study area, is shown on a Likert scale in the table below. The respondents answered two questions regarding knowledge on pharmaceutical waste, to list risks associated with storing unwanted pharmaceuticals in the house. The levels of knowledge were ranked as per the number of questions the respondent was able to answer. The Likert scale was ranked as follows: 4, 3, 2, 1 (Advanced knowledge, moderate knowledge, low knowledge and no knowledge), respectively.

Table showing Likert scale on knowledge of pharmaceutical waste, knowledge of risks associated with storing unwanted pharmaceuticals in the house.

**Table 3. Likert Scale on Knowledge**

| Knowledge Level | Knowledge on Pharmaceutical Waste *(n = 384)* | Knowledge on Risks of Storing Unwanted Pharmaceuticals in the House *(n = 384)* |
|---|---|---|
| Advanced knowledge | 8.00% | 40.31% |
| Moderate knowledge | 12.00% | 25.20% |
| Low knowledge | 21.64% | 16.49% |
| No knowledge | 58.36% | 18.00% |

Approximately 60 per cent of the respondents had no knowledge of pharmaceutical waste. These findings are contrary to a study done in Pakistan which revealed that only 3.8 per cent of the population had no knowledge of what to do with unwanted pharmaceuticals in their homes. (Ahmed et al., 2013). This lack of knowledge leads to poor disposal of unwanted pharmaceuticals, and this might pollute the environment or even lead to accidental poisoning of pets and children.

This study sought to assess if there was any association between the total family income, children under five, knowledge, medical cover ownership and distance to the medical facility of the participants and how they handled unwanted pharmaceuticals. There were four possibilities of how unwanted pharmaceuticals were handled. The first method was to return the pharmaceuticals to medical facilities; the second method was to store them in the house. The third and fourth methods were disposing of them into the environment and finishing the dose.

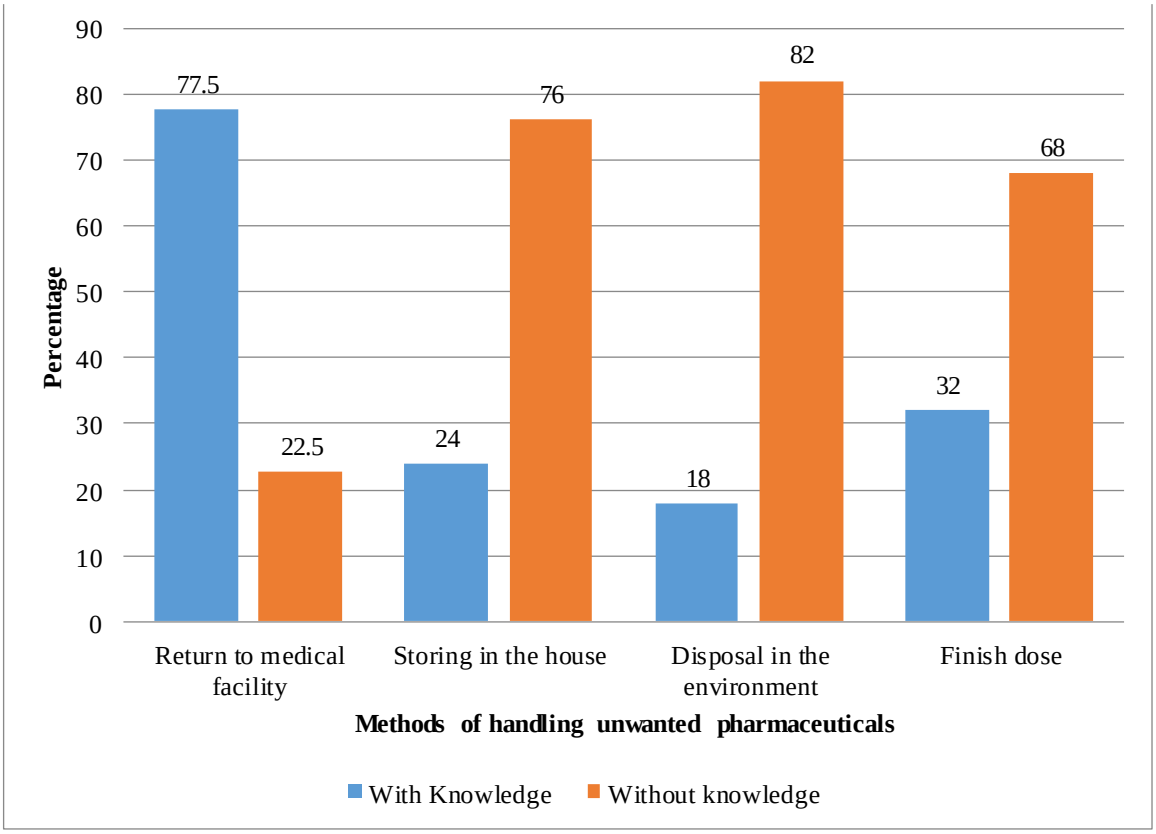


**Figure 2: Methods of Handling Unwanted Pharmaceuticals According to Knowledge**

From the figure above, it is indicated that 77.5 per cent of those with knowledge return their unwanted pharmaceuticals to the medical facilities for disposal, 32 per cent finish their dose, 24 per cent store them in the house, and only 18 per cent dispose of them into the environment. However, one respondent could have knowledge of more than one method of handling unwanted pharmaceuticals. On the other hand, the chi-square test of independence indicates a statistically significant association between knowledge of pharmaceutical waste handling and return to the medical facility (p=0.020). This implies that those with knowledge will tend to return unwanted pharmaceuticals, since they understand the effects of improper disposal.

The chi-square test of independence also reveals a statistically significant association between knowledge and the storage of unwanted pharmaceuticals (p=0.049). Those with the knowledge tend to store less since they understand the dangers of storing unwanted pharmaceuticals in the house. There is also a significant association between knowledge and disposing of unwanted pharmaceuticals into the environment (P=000). This shows that those with the knowledge tend to dispose less into the environment; this is because they understand the dangers of disposing of pharmaceuticals into the environment. The chi -square test of independence also reveals that there is a statistically significant association between the knowledge and finishing the dose (p=0.015). This indicates that those with the knowledge tend not to finish their dose; this might be due to understanding the intolerable effects, which makes them go for further consultation; hence, the dose might be changed, leaving the previous dose. On the other hand, of those without knowledge, 82 per cent dispose of them into the environment, 76 per cent store them in the house, 68 per cent finish the dose, and only 22.8 per cent return them to the medical facilities.

From the results, it is clearly shown that disposal is influenced by knowledge, as those with knowledge tend to use proper methods such as returning to a medical facility, and very few use unsafe methods such as disposing into the environment. The majority of those who have no knowledge use unsafe methods such as disposal into the environment. This implies that if communities can be educated on pharmaceutical waste handling and its effects on the environment if poorly disposed, then they are likely to be keen on how they dispose of it. In addition, the HBM theoretical framework

also agrees that with knowledge, awareness of the dangers of improper disposal is increased, benefits of proper disposal are well known and confidence in performing the correct disposal methods is improved.

For those who had information on the effects of unwanted pharmaceutical waste if poorly managed, they said that the sources of information on pharmaceutical disposal were doctors, television and newspapers, constituting 9 per cent, 8 per cent and 3 per cent, respectively. A comparable study carried out in Pakistan reported that 51 per cent of respondents obtained information on proper pharmaceutical disposal from newspapers, while 20 per cent cited physicians as their source.

**Distance**

When analysing waste disposal practises in regard to distance to the medical facility, the respondents behave differently based on how far they reside from the medical facility (Figure 3).

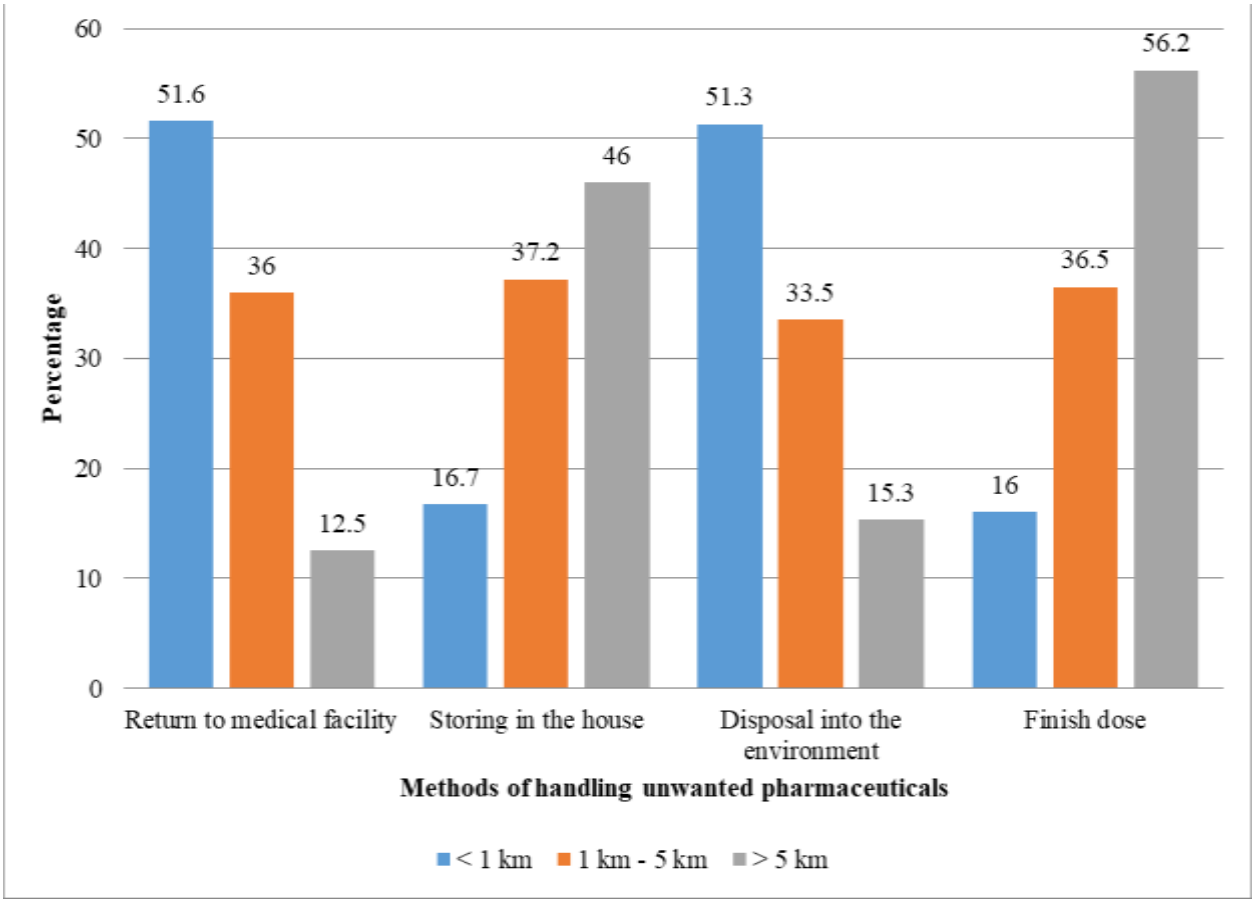


**Figure 3: Disposal Practices in Regard to Distance to Medical Facilities**

From the Figure 3, we can identify that the respondents who are close to the medical facility will tend to return the unwanted pharmaceuticals to the facility, they will store less which is 16. 7 per cent, dispose more into the environment and will rarely finish the dose, mainly because they will always go to the medical facility when unwell since it is close. A Chi-square test of independence established a significant relationship between respondents' distance from the medical facility and their return of pharmaceuticals to the facility ($p = 0.001$). This implies that those who reside close to the medical facility will tend to return the unwanted pharmaceuticals since they spend less time taking them for disposal. There was also a statistically significant association between distance and storing of unwanted pharmaceuticals ($p=0.000$). Since those who reside close to the medical facility will tend to store less because they can always access the medication whenever they feel sick, unlike those who reside far from the medical facility, who will store more in case of an emergency since the medical facility is far, they can use the medication they store.

On the other hand, those who are more than 5 kilometres from the medical facility will return less and store most of the unwanted pharmaceuticals in case of an emergency, since accessing the medical facility will take them time. This concurs with the primary HBM construct under perceived barriers cues to action that indicates that greater distance reduces access to disposal services while closer facilities provide more cues to action.

These results are consistent with those of Mamady (2016) who found out that residents residing closer to permitted municipal dumpsites dispose of their waste at the accredited municipal dumpsite but the respondents residing far over 200 meters away from permitted municipal dumpsites discriminately dispose of their waste in the open land (56.5% -closer to the municipal dump site versus 39.9%-far from the municipal dumpsite) or by burning (15.9% - closer to the municipal dump site versus 26.0%-far from the municipal dumpsite).

**Total Income**

Figure 4 shows how family income influences disposal practices of unwanted pharmaceuticals.

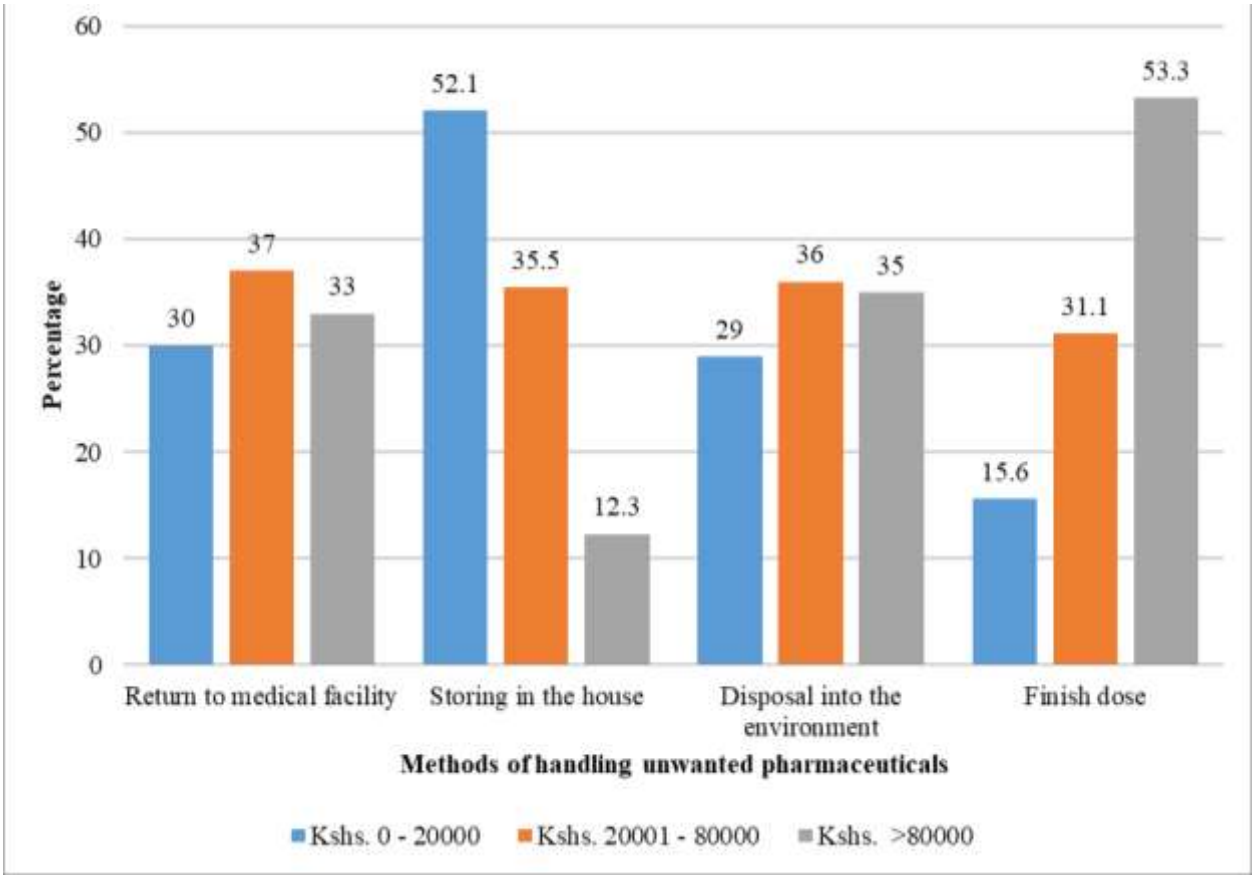


**Figure 4: Disposal Practices in Regard to Total Family Income**

The low-income earners tend to store more, and the majority finish their dose as compared to the high-income earners, as shown in Figure 4 above. Chi- squire test of independence also revealed that there was a statistically significant association between total family income and storing of unwanted pharmaceuticals (p=0.000). The low-income earners tend to store more pharmaceuticals than the high-income earners. This is because they may lack money to buy medication when a member gets sick, and they might use the stored medication, unlike the high-income earners. There was also a statistical relationship between total family income and finishing the dose (p=0.020), where the high-income earners tend to finish the dose as compared to low-income earners. This might be due to the fact that low-income earners want to keep the remaining dose for future use or for sharing with another member who might fall sick.

Figure 4 above indicates that income does not influence the disposal of unwanted pharmaceuticals into the environment, since both high- and low-income earners

use undesirable methods when disposing of unwanted medicine. It further indicates that there is not much difference in returning the medication to the medical facility across the socio-economic status.

Most high-income earners (70%) were aware of the risks associated with keeping unwanted pharmaceuticals at home, which may explain why only 5.2 per cent reported storing them. They further indicated the risks, with 53.39 per cent citing child poisoning, followed by misuse by adults with 10.68 per cent. Hence, they opt to dispose of them into the environment. This is in line with the HBM primary construct under perceived barriers that availability of financial resources increases access to knowledge on proper disposal; hence, this influences the handling methods of individuals with high income. In addition, the findings agree with (Wilcox, 2013) that sewer systems and dumping in a trash remain primary methods due to concerns such as protecting children and pets against accidental poisoning. The findings are also consistent with a 2004 survey in America which showed that 14.5 per cent of young adults misuse prescription drugs (Siler & Brown, 2009).

On the contrary, Ahmed et al. (2013) in a study in Pakistan indicated that 80 per cent of the respondents showed their concern that improper disposal of pharmaceuticals can affect the environment and the health of the public. The implications of being aware of risks of storing unwanted pharmaceuticals in the house contribute to the use of other methods to dispose of the unwanted medication, which may pollute the environment.

**Children Under 5 years**

Figure 5 shows how families with children under five years influence disposal practices of unwanted pharmaceuticals.

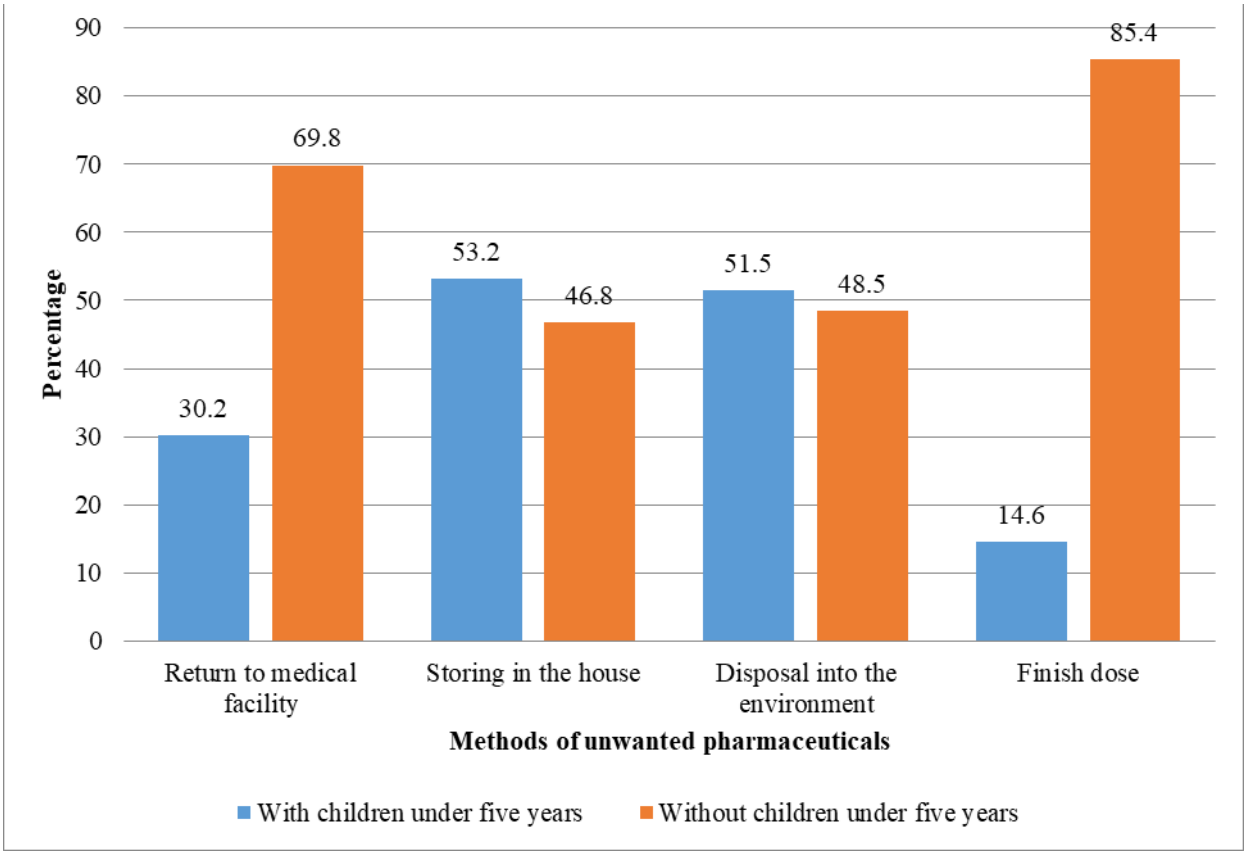


**Figure 5: Pharmaceutical Disposal Practices in Families with Under Five Children**

From Figure 5 above, both groups dispose of them into the environment and store them in the house. The difference comes in returning the unwanted pharmaceuticals to the medical facility and finishing the dose. Those without children under five years tend to return them to the medical facility more compared to those without. The majority of those without children under five years finish their dose as compared to those

with children under five. There was no major difference between those with children and those without children under five in disposing into the environment and storing in the house. This is clearly revealed by the chi-square test of independence, which shows there was a statistically significant relationship between children under five and return to the medical facility (p=0.000). This means that those with children under five return less compared to those without children under five. This implies that they return less since children under five get sick more often; hence, the majority keep the unfinished dose for future use, having less to dispose of.

There was a statistical relationship between children under five and finishing the dose (p=020). Those without children under five years tend to finish their dose as compared to those with children under five years. This is because most medication for the children, especially the syrup quantities, is not standardised; hence, they are in excess. The findings in the study differ from the HBM primary construct under perceived susceptibility. In the study, individuals with children under five years tend to store a lot of unwanted pharmaceuticals, and yet it is believed in the theory that there is a greater risk of accidental poisoning when storing pharmaceuticals in the house where there are children under five. That is expected to motivate families with children under five years to practice safer disposal of unwanted pharmaceuticals.

Approximately 47 per cent of the households with children under five said they dispose of pharmaceuticals into the environment mainly because most medications are antibiotics, which they are advised by the physicians not to use after the indicated period.25 per cent and 22 per cent with children under five and without children under five, respectively, store pharmaceuticals in the house to cater for self-medication in such a condition that develops in the future. These practices have several important consequences. Keeping unused or expired medicines in household cabinets and cupboards poses a potential risk to unintended recipients, including humans and domestic animals. In addition, the disposal of pharmaceuticals into water bodies and drinking water sources can adversely affect aquatic ecosystems. For example, exposure to the non-steroidal anti-inflammatory drug (NSAID) diclofenac has been associated with renal failure in vultures after they consumed carcasses of cattle that had been treated with the drug (Griffith, 1990).

**Medical Cover Ownership**

Figure 6 illustrates how those with medical cover and those without medical cover handle their unwanted pharmaceuticals.

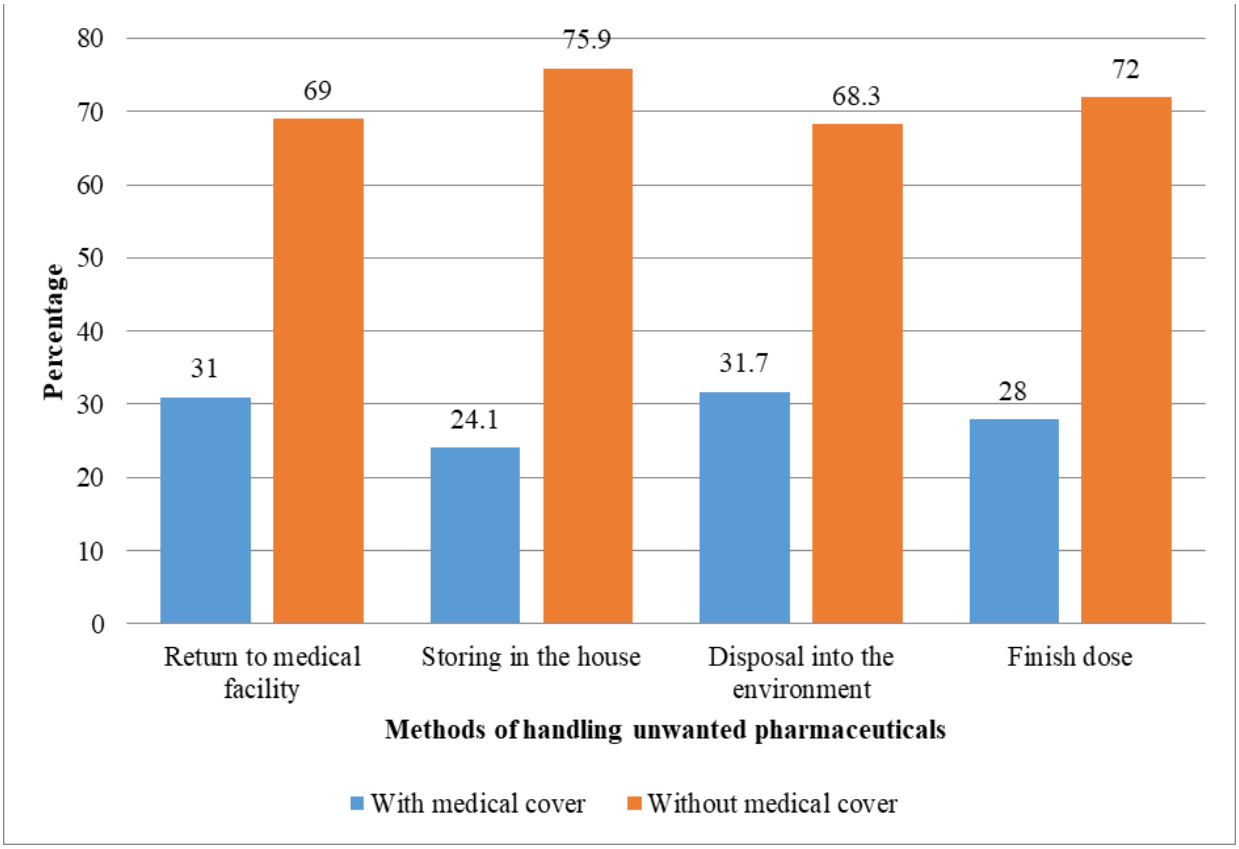


**Figure 6: Disposal Practice in Regard to Medical Cover Ownership**

Sixty-nine per cent (69%) of those without medical cover return their unwanted pharmaceuticals to the medical facility, while only 31 per cent of those with medical cover return them. Seventy-five point nine per cent (75.9%) of those without medical cover store medication in the house, as compared to 24.1 per cent of those with medical cover store medication in the house. This finding was further supported by the Chi-square test of independence, which indicated a statistically significant association between ownership of medical cover and the return of unwanted pharmaceuticals to a medical facility ($p = 0.019$). This means that those with the medical cover will return less, since they will also access other medication whenever they need.

Those without may return, since sometimes they need to change the prescription in case they develop intolerable effects, and they want to exchange without paying. There was also a statistically significant association between medical cover ownership and disposing of unwanted pharmaceuticals into the environment ($p=0.000$). Those with medical cover dispose less into the environment. There was also a statistically significant association between medical cover ownership and finishing the dose ($p=0.000$). Those with medical cover don't finish the dose as compared to those without, who finish the dose. This is because they fear getting sick again if they do not complete the dose, which might force them to buy medication for the recurrence of the sickness. There was also a significant association between medical cover ownership and storing of unwanted pharmaceuticals ($p=0.007$). Those with medical cover tend to store less. The implication of this is that with the ownership of the cover, one does not need to store the medication for future use since they will always get them anytime they need, and in case of an emergency, they will rush to the medical facility for treatment. Unlike those without, who will need cash for their medication and may need to use what they store in the house.

## CONCLUSION AND RECOMMENDATIONS

**Conclusion:** The study concludes that lack of knowledge on pharmaceutical waste was a major factor which influenced the household disposal of unwanted pharmaceuticals. Other factors which influenced the way the households handled unwanted pharmaceuticals were: distance to the medical facility, total family income, children under five in the family and ownership of medical cover.

**Recommendations:** The study recommends that there is a need to establish public awareness and educational programs regarding management and handling of unwanted pharmaceuticals among households, that would highlight the effects on humans and the environment if poorly disposed of. Ultimately, it suggests the standardisation of pharmaceutical quantities to avoid unused pharmaceuticals that will need disposal. There should be provision of mobile take-back programmes for remote households. There should be provision of focused messaging for households with children under five years.

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