

**ASSESSMENT OF DISPOSAL PRACTICES OF PHARMACEUTICAL WASTE
AMONG HOUSEHOLDS WITHIN NAKURU TOWN, NAKURU COUNTY, KENYA**

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**A Thesis Submitted to the Graduate School in Partial Fulfilment for the Requirements of
the Master of Science Degree in Environmental and Occupational Health of**

Egerton University

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AUGUST, 2018

DECLARATION AND RECOMMENDATIONS

DECLARATION

I hereby declare that this thesis is my original work and has not been presented for award of degree in Egerton University or elsewhere.

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RECOMMENDATIONS

This thesis has been submitted for examination with our recommendations as the university supervisors.

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DEDICATION

This work is dedicated to my late mother Elizabeth Orina, dad Jeremiah Orina, husband Dr. Samuel Kerama, and children Jordan and Cayden.

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ABSTRACT

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 when they are no longer usable for intended purpose or are being discarded for other reasons such as contamination and expiration. Improperly disposed pharmaceuticals end up in garbage collection centres and water purification systems which are not sufficiently equipped to manage this form of waste. There is growing public concern over presence of active pharmaceutical ingredients in water and the environment. This pharmaceutical waste also includes antimicrobials which interfere with water treatment process since most depend on biodegradation. Pharmaceuticals have immense effects on non-target organisms, such as medicine resistance in humans, increases in morbidity and mortality of the population due to unintentional poisoning. The main objective of this study was to assess the disposal practices of pharmaceutical waste among households in Nakuru Town. This was achieved through conducting a social survey. Data was then processed and analysed using descriptive and inferential statistics. Out of 384 households who participated in the study, 35.8% and 14.4% of the respondents indicated that antibiotics and pain killers were the most commonly disposed of pharmaceuticals respectively. In this study the most commonly used method of disposal was flushing in the toilet. Seventy eight percent (78.4%) of the respondents had no knowledge of pharmaceutical waste handling and management, whereas 71.6% were aware of the risks associated with storing unwanted pharmaceuticals in the house. Eighty percent (80%) have never received any information on how to dispose unwanted pharmaceuticals. Fifty five percent (55%) of the respondents were willing to participate in take-back programs as the most feasible and safe disposal strategy that can be used to manage pharmaceutical waste. However, over 80% of them expressed their scepticism on implementation of the mail-back programs since it is expensive and neither practical nor feasible under the prevailing economic conditions and governance structure. In conclusion, there are a lot of unwanted pharmaceuticals among households and the public has no knowledge on how to manage them hence they end up using unsafe methods which can pollute the environment. Sensitization of the public on the dangers of poor disposal of pharmaceuticals and provision of collection points for proper disposal are recommended.

TABLE OF CONTENTS

DECLARATION AND RECOMMENDATIONS	ii
COPYRIGHT	iii
DEDICATION	iv
ACKNOWLEDGEMENT	v
ABSTRACT	vi
TABLE OF CONTENTS	vii
LIST OF TABLES	x
LIST OF FIGURES	xi
LIST OF ACRONYMS	xii
CHAPTER ONE	1
INTRODUCTION	1
1.1 Background information	1
1.2 Statement of problem.....	3
1.3 Broad objective	3
1.4 Specific objectives	3
1.5 Research Questions.....	4
1.6 Justification.....	4
1.7 Scope of the study.....	5
1.8 Limitations and assumptions.....	5
CHAPTER TWO	7
LITERATURE REVIEW	7
2.1 Sources of Pharmaceutical waste.....	7
2.2 Commonly disposed pharmaceuticals.....	7
2.3 Current disposal methods of pharmaceuticals	10
2.4 Factors influencing disposal of pharmaceutical waste.....	13
2.5 Awareness and perception on disposal of pharmaceutical waste	14
2.6 Risks of pharmaceutical waste.....	15
2.7 Legal framework of pharmaceutical handling and disposal	16
2.8 Laws and statutes related to pharmaceutical waste in Kenya	17
2.9 Research Gaps.....	18
2.10 Theoretical Framework.....	19
2.11 Conceptual Framework.....	20

CHAPTER THREE	23
METHODOLOGY	23
3.1 Study Area	23
3.1.1 Location	23
3.1.2 Socio-economic activities	24
3.1.3 Population	25
3.1.4 Climate.....	25
3.2 Study design.....	25
3.3 Sampling Procedure	26
3.4 Validity of instruments	27
3.5 Reliability.....	28
3.6 Data analysis	28
3.7 Ethical Considerations	28
CHAPTER FOUR.....	30
RESULTS AND DISCUSSION	30
4.1 Socio- demographic information of the study population	30
4.2 Commonly disposed pharmaceutical wastes	32
4.3 Current pharmaceutical waste disposal practices	34
4.3.1 Disposal of medication	34
4.3.2 Perceptions on disposal of unwanted pharmaceuticals.....	36
4.4 Factors that influence pharmaceutical waste disposal	37
4.4.1 Knowledge	37
4.4.2 Distance.....	40
4.4.3 Total Income	42
4.4.4 Children under 5 years	43
4.4.5 Medical cover ownership.....	45
4.5 Perception on Feasible safe disposal strategies that can be used to manage pharmaceutical wastes.....	46
CHAPTER FIVE	50
CONCLUSION AND RECOMMENDATIONS.....	50
5.1 Summary of the findings.....	50
5.2 Conclusions.....	50
5.3 Recommendations.....	51
5.3 Recommendation for further research	51

REFERENCES.....	52
APPENDICES	57
Appendix 1:.....	57
Appendix 2:.....	58
Appendix 3:.....	59
Appendix 4:.....	73
Appendix 5:.....	74
Appendix 6:.....	79

LIST OF TABLES

Table 1: Various types of pharmaceuticals commonly used among households.....	9
Table 2: The commonly dispensed pharmaceuticals in Rift Valley General Hospital	10
Table 3: Recommended methods of disposal of pharmaceutical waste	13
Table 4: Sample size calculation.....	27
Table 5: Summary of data analysis	29
Table 6: Distribution of respondents' demographic characteristics in Nakuru town	30
Table 7: Quantity of pharmaceuticals disposed	34
Table 8: Disposal of medication in their various forms.....	35
Table 9: Perceptions on disposal of unwanted pharmaceuticals.....	36
Table 10: Likert scale on knowledge	38

LIST OF FIGURES

Figure 1: Theoretical prepositions of the health belief model	19
Figure 2: Conceptual framework	22
Figure 3: Map of study area	24
Figure 4: Percentage of the commonly disposed pharmaceuticals	32
Figure 5: Methods of handling unwanted pharmaceuticals according to knowledge.....	39
Figure 6: Disposal practices in regard to distance to medical facilities.....	41
Figure 7: Disposal practices in regard to total family income	42
Figure 8: Pharmaceutical disposal practices in families with under five children	44
Figure 10: Feasible strategies for disposal of unwanted pharmaceuticals.....	47

LIST OF ACRONYMS

API:	Active Pharmaceutical Ingredients
EPA:	Environmental Protection Agency
GOK:	Government of Kenya
HBM:	Health Belief Model
KNBS:	Kenya National Bureau of Statistics
NDCP:	National Drug Control Policy
NEMA:	National Environmental Management Authority
NIDA:	National Institute on Drug Abuse
NSAIDs:	Non- Steroidal Anti-Inflammatory Drugs
OTC:	Over the Counter
SDGs:	Sustainable Development Goals
UK:	United Kingdom
US:	United States
WHO:	World Health Organization

CHAPTER ONE

INTRODUCTION

1.1 Background information

Pharmaceutical is a drug that is used to diagnose, cure, treat or prevent diseases. It becomes a pharmaceutical waste when it is no longer usable for intended purpose, or is being discarded for other reasons e.g. contamination, already dispensed and expiration. The term waste according to Environmental Management and Co-ordination Act 2015 is ‘any matter whether liquid, solid, gaseous which is discharged, emitted or deposited in the environment in such volume, composition or manner likely to cause an alteration of the environment’ (GOK, 1999). This waste can be hazardous waste, non-hazardous waste or controlled substance (Hoboy, 2011) It is a drug that will never be used that includes all expired pharmaceuticals, all unsealed syrups or eye drops irrespective of its status whether expired or not, all cold chain damaged pharmaceuticals that should have been stored in cold chain but was not hence it has been damaged, all bulk or loose tablets and capsules also includes all unsealed tubes of creams and ointment whether expired or not (WHO, 1999). This can be in healthcare setting or in the home. This waste includes partial vials (safety caps removed), un-dispensed, pre-filled syringes, partial syringes, discontinued medicines, un-administered medicines, prescription medicines or physician treatment samples (Hoboy, 2011).

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. Most of them frequently become waste for a variety of reasons such as: the patient’s medical conditions resolving before completion of a dose, the patient may experience intolerable effects and the prescriber may stop the usage or change it. They also become waste when a patient refuses to take the pharmaceutical as prescribed, the pharmaceutical is not effective and the prescriber stops it or change it and the pharmaceutical may expire before the dose is completed. At times the patient may die and leave the pharmaceutical which becomes waste (Bain 2010a).

Unwanted pharmaceuticals are managed in a variety of ways, such as keeping them at home, dumping them in the trash, rinsing them in the sink, flushing them down the toilet and others take them back to the pharmacy for proper disposal (Dharmender *et al*, 2013). Pharmaceutical waste can also emanate from donations during conflicts and natural disasters as a sign of humanitarian assistance as they sometimes arrive near or past expiry date. Others

may be unrecognizable if labelled in foreign language or may have been given in unwanted large quantities ending up as waste (WHO, 1999).

Recently researchers found pharmaceuticals such as antibiotics, hormones and controlled substances in almost all environmental media. There is enough evidence that pharmaceuticals harm aquatic life and humans. Humans also feed on aquatic organisms that live in water contaminated with the antibiotics and hormones. They also use the same water even for drinking.

Evidence from rodent and fish study suggest that some endocrine-disrupting compounds, including those found in prescribed synthetic hormones, may contribute to tumour formation in humans (WHO, 1999). Anti-neoplastic or cytotoxic drugs must be handled carefully as they have the ability to kill or stop the growth of living cells and can have extremely serious effects, such as interfering with reproductive processes in various life forms (Atul *et al*, (2016). Exposure of pharmaceuticals to non-target organisms has been linked to increase in infertility, genital defects and cancers and neurological disorders in children which have been exposed to them especially exposure to hormones (Obonyo & Mutai , 2014).

There exist safe methods of disposal of pharmaceuticals among households which are already practised by other countries. This includes the take back programmes which provide safe and environmental friendly options for consumers. Other examples are mail back programmes where the consumers send their unused drugs to the central location through the postal service. This is operational in various countries such as United States. Another take back program is the use of drop off models where permanent collection sites exist or a one day event where consumers take their unwanted pharmaceuticals and they are later disposed in a recommended way (Siler & Brown , 2009).

Disposal of pharmaceutical waste among households is a global challenge especially in developing countries like Kenya. This study assessed the disposal practices of pharmaceutical waste, identifying and describing the commonly disposed pharmaceutical waste, assessing the current disposal methods, assessing the factors influencing pharmaceutical waste disposal and assessing the factors that influence disposal of pharmaceutical wastes. The study also sought to document feasible safe disposal strategies that can be used to manage pharmaceutical waste among households.

1.2 Statement of problem

In the last few decades studies in other countries have shown 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 waste water treatment systems which are not sufficiently equipped to manage this form of waste (Wagama, 2016). Pharmaceuticals have immense effects on non-target organisms such as aquatic life and in humans. Improper disposal of pharmaceuticals might be the cause of dysfunction of sewage treatment facilities since they have been shown to be toxic to beneficial bacteria especially the antibiotics. There is inadequate information on handling of pharmaceutical waste at household level. Further, 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 human such as medicine resistant, accidental poisoning of children and pets. This can also happen in the study area if the pharmaceutical waste is not properly disposed. Nakuru was dubbed the cleanest town in East Africa though this has changed due to rapid urbanisation and high population growth (Kanani, 2014). Waste in Nakuru is not segregated and medical wastes have ended up at the dumpsite- both from households and health facilities (Kahenda & Wagama, 2016). This has brought about rising cases of medical waste which have been carelessly disposed in the Nakuru Gioto dumpsite. From the academic trips made to the dumpsite it was clearly shown that there were medical waste haphazardly disposed there. Therefore there is need to assess the disposal practices of pharmaceutical waste among households in the study area.

1.3 Broad objective

To assess the disposal practices of pharmaceutical waste among households in Nakuru town, Nakuru County

1.4 Specific objectives

1. To determine and characterize the commonly disposed pharmaceutical waste among households in Nakuru town.
2. To assess the current pharmaceutical waste disposal practices among households in Nakuru town.

3. To assess factors that influence pharmaceutical waste disposal among household in the study area.
4. To document feasible safe disposal strategies that can be used to manage pharmaceutical waste among households in Nakuru town.

1.5 Research Questions

1. What are the common types of pharmaceutical wastes disposed among households in Nakuru town?
2. How are pharmaceutical wastes currently disposed among households in Nakuru town?
3. Which factors influence pharmaceutical waste disposal among households in the study area?
4. What are the feasible safe disposal strategies that can be used to manage pharmaceutical waste among households in Nakuru town?

1.6 Justification

Pharmaceuticals enter the environment via water, sewage, manure and animal carcasses and they disperse through food chain. Pharmaceuticals are designed to alter physiology at low concentrations and can be particularly potent contaminants in high concentrations to non-target organisms. Though there is inadequate evidence on exact harm of pharmaceuticals on human, action should be taken because they already exist in our environment. The Nation's experience with chemicals such as asbestos and lead which demonstrate that it will be costly in terms of health, human lives and in monetary terms, action should be taken to avoid being overwhelmed in the future with these effects.

This study will make a contribution to the Sustainable Development Goals (SDGs) most notably goal 6 target 6.3 that aims to achieve improved water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials into water sources by 2030. Further, it will contribute to Goal 3 target 3.9 that aims to reduce the number of deaths and illness from hazardous chemicals and air, water and soil pollution and contamination by 2030. The study findings will be useful in the attainment of Kenya's Vision 2030, the social pillar on the environment which aims at regulating pollution and waste management and seeks to create "a just, cohesive and equitable social development in a clean

and secure environment”. Data generated from this study can be beneficial for policy makers and relevant authorities especially those working on environmental and public health management. The findings will form a database that can be utilized in development and improvement of guidelines for disposal of pharmaceutical waste among households in Kenya.

1.7 Scope of the study

The scope of this study was confined to Milimani, Free area and Kaptembwo which fall within Nakuru town. A social survey design was used to carry out the study from May to June 2016. Data was collected from households in the selected areas. The demographic factors considered as intervening included age, education, awareness, gender. Age of respondent was between 18 to 65 years. The study focused on the following aspects: commonly disposed pharmaceuticals waste, current pharmaceutical waste disposal practices, factors that influence pharmaceutical waste disposal and feasible safe disposal strategies that can be used to manage pharmaceutical waste among households in Nakuru town.

1.8 Limitations and assumptions

- Inability to establish the expiry date for cases where the original packages were missing. This was solved by the researcher’s operationalization of the term expiry date of the pharmaceutical since it was not guaranteed once the drug container was opened and improperly stored.
- The political and security situation remained stable thus allowing administration of household questionnaires and community level interactions to be carried out.
- Prejudice- this may have arisen out of suspicion from respondents on the interviewers and the actual use of information that was being gathered.
- The local community in the study area was to be friendly and was to provide true information on what they were to respond to the questions.

1.9 Definition of terms

Characterization- is to describe pharmaceuticals in terms of naming the commonly disposed, its type whether it is syrup, tablets..., the source and finally classification on the basis of pharmacological properties and their pharmacological actions e.g. Antipyretics, Analgesics, Antibiotics...

Diagnosis- it refers to pharmaceuticals which are used to determine cause of an illness or disorder. They include diagnostic radiopharmaceuticals such as Adreview which is used to detect certain kinds of cancer of the adrenal glands.

Expiry- these are pharmaceuticals which are past their drug expiration date which exist in most medication labels, including prescription and over the counter, though their stability is not guaranteed once the original package is opened and storage conditions are not followed.

Households - The smallest domestic unit consisting of one or more people who share living accommodation.

Improper disposal – any disposal of pharmaceuticals which is not following the safe disposal guidelines by World Health Organisation (1999) on how to dispose of Pharmaceuticals. Improper disposal includes; flushing pharmaceuticals down the toilet and sink, throwing in the trash, storing of unwanted pharmaceuticals in the house.

Non target organisms - any organism which is unintentionally affected in this case by pharmaceuticals this includes aquatic life like fish, microbes and even humans who are not intended to take those medications.

Pharmaceuticals - these are drugs or substances used to diagnose, cure, treat or prevent diseases for humans and pets.

Pharmaceutical Waste - refers to drugs which are no longer usable for intended purpose and it will never be used whether expired or not for humans and pets.

Social economic status- it is an individual or family's economic and social position in relation to others based on their income.

Take back programmes- these are initiatives which entail collection of unwanted pharmaceuticals from household to hospitals where they are later disposed of in a safe way which cannot pollute the environment.

CHAPTER TWO

LITERATURE REVIEW

2.1 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% 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 leads to accumulation of unwanted pharmaceuticals. There is a wide spectrum of sources such as health care facilities, household medicine cabinet, and first aid kits, to less recognize 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, 2008). This reasons ranges 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 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 those medication applied dermally and from excrete via skin sweat and through disposal to sewerage or trash of unwanted pharmaceuticals (Daughton & Ruhoy, 2008). This particular study focuses on the third origin which is disposal of unwanted pharmaceuticals from consumer sector.

2.2 Commonly disposed pharmaceuticals

The commonly disposed pharmaceuticals worldwide include controlled substances such as narcotics and psychotropic substances, anti-infective drugs, antineoplastic, cytotoxic-anti-

cancer drugs, antiseptics and disinfectants. These pharmaceuticals can be in form of solids, semi-solids or powders (WHO, 1999).

Pharmaceuticals to be disposed can further be categorised by dosage form that is solids, semi solids, liquids and powders. They include tablets, capsules, granules, powders for injection, mixture creams, lotions, gels and suppositories. Others are in liquid form such as solutions, suspensions, syrups and ampoules. They can also be in aerosol canisters, which include propellant driven sprays and inhalers (WHO, 1999).

In a study carried out in Basrah, Iraq showed that antibiotics were the most commonly stored drugs among household with 26.43 %, followed by the antipyretic/analgesics with 19.58% and NSAIDs (non-steroidal anti-inflammatory drugs) with 11.45%. These drugs constituted 57% of the total drugs stored. Thirty one percent (31%) of these drugs represented the drugs in current use at the time of visiting, while 45% were drugs leftover or unused drugs, and 23% were drugs kept for future. The results also showed that 13% of the drugs were out of date (Jasim, 2010).

In study carried out in Kenya to assess pharmaceutical waste management practices in community pharmacies in Embakasi Division showed that the waste generated is 36.2% solid followed by 24.6% liquid , 20% semisolid waste and powder waste with 19.2% (Obonyo & Mutai, 2014). There is inadequate data on current household pharmaceutical waste management and the extent of the problem. Generally, pharmaceutical waste in households is not being properly handled. The American Environmental Protection Agency (EPA) reports in recent years have cited multiple studies by analytical chemists on pharmaceutical waste (Daughton, 2003).

Table 1: Various types of pharmaceuticals commonly used among households

Sub group	Common use	Compound
Analgesics	Antipyretic, pain reliever	Acetaminophen (Paracetamol) Acetylsalicylic acid (Aspirin)
Antiepileptic drugs	Anticonvulsants	Carbamazepine Phenobarbitone
Antihyper-lipidemics	Lipid regulator	Clofibrac acid Atorvastatin gemfibrozil
Antimicrobials	Antibiotics	Tetracycline Sulfamethoxazole Trimethoprim Erythromycin Amoxicillin
Non-steroidal inflammatory (NSAIDs)	anti- drugs Anti-inflammatory	Diclofenac Ibuprofen Ketoprofen Naproxen

(Source: Beckel et al., 2011)

The commonly dispensed pharmaceuticals from secondary data from Rift Valley General Hospital (PGH) includes:

Table 2: The commonly dispensed pharmaceuticals in Rift Valley General Hospital

Sub group	Common use	Compound
Anti- hypertensives	Treatment of hypertension(high pressure)	of blood Nifedipine Amlodipine Methyl dopa Captopril Enalapril
Respiratory medications	Treatment of asthma	Salbutamol (Tablets/ inhaler) Prednisolone
Diabetic medicines	Treatment of diabetes	Insulin Glibenclamide Metformin
Antipsycotics	Treatment of mental illness	Chlorpromazine Haloperidol Fluoxetine Benzhexol
Thyroidal diseases medicine	Treatment of Goitre	Levothyroxine Carbimazole
Anti inflammatory	Treatment of inflammation, pain and swelling	Diclofenac Ibuprofen
Topical preparations	Treatment of skin conditions	Clotrimazole cream Hydrocortisone cream Tetracycline ointment
ARVS	Treatment/ management of HIV/AIDs	Zidovudine Lamivudine Nevirapine Tenofovir Efavirenz
Anti-TB	Treatment of tuberculosis	Rifampicin Isoniazid Pyrazinamide Ethambutol
Antimalarials	Treatment of malaria	Artemether Lumefantrine Quinine Sulfadoxine

Source: Rift Valley General Hospital, 2016

2.3 Current disposal methods of pharmaceuticals

The methods of disposal of unwanted pharmaceuticals determine their presence in the environment and their potential to contaminate water. Households contribute to environmental concerns related to pharmaceutical waste since they dispose the unwanted

pharmaceuticals through sink, toilet or in a trash. All of these methods have detrimental impacts on the environment. Globally, the disposal methods currently used are evident in various studies which have been conducted worldwide (Beckel *et al.*, 2011).

In a study conducted in Thailand, it was found that 89.4% of people kept some kind of drugs in their houses. Neuromuscular drugs were the most common group. The study also revealed that there were leftover medicines at homes and they were discarded when they are not used. The most commonly used method of discarding them was trashing them into the rubbish bin. This method accounted for 81.4% of solid dosage form, 64.6% of liquid dosage form and 66.6% of external use drugs. Liquid dosage forms were also put into the drainage system (7.4%) (Arkaravichien *et al.*, 2014).

Studies conducted in the southern and central part of Ethiopia, revealed that approximately 15% and 50% of the persons with perceived illnesses practiced self-medication respectively (Abay, 2010). The study carried out in North West Ethiopia showed 27.2% self-medication prevalence in Gonder Debarq and Kola-Diba study areas (Abula & Worku, 2001). This tendency of self-medication leads to accumulation of unwanted drugs that are bought but not fully utilized. This contributes to high levels of domestic pharmaceutical waste generated which pose challenges on their proper disposal (Abay, 2010).

In another study carried out in Basrah, Iraq showed that out of 300 households visited 94% stored medication in their homes. These totalled to 4279 different types of drug preparations ranging from 1 to 72 products per household. The study also showed that 70% of the families kept ranging from 1 to 20 products of which approximately half of the products were stored in their houses. At the time of visiting 45% of the drugs were unused and 23% were stored for future use (Jasim, 2010).

Large portion of pharmaceuticals in water emerge from poor methods of disposal of unwanted pharmaceutical in households and medical facilities. Most people flush unwanted pharmaceuticals down the toilet or dispose them together with domestic waste. This was evident in various studies conducted in Tacoma, Washington. The study found out that 54% of respondents stored pharmaceuticals in their homes and 35% flushed them in the toilet or sink. A similar trend was reported in a study conducted in Southern California where 45% dispose in a trash and 28% down the toilet and sink. In King County Washington 52% disposed their unwanted pharmaceuticals in a trash and 20% flushed them down the toilet and sink. Only 1% returns their unwanted pharmaceuticals to the doctor or pharmacy. In another

study done in U.S. it was found out that only 2% of people finish their prescriptions, a very high percentage of drugs – as much as 50% of many prescriptions and 80% of antibiotics are said to go unused (Wu *et al.*,2009).

A study carried out in Ethiopia found that unwanted pharmaceuticals are thrown into a trash, flushed down the toilet, burnt, buried, given to a sick neighbour or thrown to the environment. Others keep them in the house for the next use because they don't know the right way to dispose them (Mekonnen & Fentie, 2014).

A study carried out in Tanzania also showed that of the 300 households visited, 25 (8.3%) were found to store antimalarial (Temu *et al.*, 2006). In a study carried out in Kenya Embakasi Division community pharmacies showed that even at the pharmacy level the pharmaceutical waste generated was 34% solids and 59% liquid forms were disposed by waste disposal companies. Approximately 19.2% disposed their semisolid pharmaceutical waste through sewer and incineration (Obonyo & Mutai, 2014).

To respond to the gap available for proper disposal options of pharmaceuticals among households, many countries have come up with safer ways of tackling the problem. For instance, a large number of take back programmes have been initiated in the United States, permanent collection boxes have been set up, and special envelopes are being distributed to consumers who are then supposed to mail them back to agencies responsible.

In Washington State, residents are allowed to return the unused pharmaceuticals to selected pharmacy locations which are then disposed as hazardous waste. In British Columbia, Canada there has existed a very successful take back programme since 1996 which has been supported 93% by the pharmacies (Wu *et al.*, 2009). Lithuanian pharmacies are obliged to collect household medical waste, but Italian pharmacies collaborate voluntarily (Siler & Brown, 2009).

Table 3: Recommended methods of disposal of pharmaceutical waste

Methods of Disposal	Types of Pharmaceutical Waste
Return to donor or manufacturer for disposal	All bulk waste pharmaceuticals especially antineoplastics.
Incineration	
High temperature incineration higher than 1200°C.	Solids, semisolids, powders of antineoplastics and controlled substances.
Medium temperature incineration with minimum temperature of 850°C.	Where high temperature incinerators are absent this can be used for solids, semisolids and powders of controlled substances.
Immobilization	
Waste encapsulation	Solids, semisolids, powders and liquids of controlled substances and antineoplastics.
Inertization	Solids, semisolids and powders of controlled substances and antineoplastics.
Landfill	
Highly engineered sanitary landfill and engineered landfill.	For disposal of pharmaceuticals after immobilization.
Open uncontrolled non engineered dump	Used as last resort for untreated solids, semi solids and powders but it has to be covered immediately with municipal waste. Immobilization of solids and semi solids is preferable.
Sewer	Used for diluted liquids, syrups, intravenous fluids and very small quantities of diluted disinfectants.
Fast flowing watercourse	For diluted liquids and syrups, intravenous fluids and small quantities of diluted disinfectants.
Burning in open containers	Used as last option for packaging paper and cardboard.
Chemical decomposition	This is not allowed unless expertise and special materials needed are available.

Source: WHO 1999.

2.4 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 pharmaceutical 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 United States of America issued a list of federal guidance that limited 1 specific hazardous drugs that should be disposed directly to the sewer system because of their

potential for abuse and acute toxicity (Glassmeyer *et al.*, 2008). In another study which was 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.*,2014).

Disposal practices for unwanted pharmaceuticals are influenced by various factors: most dispose them improperly because they are not informed about the proper way to dispose them. Others do so because they don't know whether pharmaceuticals have bad effects on neither human nor environment and others do so because of non-existence of systems for unwanted pharmaceuticals among households (Dharmender *et al.*, 2013).

2.5 Awareness and perception on disposal of pharmaceutical waste

Despite increase in awareness of safe pharmaceutical disposal in the United States of America, communities still use unsafe methods to dispose of their pharmaceutical waste. This poses enormous risks to the environment by contaminating water and soil. Some may be diverted to reuse and resale. Others might be taken accidentally by children even when they have already expired (Siler & Brown, 2009).

Studies carried out in the US, UK and New Zealand indicate that there is little public awareness on the need for correct and safe disposal by returning unwanted pharmaceuticals to pharmacies or to selected collection points (Cormican *et al.*, 2010). There is evidence that in Pakistan 3.8% of the population have no knowledge of what to do with unwanted pharmaceuticals in their homes. On the other hand 80% of the respondents showed their concern that improper disposal of pharmaceuticals can affect the environment and the health of the public (Radhakrishna *et al.*, 2015).

In a study conducted in Pakistan the respondents suggested various ways in which awareness on safe disposal of unwanted pharmaceuticals can be raised. Fifty one percent (51%) of the respondents suggested that electronic media should be used while 20% suggested newspapers should be used. On the other hand, the remaining 29% suggested that pharmacies, physician and pharmaceutical industries should create the awareness creation (Radhakrishna *et al.*, 2015).

Despite the existence of environmentally-friendly pharmaceutical waste disposal methods, most households dispose of unwanted pharmaceuticals in sewer system and trashcans. These methods are often preferred due to concerns such as protecting children and pets against

accidental poisoning. Many people believe by disposing of unwanted pharmaceuticals via the sewer and municipal waste does not cause harm to the environment (Wilcox, 2013).

2.6 Risks of pharmaceutical waste

In the absence of timely and safe disposal of unwanted and expired pharmaceuticals which may be simply dumped – with the risk of environmental pollution – or repackaged for the counterfeit market. Toxicity from environmental exposure to pharmaceuticals has been reported in fish and vultures. If antibiotics are dumped, exposure to subtherapeutic concentrations of the drugs may lead to the selection of drug-resistant soil bacteria, which may then infect humans and even pass on their resistance genes to bacteria that are human pathogens. Mechanisms to deter the entry of pharmaceuticals into the environment need to be strengthened (Atul *et al*, 2016).

Pharmaceuticals Poisoning: keeping pharmaceuticals in the house is one of the most practiced methods of handling pharmaceuticals, this poses several risks related to diversion of the initial use, accidental use and overdose even the possibility of people consuming spoilt pharmaceuticals in case of an emergence (Siler & Brown, 2009).

Abuse of Pharmaceuticals: The presence of medication among households has contributed to high rate of drug abuse in America especially in teenagers. This is evident in a survey which was carried out in 2004 which showed that 14.5% of young adults aged 18-25 misuse prescription drugs such as pain relievers, tranquilizers, stimulants and sedatives because of their availability in homes (Siler & Brown, 2009). Even though restrictions and control mechanisms are available in the prescription and drug delivery system to avoid drug abuse still pharmaceutical abuse and diversion of its use are on the rise. For instance in America, It is estimated by the NIDA that 20% of the population will misuse prescribed pharmaceuticals within their lifetime for nonmedical reasons mostly pharmaceuticals for central nervous system, depressant and also stimulants are the most commonly abused drugs (Simons, 2010). If pharmaceuticals are discarded insecurely in landfills, drugs may come into the hands of scavengers or children and be diverted for resale to the general public. Accumulation of unused medications and delayed disposal can also encourage self-medication and misuse of drugs, causing serious threat for the health of a country's population (WHO, 1999).

Environmental issues: pharmaceuticals have found their way into our surface water bodies and drinking water due to improper disposal. This is clearly shown in a 2002 study from the U.S Geological survey which reported that 80% of the 139 streams studied had pharmaceuticals of a detectable concentration including hormones and steroids which are linked to the reproductive problems as they lower immune response in fish and frogs (Simons, 2010). The presence of pharmaceuticals in drinking water can further contribute to development of antibiotics resistance, or exposure of populations to irritant or mutagenic anticancer drugs and the possible link between endocrine disrupting compounds and failing fertility of the aquatic life (Mekonnen & Fentie, 2014).

Trashing pharmaceutical waste into dust bins is non-environmental friendly as the active pharmaceutical ingredients could eventually get into surface water and then may unconsciously get back to people through tap water and drinking water (Arkaravichien, 2014). Improper disposal of pharmaceuticals have serious consequences such as interference with human sperm count which according to his study has reduced up to 50% on the average since 1939 also there has been increase in infertility, genital defects and cancers and neurological disorders in children which are caused by hormones (Obonyo & Mutai, 2014).

2.7 Legal framework of pharmaceutical handling and disposal

There exist guidelines which provide advice on safe disposal of unwanted pharmaceuticals. In countries where regional, national and laws on disposal of pharmaceuticals do not exist or are insufficient, expired pharmaceuticals cause a serious threat when they are improperly disposed leading to contamination of water, wildlife, or found by scavengers who might divert it to the market for resale and misuse (WHO,1999) The simplest and least expensive way to minimize pharmaceutical disposal is to reduce and avoid generating unused pharmaceuticals. During outreach activities, EPA had many ways of smart pharmaceutical management, For example buying medicine in smaller quantities means fewer expire. By using vouchers from pharmaceutical sales representatives instead of using free “sample” pharmaceuticals, facilities can eliminate an entire waste stream (EPA, 2010).

According to the “Guidelines for Safe Disposal of Unwanted Pharmaceuticals in and after Emergencies” issued by WHO in 1999, pharmaceuticals are ideally disposed of by high temperature (above 1,200°C) incineration. However, such facilities equipped with emission control are mainly found in industrialized countries. The Guidelines describe quite a number of alternative methods for safe disposal of unwanted pharmaceuticals suitable for developing

countries. These methods include use of landfills, encapsulation, burning in alternative incinerators and chemical decomposition (WHO, 1999).

2.8 Laws and statutes related to pharmaceutical waste in Kenya

In the Constitution of Kenya (2010) Article 42 states that, every person has a right to a clean and healthy environment. It provides enforcement mechanism in article 70 hence, the way we dispose our pharmaceutical waste should be in a safe and proper way. This will be in compliance with the constitution since as citizens we have an obligation to keep our environment clean for our benefit and for the safety of fellow Kenyans (GOK, 2010).

The Environmental Management and Coordination (Waste management) Regulation, 2006 defines the responsibilities of waste generators. It also defines the duties and the requirements for transport and disposal of waste. It provides for mitigations of pollution and provides for hazardous and toxic waste. According to the fourth Schedule of the regulations, wastes containing medical waste are classified as hazardous waste and must be disposed of in accordance with the guidelines given by NEMA, not in unsafe methods (NEMA, 2006b).

The Environmental Management and Co-ordination (Water Quality Regulations, 2006) has set the standards of domestic water and waste-water. The regulations are meant for pollution control and prevention and provides for protection of water sources. If pharmaceuticals are disposed poorly for instance if flushed down the toilet as is one of the methods commonly practiced in disposal it will pollute the water hence it will be against the act (NEMA, 2006a).

The Water Act, (2016) which deals with control and conservation of water resources prohibits practices that may cause pollution to sources of water likely to be used for human consumption or domestic use or in the manufacture of food for human consumption. According to the provisions of this act, pharmaceuticals should be disposed in such a way that they don't cause pollution to water sources hence methods such as burying them or flushing them should be avoided since they will get into the waterway polluting the water (GOK, 2002).

The Food, Drugs and Chemical substance Act (Cap 254) prohibits the use of or disposal of any chemical in a manner likely to cause contamination of food or water for human consumption in a manner likely to be injurious or dangerous to the health of any person. Improper disposal of pharmaceuticals contradicts this Act (GOK, 2012).

The Public Health Act (2012) provides for maintaining and securing health. It defines what environmental nuisance is. Various health hazards are likely to emanate from improper disposal of pharmaceuticals such as accidents in homes. If unwanted pharmaceuticals accumulate in the house it might lead to child poisoning, air pollution if burnt in the open and water and land pollution if disposed in the thrush or flushed down the toilet. There is therefore need for proper disposal to ensure healthy environment (GOK, 2012).

The Draft Environmental Management and Co-ordination (Air Quality) Regulations (2008) provides for prevention, control and abatement of air pollution to ensure clean and healthy ambient air. The general prohibitions state that no person shall cause the emission of air pollutants that might interfere with the air quality. If pharmaceuticals are poorly disposed they will compromise the air quality by such unsafe methods as burning in the open (NEMA, 2008).

2.9 Research Gaps

Studies in other countries have identified the commonly disposed pharmaceuticals among households but there is inadequate documentation of the same in Kenya though this study was able to identify the commonly disposed pharmaceuticals. On the other hand, in a study carried out in Kenya only assessed pharmaceutical waste management practices in community pharmacies (Obonyo & Mutai, 2014) but not among households but this particular study was able to assess management practices of the waste among households.

Various studies have shown current disposal methods of unwanted pharmaceuticals among households and also factors influencing the disposal of pharmaceutical waste have been studied in other countries such as Thailand, Ethiopia and Iraq but none in Kenya. This study was able to identify the current disposal methods and also was able to identify the factors that influence their disposal in the study area.

Other countries like Britain, Canada and USA have responded to the gap available for proper disposal options of pharmaceutical waste among households by coming up with safer way of tackling the problem such as the take back programmes. In the same way this study was able to investigate the feasible strategies that can be used to manage pharmaceutical waste among households this was achieved by asking the respondents to give suggestions on feasible strategies, why they think it is feasible and their willingness to support the system they suggest.

2.10 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. 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.

HBM is a popular model applied in nursing especially in issues focusing on patient compliance and preventive health care practices. It addresses the relationship between a person's beliefs and behaviour. It provides a way of understanding and predicting how clients will behave in relation to their health and how they will comply with health care therapies.

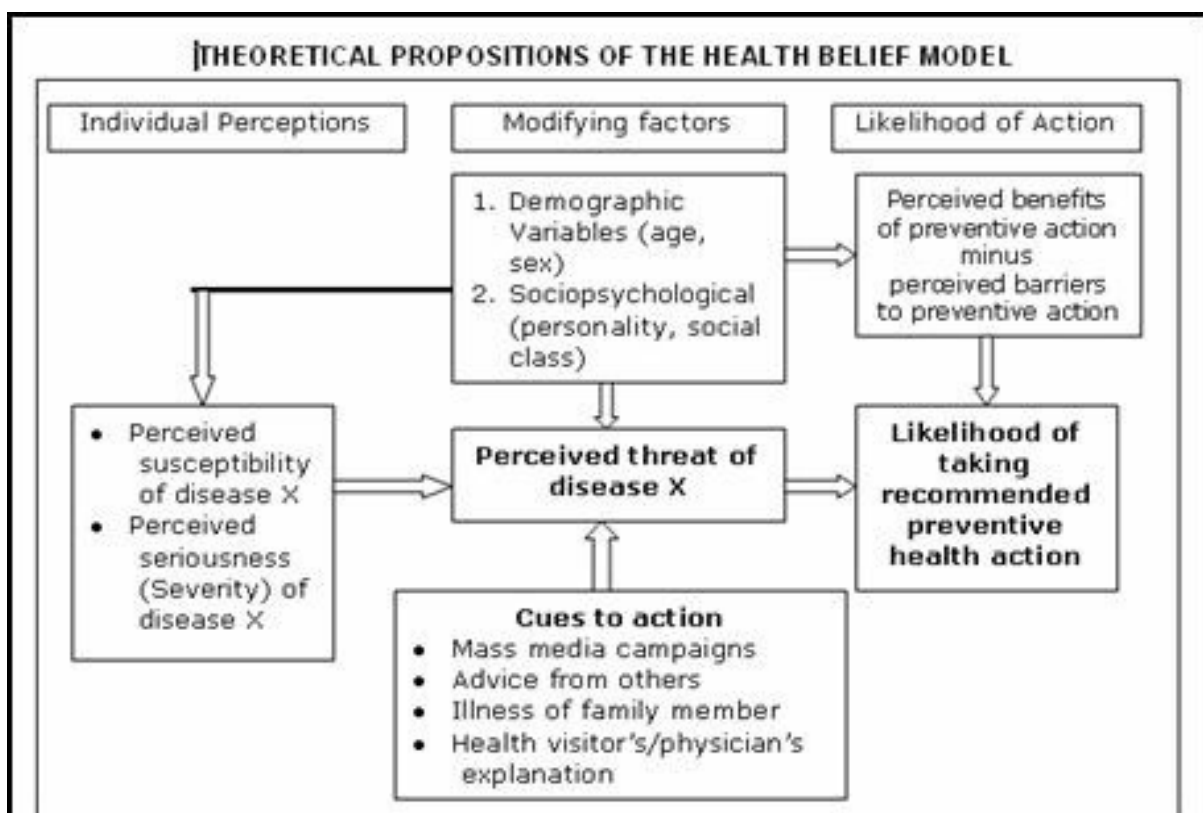


Figure 1: Theoretical prepositions of the health belief model

Source: Nursing Theories, 2013

Perceived susceptibility: refers to a person's perception that a health problem is personally relevant or that a diagnosis of illness is accurate. It will determine whether the person will adhere to his medication and if he fails to adhere to his medication it will lead to availability of unwanted pharmaceuticals among households.

Perceived severity: even when one recognizes personal susceptibility action will not occur unless the individual perceive the severity to be high enough to have serious organic or social complications. A person is likely to stop his/her medication when his condition resolves and is likely to finish if the condition persist. He can also change the dose if he experiences side effects which might lead to severity hence contributing to availability of unwanted medication among households.

Perceived benefits: refers to the patient's belief that a given treatment will cure the illness or help to prevent it. If he does not the patient is likely to stop it and this result to unwanted pharmaceuticals.

Perceived costs: refers to the complexity, duration and accessibility of the treatment. If a person can easily access his treatment he is likely to leave unwanted pharmaceuticals to seek for others in case they are not effective since he can easily access them. This contributes to availability of unused pharmaceuticals in homes.

Motivation: includes the desire to comply with a treatment and belief that people should do what. If a person does not have a motivation he is likely not to comply with the treatment hence leading to unwanted pharmaceuticals.

Modifying factors: include personality variables; patient satisfaction and socio- demographic factors. If the patient is satisfied with the prescribed medication he is likely to adhere to them but if he is not satisfied he is likely not to finish the dose hence resulting to unwanted pharmaceutical wastes.

2.11 Conceptual Framework

The model presented in Figure 2 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 household. They may also interact with intervening variables such as the legal policies and regulation, education level, medical cover 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 them off because he/she can always get medicine when he/she needs without spending extra cash.

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

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

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

Independent Variables

Intervening Variables

Dependent Variable

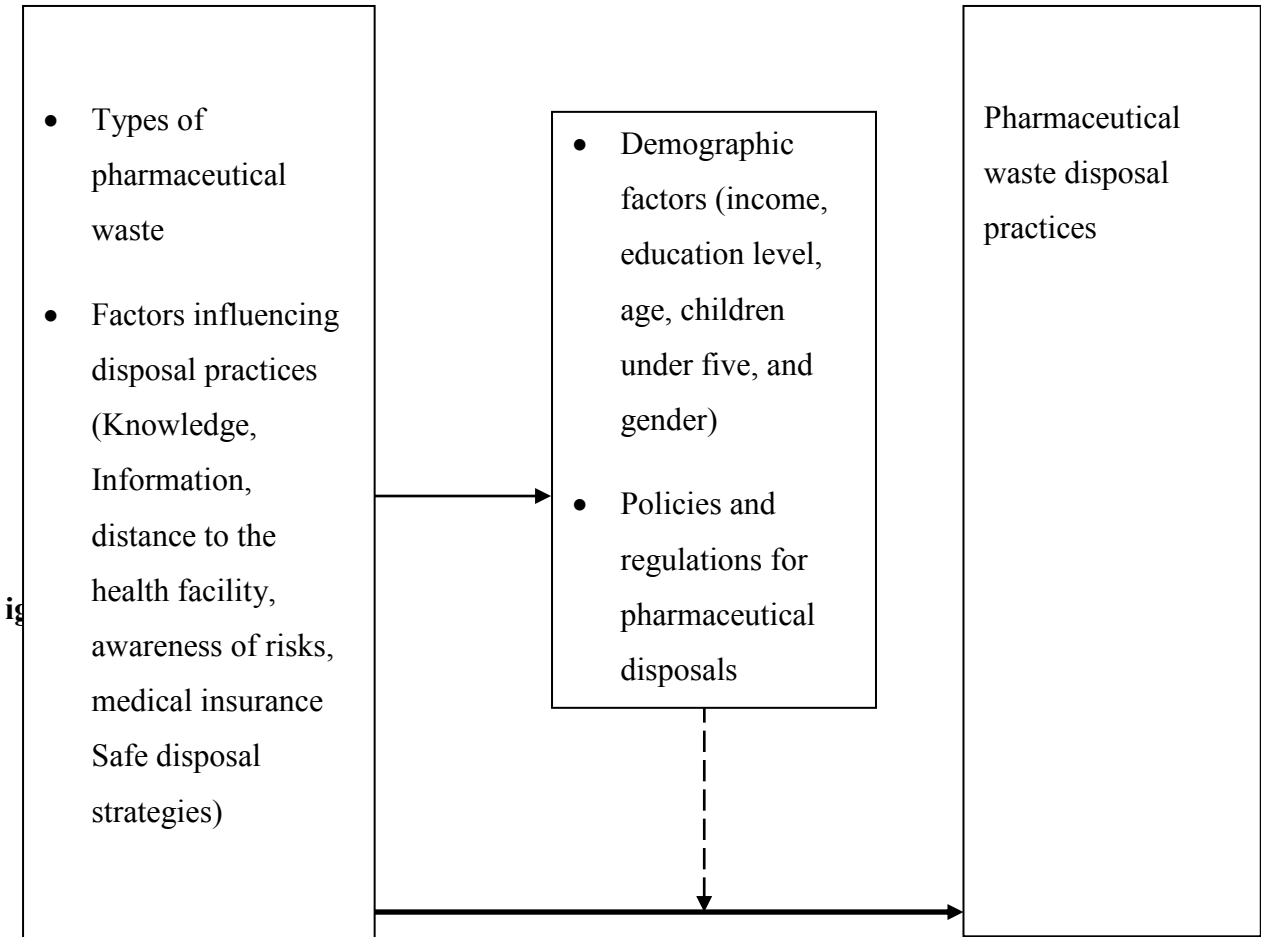


Figure 1. Conceptual framework

CHAPTER THREE

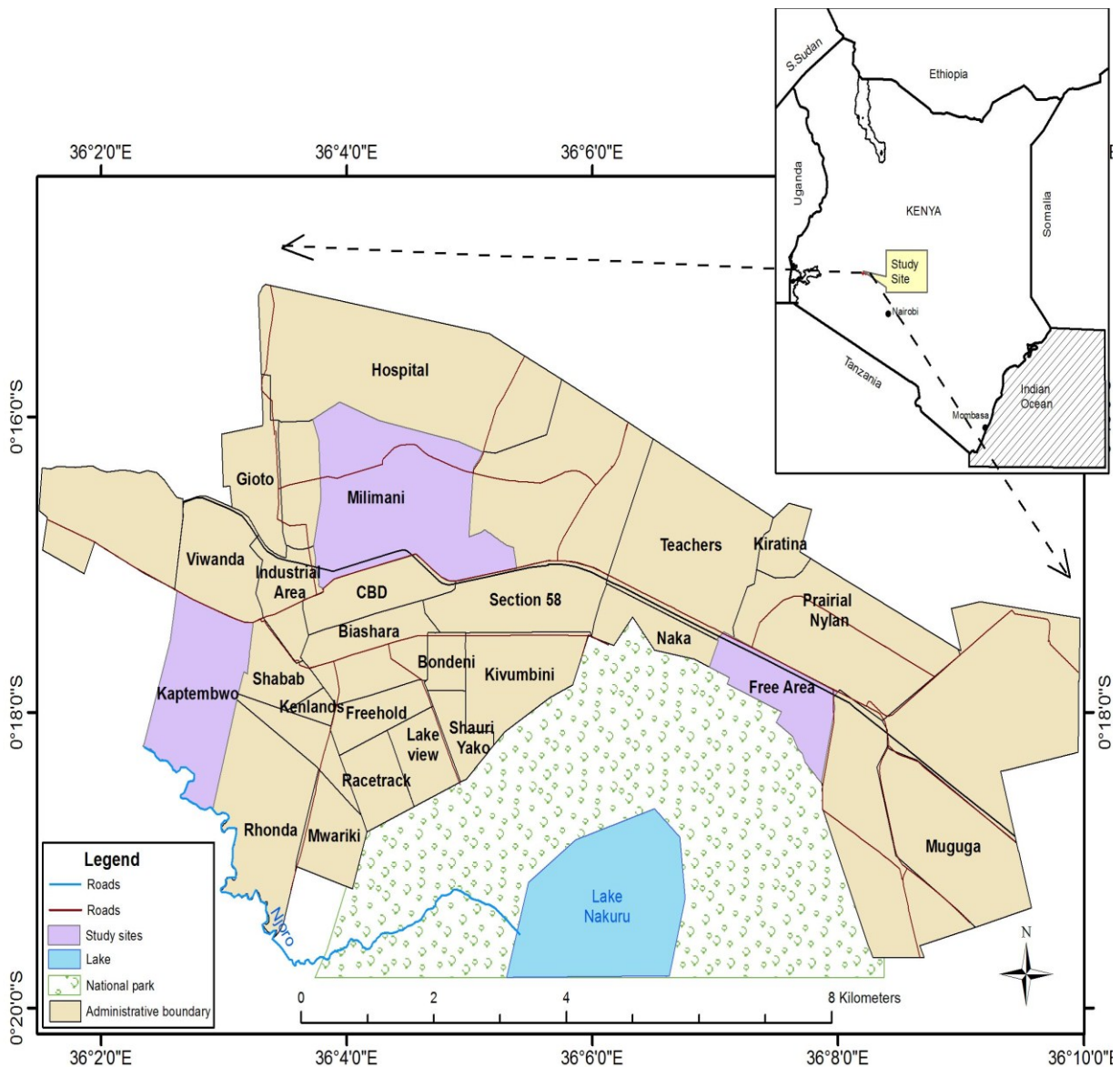
METHODOLOGY

3.1 Study Area

3.1.1 Location

Nakuru Town is in Nakuru County which is located 160 km North West of Nairobi and is the fourth largest urban centre in Kenya after Nairobi, Mombasa and Kisumu. It is situated at an altitude of 1859m above sea level and is within the region of the Great Rift Valley. The town started as a railway station on the Kenyan-Uganda railway at the turn of the last century. The name 'Nakuru' is derived from Nakurro, the Maasai word meaning a 'dusty place'. The town is located in an environmentally sensitive area (Mwangi, 2000).

Nakuru was once dubbed the cleanest town in East Africa, but this has changed due to rapid urbanization coupled with high population growth. The pressures on the environment from the anthropogenic activities in the town have increased due to pollution within the town (Kanani, 2014).



Source: Map of Nakuru town modified from Nakuru county integrated development Plan 2013 – 2017

Figure 3: Map of study area

3.1.2 Socio-economic activities

The population relies mostly on agriculture, manufacturing and tourism for their livelihoods. The area surrounding the city is known for its vast agricultural potential with numerous small farms and also vast agricultural enterprises. The crops grown provide the primary raw material for manufacturing industries found in Nakuru and Nairobi. Dairy farming is a key economic activity and provides the inputs for various milk processing plants around the city. Some of the largest flower farms in the include Homegrown, Oserrian, Karuturi and

Preesman. The bulk of flowers grown in these farms in the county mainly exported to Holland, UK and Germany .The town is also a centre for various retail businesses that provide goods and services to the manufacturing and agricultural sectors.

Nakuru County is a cosmopolitan county, with its population originating from all the major tribes in Kenya. Majority of the people migrated here for business and employment. The government is the main employer in the county.

3.1.3 Population

The population of Nakuru has been growing at the rate of 5.6% per annum. From 38,181 in 1962, the population reached 163,927 in 1989. Nakuru is now the fourth largest town in Kenya (after Nairobi, Mombasa and Kisumu), with a population of 239,000 and according to 2009 census, the population of Nakuru was 473,000 making it the largest in the mid-west (KNBS, 2009). The increasing population in the town has led to an increase in generation of waste which includes pharmaceutical waste. This can be as a result of people seeking medical attention to maintain good health.

3.1.4 Climate

The climate of Nakuru is determined by altitude and physical features. There are two rainy seasons; the long rainy season falling between March and May and the short rainy season falling between July and September. Hot and dry weather is experienced between December and February. The hot dry season is characterized by whirl winds and dust clouds particularly in residential areas along the lake. Mean annual rainfall is approximately 1000mm with the mean maximum and minimum temperature being between 19°C and 17°C respectively (Kanani, 2014).

3.2 Study design

The cross-sectional study design was used in this study. The research design was cross-sectional in that the data was collected at a single point in time to examine difference in the study subjects. The research method involved using a survey research with closed and open questions. The study was conducted to collect data that were relevant to study objectives.

Sample Size Determination

The sample size was calculated using the Anderson et al., (2007) formula: $n = (Z^2pq) / e^2$

$$n = (1.96^2 pq) / e^2$$

Where:

n = is the sample size required

Z = 1.96 which is the normal deviate corresponding to a 95% confidence interval

P = the proportion in the target population estimated to have characteristics being measured so in this case our p is the population which practice improper pharmaceutical disposal.

q = the proportion of the population without the characteristic of interests which in this case was the population that practice proper pharmaceutical disposal.

e = acceptable error precision/accuracy which is set at 0.05.

Thus:

$$p = 0.5$$

$$e = 0.05$$

$$n = (1.96^2 pq) / 0.05^2$$

$$n = 3.8416 \times 0.25$$

$$0.0025$$

$$n = 384.16$$

This gave a sample size of 384 people

3.3 Sampling Procedure

The population was first stratified to cover the administrative units in Nakuru town. For each administrative unit, simple random techniques were employed. According to 2009 population census, the total number of households in the three administrative units was 29910 (KNBS 2009) with Milimani having 1640 households, Kaptembwo 23200 households and Free Area 5070 households. In administration of the household questionnaires a minimum of 384 households was selected involving a random start of the first element and thereafter snowball sampling was applied where the existing study subjects recruited the future subjects from among their acquaintances. Proportionate sampling was undertaken in three study sites based on their total population as shown in the table below. The study used purposive sampling to select the key stakeholders from hospital who included six nurses, three medical officers, six

clinical officers and five pharmacists. A sample of the questionnaire used for stakeholders is shown in (Appendix 4).

Table 4: Sample size calculation

Location	Number of households	Calculation Of Sample Size	Sample Size
Milimani	1640	$(1640/29910) \times 384$	21
Kaptembwo	23200	$(23200/29910) \times 384$	298
Free Area	5070	$(5070/29910) \times 384$	65
Total	29910	$(29910/9910) \times 384$	384

Data was collected through predetermined questions based on study objectives in order to obtain the required data concerning the research. Close and open ended questionnaires (Appendix 3) 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 field work. The household questionnaires were administered involving a random start of the first element and thereafter snowball sampling was applied. A sample of this questionnaire is presented in appendix section.

3.4 Validity of instruments

Validity is the accuracy, soundness or effectiveness with which an instrument measures what it is intended to measure. 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). Also pilot testing was done on 20 households from section 58, Rhonda and Naka residential estates within in Nakuru town. The administrative units were not included in the sample size. The respondents were encouraged to make comments and suggestions concerning the instructions, clarity of questions asked and their relevance. From the analysis of the data collected during pilot testing using statistical package for social scientists, the instruments were found to be reliable and hence used in the main research study.

3.5 Reliability

Before primary data collection started, pilot-testing was carried out in section 58, Rhonda and Naka administrative units in Nakuru town, 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 Cronbach's reliability coefficient value of 0.765 which was a good estimate of reliability of the instruments for they were above the minimum threshold recommended. When the reliability estimate is closer to 1.00, the instruments used are good as recommended by Fraenkel & Wallen (1990).

3.6 Data analysis

Both SPSS and Excel spreadsheet software 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 excel spreadsheet. The closed ended responses were appropriately labelled and entered into the statistical package for social science software (SPSS). The data was then presented using bar graphs, and percentages among others.

3.7 Ethical Considerations

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.

Table 5: Summary of data analysis

Research Questions	Variables	Statistical Tools
What are the commonly disposed pharmaceuticals among households in Nakuru County?	Types of pharmaceutical waste <ul style="list-style-type: none"> ➤ Injectables ➤ Suspensions, Syrups and ampoules ➤ Tablets, capsules and granules ➤ Ointments/creams, lotions and suppositories 	Descriptive statistics
What are the current pharmaceutical waste disposal practices among households in Nakuru County?	Practices of pharmaceutical waste disposal <ul style="list-style-type: none"> ➤ Flushing ➤ Dumping ➤ Burning ➤ Storing in the house 	<ul style="list-style-type: none"> • Descriptive statistics
What are the factors that influence pharmaceutical waste disposal among households in the study area?	<ul style="list-style-type: none"> ➤ Factors that influence pharmaceutical waste disposal; Social economic status, income level, distance from medical facility, medical cover ownership, level of awareness and attitudes. 	<ul style="list-style-type: none"> • Descriptive statistics • Chi-square Test of independence
What are the feasible safe disposal strategies that can be used to manage pharmaceutical waste among households in Nakuru town?	The most feasible strategy <ul style="list-style-type: none"> ➤ Mail back programme ➤ Drop off models ➤ Take back programme ➤ Return to pharmacy ➤ Finish dose 	<ul style="list-style-type: none"> • Descriptive statistics

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Socio- demographic information of the study population

Sixty four point eight percent (64.8%) of the respondents in the study area were female. The youngest respondent in the sample was 18 years and the oldest was 69 years. The findings on household size revealed that the average household size in the study was 4, with 25.3% having 5 members (Table 6). Approximately 63% of the respondents indicated that their total family income was between (0 and 20,000) Kenyan shillings per month (Table 6).

Table 6: Distribution of respondents' demographic characteristics in Nakuru town

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.
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	110	28.6
2	90	23.4
3	19	4.9
Total	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% of the respondents had no formal education whereas 43.5% had attained secondary level education (Table 6). These figures are considerably different compared with those contained in the KNBS (2013) report for Nakuru County where 17.3% the population had no formal education, 54.9% had primary education and 27.9% 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 on safe disposal practices of unused pharmaceuticals.

4.2 Commonly disposed pharmaceutical wastes

The results of the commonly disposed pharmaceutical waste are given in Figure 4.

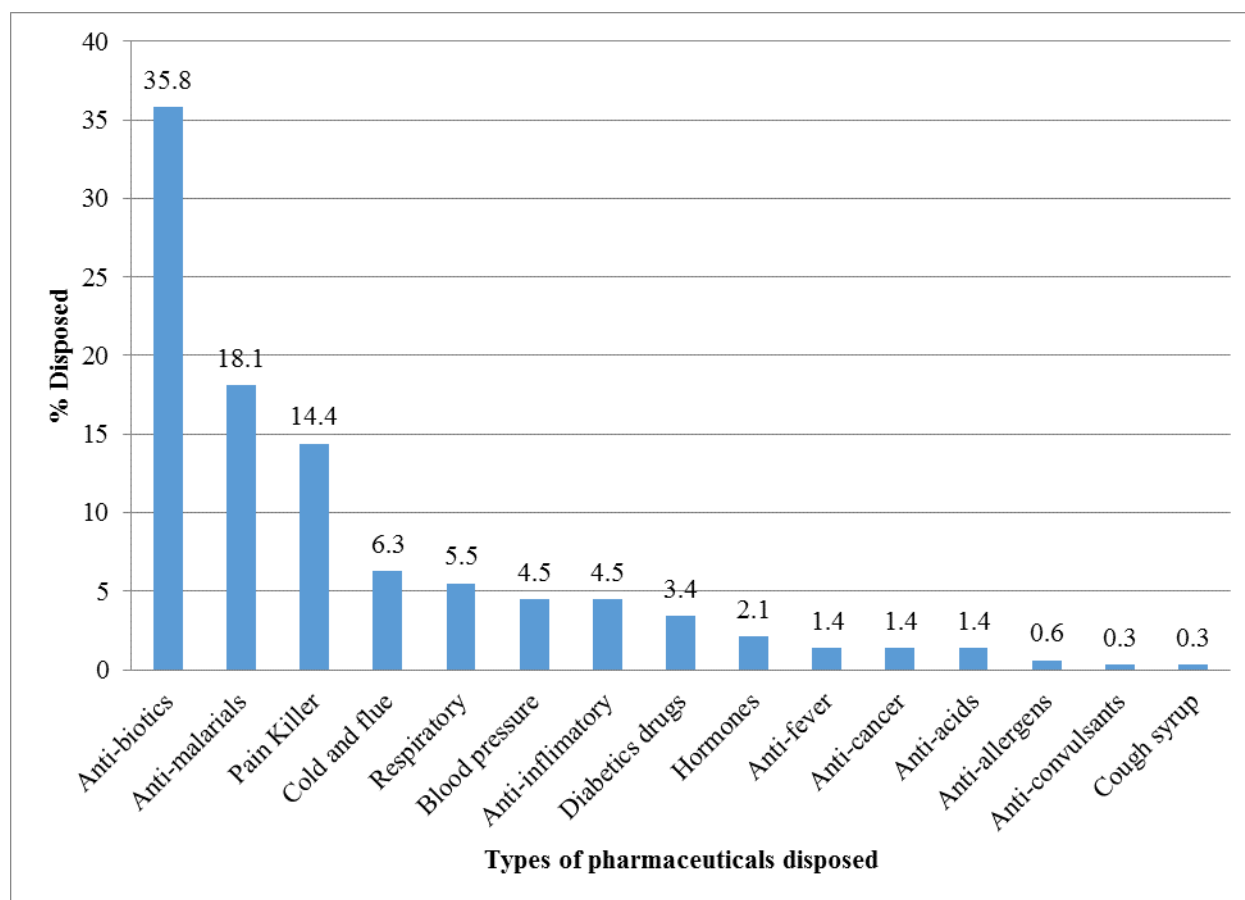


Figure 4: Percentage of the commonly disposed pharmaceuticals

The household survey indicated that approximately 36% of the pharmaceuticals disposed of were anti-biotic. However Atul *et al*, (2016) indicated that the commonly unused medications were pain killers followed by cardiovascular diseases medication. On the other hand pain killers were the commonly stored with 28% followed by anti-malarial with 19.5% and anti-biotic with 18%. Our study findings are similar findings to those of Tasim (2010) in Basrah, Iraq that showed that commonly stored were anti-biotics with 26.43%. However, Arkaravichien (2014) in a study in Thailand indicated that neuromuscular drugs were the most common group of pharmaceuticals stored in the house.

Out of the 384 households in this household survey, 50.26%, 54.69%, 1.04% disposed of syrup, tablets and cream and ointment, respectively. Other studies in Kenya though in pharmacy level have shown similar findings that 59%, 34% and 19.2% of the disposed

pharmaceuticals are in liquid, solid, and semi – solid, respectively (Obonyo & Mutai, 2014).

On the other hand data collected from 20 stakeholders indicated that diabetic drugs were the most dispensed with 14%, followed by antibiotics with 13%. This implies that antibiotics are both the most dispensed and most disposed of kind of pharmaceuticals. Ninety percent (90%) of the stakeholders (which included the pharmacists, medical doctors, clinical officers and nurses) said they encounter patients who report intolerance/side effects to prescribed or self-medicated medicines of which 45% said they changed their prescriptions but the patients remained with the previous medication which becomes unwanted. This implies that antibiotics being highly dispensed and disposed of kind of pharmaceuticals are likely to contaminate our waterways. This can further contribute to development of antibiotics resistance, or killing of essential bacteria which help in water treatment plant (Mekonnen & Fentie, 2014).

Forty seven percent (47%) of the respondents don't know the quantity they disposed as shown in Table 7 below and for those who know majority were not able to estimate the quantity but they admitted it is a lot. Similar studies in the United States which indicated that a lot of medication is disposed as much as 2.8 million pounds per year which is nearly 45% of their medication (Atul *et al*, 2016). From data which was collected from the stakeholders majority 70% accepted that the quantities of the standardised medicine especially for the syrups, creams, ointment and suspensions were more than what the patient could finish as per the dose prescribed, This contributes a lot to the availability of large quantities of pharmaceuticals which end up unwanted hence need to dispose.

Table 7: Quantity of pharmaceuticals disposed

Quantity disposed	N	Percentage disposed
0 – 30 ml	n =15	4%
31 – 60 ml	n =27	7%
61 – 90 ml	n =19	5%
91 – 120 ml	n=12	3%
>121 ml	n=35	9%
Can't estimate but it is a lot	n=88	23%
I don't know	n=92	24%
Not applicable	n=96	25%

Over 80% of the respondents indicated that they did not own any pet and for the few who owned a pet 7.6% owned a dog followed by 5.5% who owned a cat and only 0.8% owned both. The commonly used medicines for pets were anti-biotic and de-wormers of which 3.2% had never bought medicine for their pets. Of those who have ever owned medication for pets, they said that their pets completed their doses.

4.3 Current pharmaceutical waste disposal practices

In this study pharmaceuticals were being disposed using different methods (Table 8). The respondents further gave their perception on who was responsible for proper disposal of unused pharmaceuticals among households as shown in (Table 9). The respondents also responded on whether they had received any information on disposal of unwanted pharmaceuticals among households.

4.3.1 Disposal of medication

The study findings on current pharmaceutical waste disposal practises are shown in Table 8. The study indicated that the most commonly used method of disposal of all forms of medication was flushing in the toilet with 27% for liquid medication, 26.3% for tablets and capsules and 8.59% for ointments and creams (Table 8).

Table 8: Disposal of medication in their various forms

Type of pharmaceutical wastes Disposal Methods	Liquid medication	Tablets and capsules	Ointments and creams	Injectables
Drainage	10%	3.6%	0.52%	0%
Take back to Hospitals	2%	1.8%	1.83%	0%
Burning	0	6.5%	3.13%	0.80%
Flashing in the toilet	27%	26.3%	8.59%	0%
Throwing in the open	7%	1.3%	0.52%	0%
Throwing in the pit latrine	14%	13.3%	7.03%	0%
Storing in the house	1%	1.6%	0%	0%
Burying	2%	1.8%	1.82%	0%
Dumping together with other garbage	20%	19.8%	7.03	0%

Similar findings were found in a study conducted in Tacoma, Washington that revealed that 35% of the respondents flushed pharmaceuticals in toilet or sink. However Arkaravichien (2014), in a study conducted in Thailand found out that trashing them into the rubbish bin was the most commonly practised method of disposal.

Flashing pharmaceuticals in the toilet ends up in water purification systems which are not sufficiently equipped to handle them hence they end up in our drinking water which can further contribute to development of antibiotics resistance, or exposure of populations to irritant or mutagenic anticancer drugs and the possible link between endocrine disrupting compounds and failing fertility of the aquatic life (Mekonnen & Fentie, 2014).

Disposing unwanted pharmaceuticals using methods such as burning, burying, throwing in the pit latrine, dumping together with other garbage are undesirable in the sense that they contribute to environmental pollution to both human and animals, for instance presence of hormones and steroids in water are linked to the reproductive problems and lowers immune response in fish and frogs and they may find their way into our service bodies and drinking water. This is clearly shown in 2002 study in the US geological survey (Simon 2010).

Trashing unwanted pharmaceuticals together with the garbage is non environmental friendly since the active pharmaceutical ingredients could eventually get into the service water and unconsciously get back as drinking water (Arkavichien, 2014). Throwing unwanted pharmaceuticals in the open if pharmaceuticals are insecurely discarded into the open they

may come in the hands of scavengers and be diverted for resale to the general public or may even be accidentally taken by children and pets (WHO, 1999).

Storing unwanted pharmaceuticals in the house is undesirable since it poses several risks related to diversion to the initial use, accidental use and over dose even the possibility of people consuming expired medicine in case of an emergency. Storing unwanted pharmaceutical has contributed because of their availability in homes (Siler & Brown, 2009). Accumulation of unwanted pharmaceuticals also encourages self-medication and misuse of drugs causing a serious threat to the community (WHO, 1999).

4.3.2 Perceptions on disposal of unwanted pharmaceuticals

The respondents gave their perceptions on who was responsible for proper disposal of unwanted pharmaceuticals among households as shown in Table 9. In the study 33.3% of the respondents indicated that it is the government's responsibility to ensure proper disposal of pharmaceuticals among households whereas 27.3% indicated that it was the individual's responsibility.

Table 9: Perceptions on disposal of unwanted pharmaceuticals

Entity responsible	N	Percentages
Government	128	33.3%
Self/individual	105	27.3%
Ministry of Health	49	12.8%
Medical practitioner	37	9.6%
Manufacturer	23	6%
Environment agency	23	6%
Public health officers	18	4.7%
President	1	0.3%

The respondents further gave major reasons for their responses. Reasons given include the institutions indicated as having financial ability with 26.8% followed by they have information on dangers with 18.5% followed by they are responsible for our health 16.4% and 14.6% said we should keep our environment clean as the reason why they think individuals should be responsible. However, Wu *et al.* (2009) indicated that in British Columbia and Canada there exist a very successful take-back programme since 1996 which has been supported 93% by the pharmacies.

The respondent's perception on who is responsible implies that if the government puts up the programmes for managing unused pharmaceuticals and support the individuals especially

financially and train them on dangers of improper disposal of pharmaceuticals then the unwanted pharmaceuticals will be managed among households.

4.4 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.

4.4.1 Knowledge

Knowledge on pharmaceutical waste which included awareness on pharmaceutical wastes and risks associated with storing unwanted pharmaceuticals in the house in the study area is shown on Likert scale on 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 on pharmaceutical waste, knowledge on risks associated with storing unwanted pharmaceuticals in the house.

Table 100: Likert scale on knowledge

Question Knowledge	19. Knowledge on pharmaceutical waste n=384	20. Knowledge on risks of storing unwanted pharmaceuticals in the house n=384
Advanced knowledge	8%	40.31%
Moderate knowledge	12%	25.20%
Low knowledge	21.64%	16.49%
No knowledge	58.36%	18.00%

Approximately 60% of the respondents had no knowledge on pharmaceutical waste. These findings are contrary to a study done in Pakistan which revealed that only 3.8% of the population had no knowledge of what to do with unwanted pharmaceuticals in their homes. (Radhakrishna *et al* 2015). 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 them into the environment and finishing the dose.

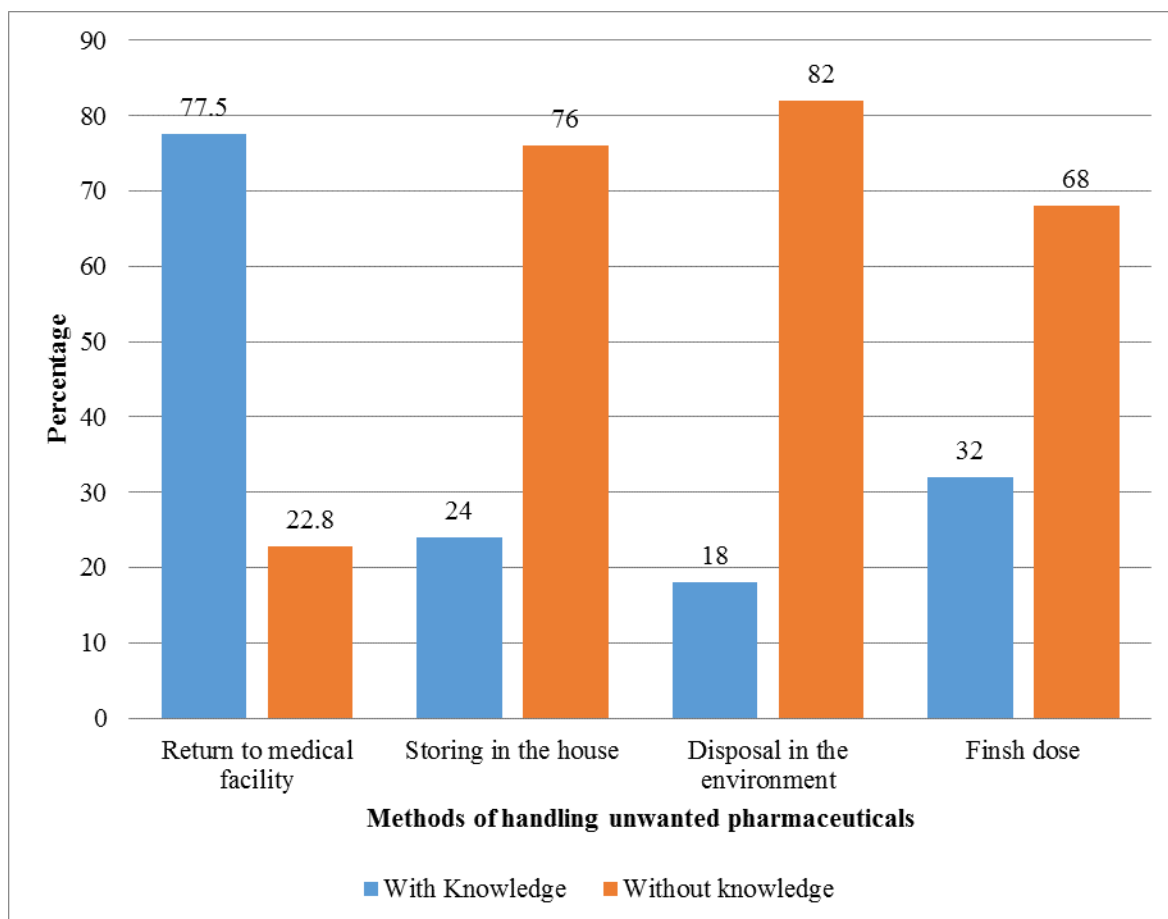


Figure 5: Methods of handling unwanted pharmaceuticals according to knowledge

From the figure above it is indicated that 77.5 % of those with knowledge return their unwanted pharmaceuticals to the medical facilities for disposal, 32% finish their dose, 24% store them in the house and only 18% dispose into the environment. On the other hand the chi-square test of independence shows that there is a statistically significant association between knowledge on pharmaceutical waste handling and return to the medical facility ($p=0.020$). This implies that those with the knowledge will tend to return the unwanted pharmaceuticals since they know the effects of improper disposal of pharmaceuticals. Chi square test of independence also reveals that there was a statistically significant association between the knowledge and storing of unwanted pharmaceuticals ($p=0.049$). Those with the knowledge will 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 unwanted pharmaceuticals into the environment ($P=0.000$). This shows that those with the knowledge tends to dispose less to the environment, this is because they understand the dangers of disposing pharmaceuticals into the environment. The chi -square test of independence also reveals that there is a statistically significant association between the

knowledge and finishing dose ($p=0.015$). This indicates that those with the knowledge will tend not to finish their dose, this might be due to understanding of 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% dispose into the environment, 76% store in the house, 68% finish dose and only 22.8% 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 return to medical facility and very few use unsafe methods such as disposing into the environment. 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 their effects on the environment if poorly disposed then they are likely to be keen on how they dispose them.

For those who had information on unwanted pharmaceutical waste effects if poorly managed they said that the sources of information on pharmaceutical disposal were doctors, television and newspapers constituting 9%, 8% and 3%, respectively. A similar study conducted in Pakistan 51% and 20% of the respondents indicated that they received information on appropriate pharmaceutical disposal from newspapers, physician and pharmaceutical industries, respectively (Radhakrishna et al. 2013).

4.4.2 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 5).

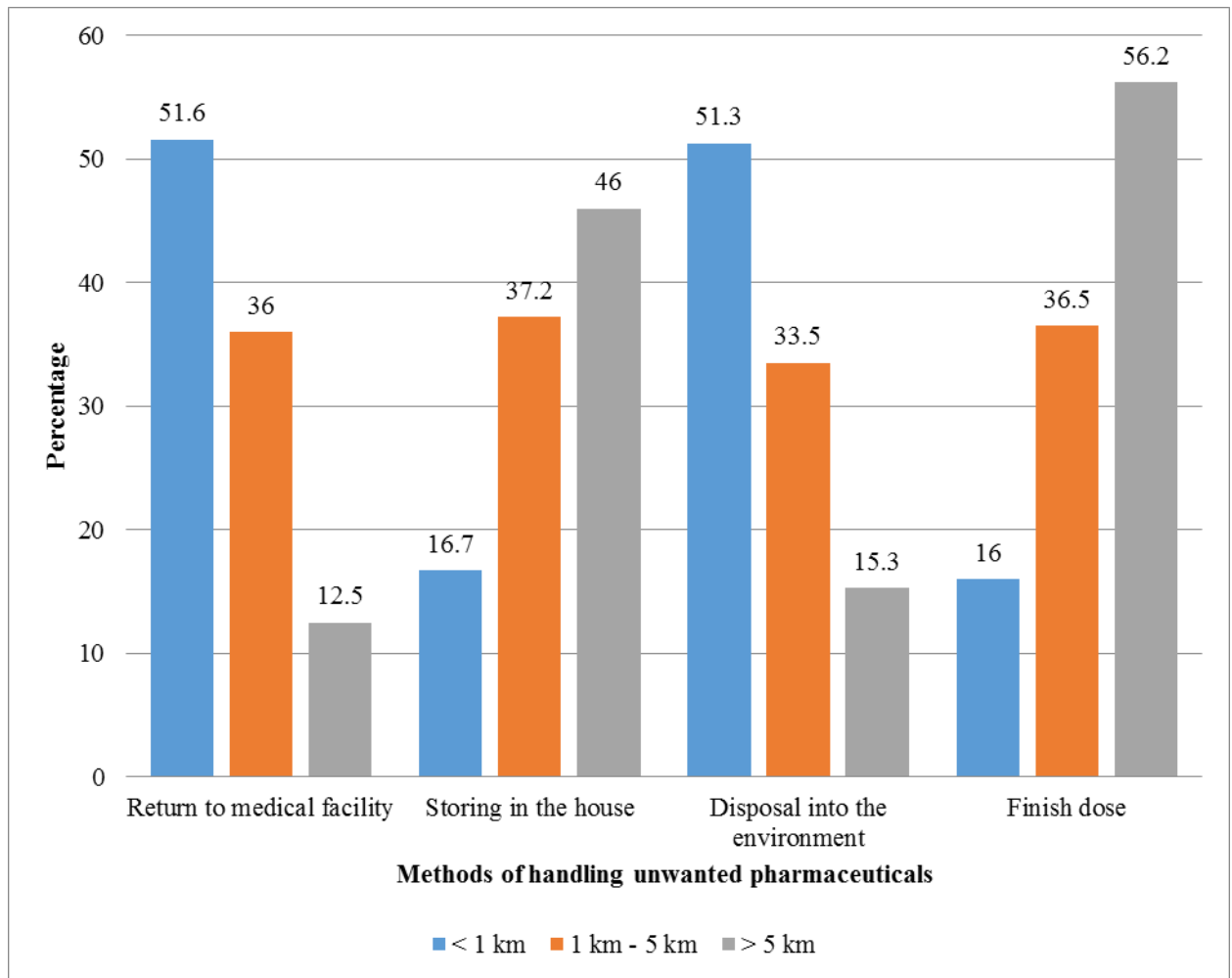


Figure 6: Disposal practices in regard to distance to medical facilities

From the Figure 6, 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%, dispose more into the environment and will rarely finish the dose majorly because they will always go to the medical facility when unwell since it is close. Chi-square test of independence also showed that there was a statistically significant association between distance and return to the medical 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 statistical 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 far more than 5 kilometres to the medical facility will return less, store most of the unwanted pharmaceuticals in case of an emergency since accessing the medical facility will take them time.

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).

4.4.3 Total Income

Figure 7 shows how family income influences disposal practice of unwanted pharmaceuticals.

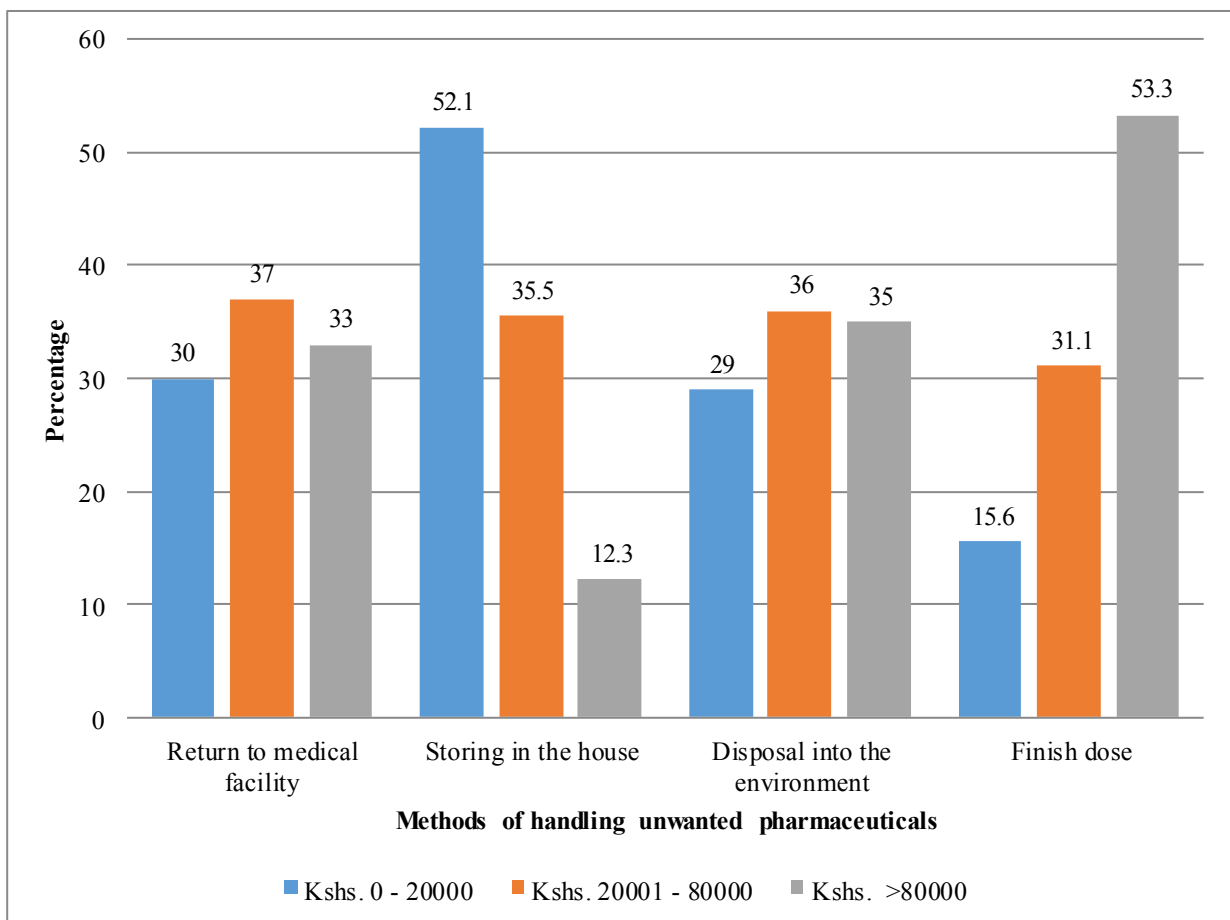


Figure 7: Disposal practices in regard to total family income

The low income earners tend to store more and majority finish their dose as compared to the high income earners as shown in the figure 7 above. Chi-square 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 dose ($p=0.020$), where the high income earners tend to finish dose as compared to low income earners. This might be due to the low income earners will want to keep the remaining dose for future use or for sharing with another member who might fall sick.

The figure 7 above indicates that income does not influence disposal of unwanted pharmaceuticals into the environment since both the high and low income earners use undesirable methods whenever they want to dispose the unwanted medicine. It further indicates that there is no much difference in returning the medication to the medical facility across the socio-economic status.

Majority of the high income earners 70% were aware of risks associated with storing unwanted pharmaceuticals in the house that is why only 5.2% stored. They further indicated the risks in which 53.39% said children poisoning followed by misuse by adults with 10.68%.hence they opt disposing into the environment. This finding agrees with (Wilcox, 2013) that sewer system 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% of young adults misuse prescription drugs (Siler and Brown, 2009).

On the contrary, Radhakrishna (2015) in a study in Pakistan indicated that 80% of the respondents showed their concern that improper disposal of pharmaceutical can affect the environment and health of the public. The implications of being aware of risks of storing unwanted pharmaceuticals in the house contribute to using of other methods to dispose the unwanted medication which may pollute the environment.

4.4.4 Children under 5 years

Figure 8 shows how families with children under five years influence disposal practice of unwanted pharmaceuticals.

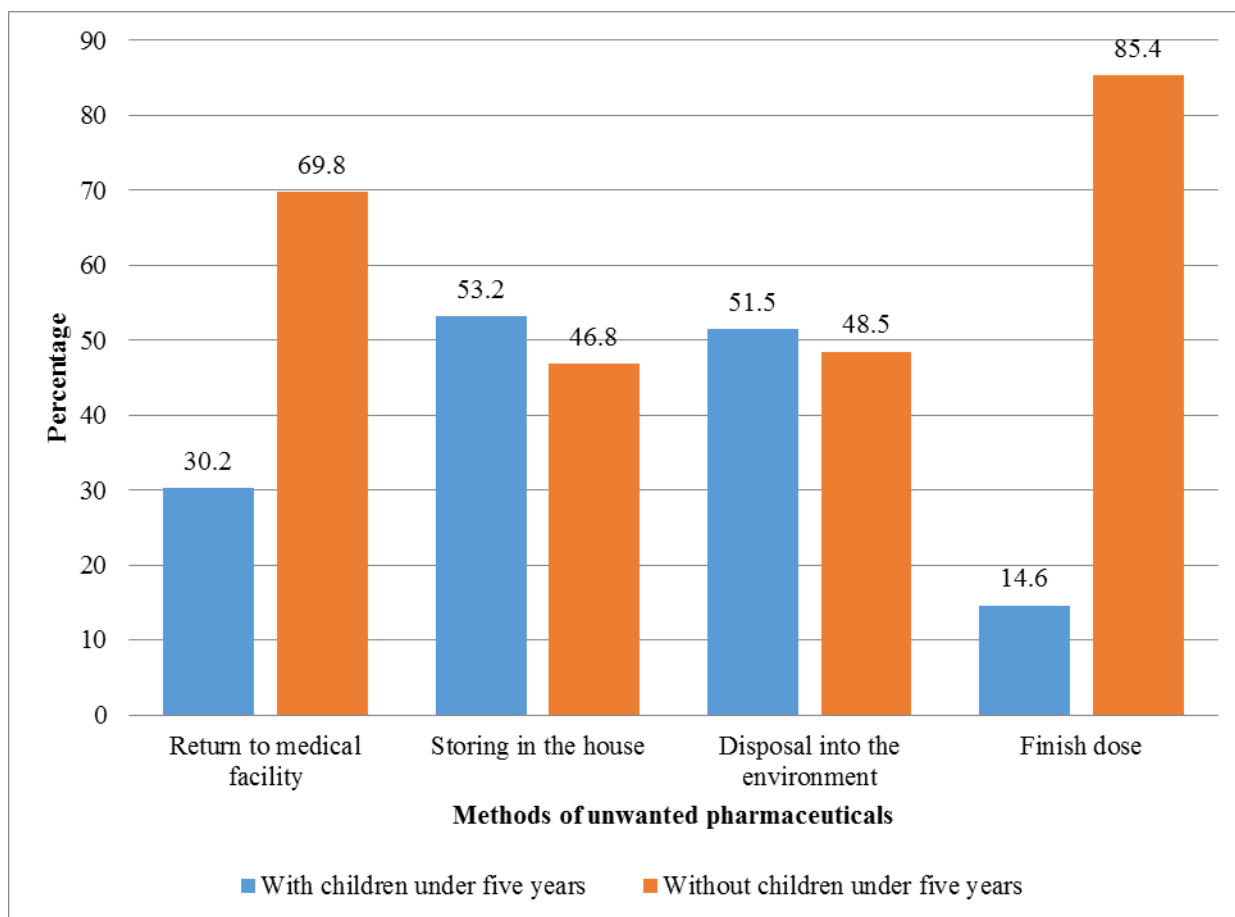


Figure 8: Pharmaceutical disposal practices in families with under five children

From the figure 8 above both groups dispose into the environment and store in the house. The difference comes in returning the unwanted pharmaceuticals to the medical facility and finishing the dose. Those without children tend to return them to medical facility more as compared to those with children under five. Also majority of those without children 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 chi-square test of independence that shows there was statistically significant relationship between children under five and return to medical facility ($p=0.000$). This means that those with children under five returns less as compared to those without children under five. This implies that they return less since children under five get sick more often hence majority keep the unfinished dose for future use hence having less to dispose. There was a statistical relationship between children under five and finishing dose ($p=0.020$). Those without children tend to finish their dose as compared to those with children. This is because most medication for the children especially the syrups quantities are not standardized hence they are in excess.

Approximately 47% of the households with children under five said they dispose pharmaceuticals into the environment mainly because most medications are antibiotics which they are advised by the physicians not to use after the indicated period. Twenty five (25%) and 22% with children under five and without children under five respectively store pharmaceuticals in the house to cater for self-medication in such a condition developed in the future. Those practices have various implications such as: Presence of unused and expired medications in cabinets and cupboards is a potential threat and can be harmful to non-target organisms such as humans and pets. Specifically, the presence of discarded medicines in waterways and drinking water can harm aquatic life. For instance, non-steroidal anti-inflammatory drugs (NSAID) diclofenac has been shown to induce renal failure in vultures following the ingestion of carrion from cattle treated with this drug (Griffith 1990).

4.4.5 Medical cover ownership

Figure 9 illustrates how those with medical cover and those without medical cover handle their unwanted pharmaceuticals.

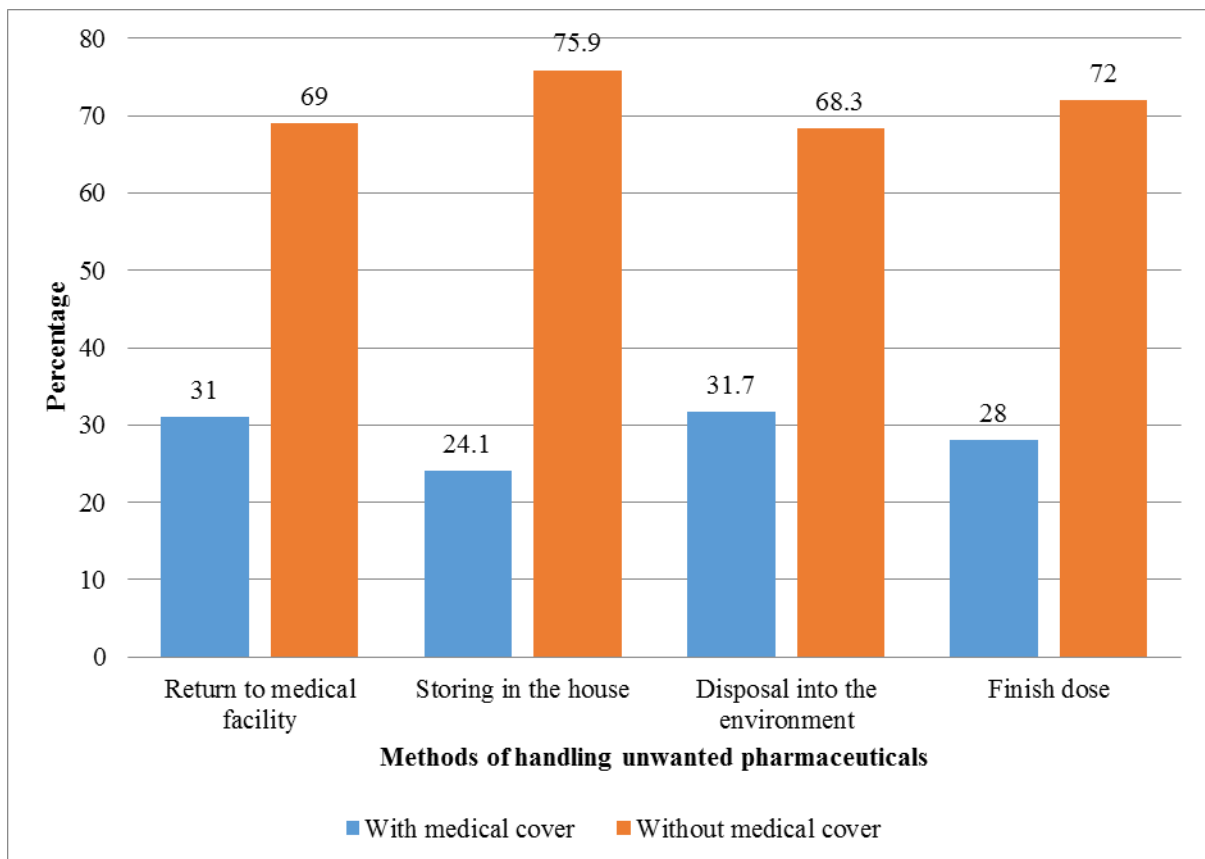


Figure 9: Disposal practice in regard to medical cover ownership

Sixty nine percent (69%) of those without a medical cover return their unwanted pharmaceuticals to the medical facility while only 31% of those with medical cover return them. Seventy five point nine (75.9%) of those without a medical cover store medication in the house as compared to 24.1% of those with a medical cover store in the house. This was also shown in the chi-square test of independence which revealed that there was a statistically significant relationship between medical cover ownership and return to medical facility of the unwanted pharmaceuticals ($p=0.019$). 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 pay. There was also a statistical significant 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 statistical association between medical cover ownership and finishing dose ($p=0.000$). Those with a medical cover don't finish the dose as compared to those without who finish dose. This is because they fear getting sick again of not completing the dose which might force them to buy medication for the reoccurrence of the sickness. There was also a significant association between medical cover ownership and storing of unwanted pharmaceuticals ($p=0.007$). Those with the medical cover tends to store less. The implication of this is 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.

4.5 Perception on Feasible safe disposal strategies that can be used to manage pharmaceutical wastes

The objective entails opinion given by respondents on safe ways that can be used to dispose unwanted pharmaceuticals among households and that can be practical in Kenya, taking into consideration the level of awareness, financial ability and available resources. The methods are already operational in other for example in British Columbia and Canada there existed a successful take back programme since 1996. The opinions are given in figure 10 below.

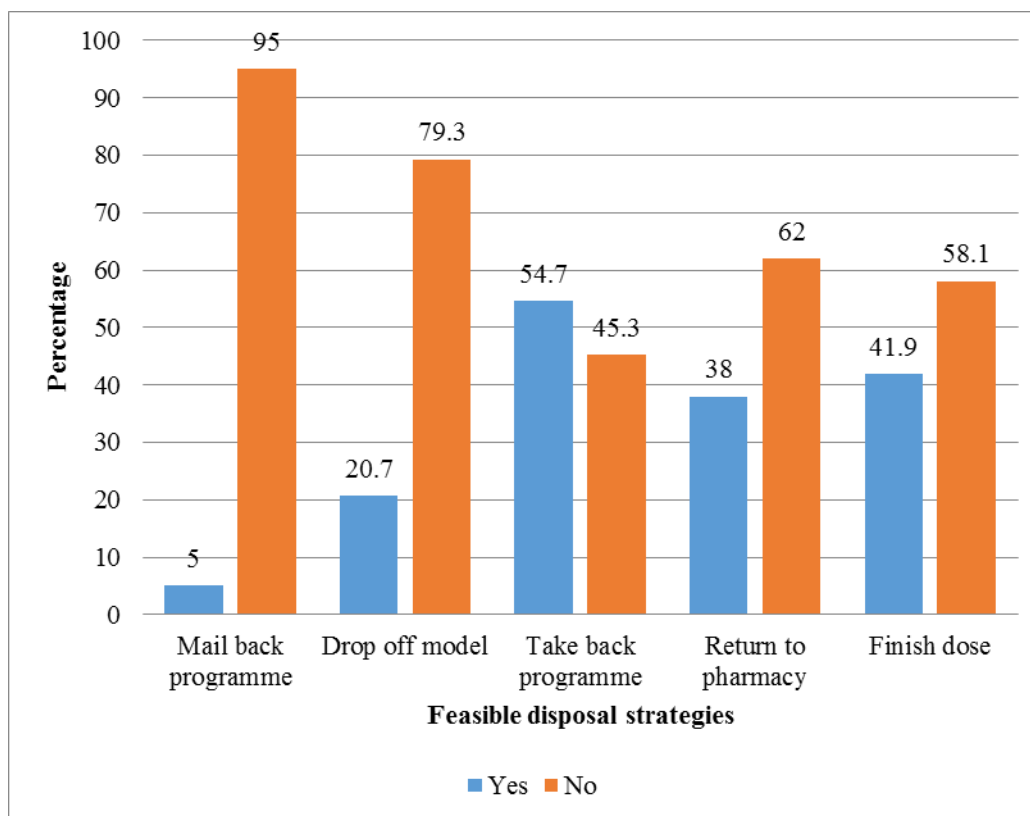


Figure 90: Feasible strategies for disposal of unwanted pharmaceuticals

The mail back programme where the households (consumers) send their unused pharmaceuticals to manufacturers by use of postal services was the least appealing among the respondents terming it as expensive, fear and resale and time consuming. This method is however appealing and operational in many developed countries including the United States (Siler and Brown, 2009).

The drop off models where permanent collection site exists and requires consumers to take their unwanted pharmaceuticals to be later disposed in recommended way. In this study, the majority rejected the method and gave major reason as fear resale of unwanted pharmaceuticals. For those who accepted the method 20.57% said it is easy and accessible in addition to being affordable. These findings are in agreement with those in the National Guidelines for Medical Disposal that indicated that if pharmaceuticals are discarded haphazardly they end up in the hands of scavengers and may be diverted for resale to the general public. (WHO, 1999).

Take back programme involves taking unwanted pharmaceuticals back to the hospital for proper disposal. Majority of the respondents 54.7% said the method is feasible and can work in Kenya. 35.9% gave the major reasons why it can work as it is easy to access and 18.8%

indicating that it is affordable while for those who rejected the method cited distance and time as the main reasons.

Return to pharmacy involves the consumers taking their unwanted pharmaceuticals to nearby pharmacies for proper disposal. Over 35% indicated the fear for resale by the pharmacy as the main reason for their not supporting it. For those who chose the method as the most feasible gave the major reasons being easy and accessible.

Finish dose is where the patient adheres to his medications as prescribed by the physician by completing all the medication. Fifty eight percent (58.1%) of the respondents said that it is not practical to finish the dose always due to some reasons that cannot be avoided such as patient death, intolerable effects and expiration before finishing the dose. These findings are consistent with those of Bain (2010) who indicated that unwanted pharmaceuticals cannot be avoided. Those in support of this disposal method indicated that it is feasible.

On perception of the feasible strategies the take back programme was the most preferred. This is practical since in Kenya the high temperature incineration facilities are available in hospitals so at the hospitals the unwanted pharmaceuticals will be destroyed in safe way. The programme has successfully existed in Canada since 1996 (Wilcox, 2013). Disposal by incineration which are already available in Kenyan government hospitals is acceptable method worldwide since pharmaceuticals are ideally disposed of by high temperature (above 1,200 °C) incineration. On the other hand mail back programme was the most rejected and the method is not practical in Kenya since the manufacturers are far away and the public cannot use their money to send the medication back to the manufacturers for proper disposal though the method is practical in other countries.

The above perceptions on safe disposal of unwanted pharmaceuticals are necessary in the sense that despite the existence of safe disposal methods of unwanted pharmaceuticals among households in developed countries, households still use poor methods (Wilcox, 2013). This implies that the existence of the programmes does not need proper disposal but existence of the methods which the community are comfortable with.

Respondents were further asked on their willingness to pay some money for proper management of unwanted pharmaceuticals among households. Over 65% of the respondents indicated that they were not willing to pay any money for proper disposal. For those who were willing to pay, 22.9% of them accepted to pay any amount to support the system. On the

other hand, 60% of the stakeholders were willing to accept the pharmaceuticals from household and dispose them according to the guidelines for pharmaceutical disposal within their facilities. This is in line with what happens in other countries where stakeholders take responsibility of unwanted pharmaceuticals from household. Lithaunian pharmacies are obliged to collect household pharmaceuticals wastes but Italian pharmacies are involved in voluntary collaborative efforts in their disposal (Siler and Brown, 2009). This implies that individuals can support the programmes of proper disposal if there is no money involved. The willingness of stakeholders to take unwanted pharmaceuticals on households is a positive step in the sense that if the programmes start there is no need of constructing expensive landfills or additional incineration for handling unwanted pharmaceuticals from households.

Disposal of unwanted pharmaceuticals among households being a worldwide challenge, most developed countries have come up with programmes for safe disposal of unwanted pharmaceuticals. This is to respond to reducing the potentially negative effects of flushing drugs or disposing them together with other garbage and storing them in the house to prevent drug abuse and preventing accidental poisoning in homes. Despite availability of such programmes, communities still use unsafe methods (Siler & Brown, 2009).

CHAPTER FIVE

CONCLUSION AND RECOMMENDATIONS

5.1 Summary of the findings

The most commonly disposed pharmaceuticals were anti-biotic followed by anti-malarial. On the other hand they indicated the least disposed as anti-convulsants and cough syrups. The most commonly used method of disposal of unwanted pharmaceuticals was flushing in the toilet while the least practiced were storing in the house and burying. They gave major reasons as avoiding children and pets poisoning.

Most respondents 58.36% had no knowledge on pharmaceutical waste hence they did not know what to do with the unwanted pharmaceuticals in their homes. A large proportion of the respondents therefore used improper methods such as throwing them into the environment or storing them into the house in unfavourable conditions. 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.

Most of the respondents suggested that taking the unwanted pharmaceuticals back to hospital for proper disposal (take back programme) as the most feasible strategy that can be used to manage unwanted pharmaceutical wastes among households in Kenya. However the majority were not willing to pay any extra money per prescription to support the system. On the other hand mail back program was rejected by the majority giving reasons that the method is expensive and that they fear the manufacturers might sell the contaminated medication back to them.

5.2 Conclusions

The most commonly disposed pharmaceuticals were anti-biotic followed by anti-malarial. On the other hand they indicated the least disposed as anti-convulsants and cough syrups.

The current method of disposal mostly used in disposing unwanted pharmaceuticals was flushing in the toilet while the least practiced were storing in the house and burying.

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.

The most feasible strategy of disposing the unwanted pharmaceuticals was taking them back to hospital for proper disposal (take back programme). The method is feasible and if financially supported by the government or any other body it can be sustainable, since the households are not willing to pay any amount to support the programme. On the other hand, mail back program was the most rejected and respondent gave their major reasons being the method is expensive and that they fear the manufacturers might sell the contaminated medication back to them.

5.3 Recommendations

From the conclusions above, the following recommendations were made;

- i. The local authorities need to establish pharmaceutical collection programs to reduce the quantity of unwanted pharmaceuticals entering the environment and reduce the amount of pharmaceuticals available for diversion (abuse by adults) or accidental poisoning by children and pets.
- ii. There is need to establish public awareness, educational programs regarding management and handling of unwanted pharmaceuticals among households, that would highlight effects on human and environment if poorly disposed.
- iii. Since there are no existing documented policies on pharmaceutical wastes management among households in Kenya, there is need by the state government to formulate policies and incorporate with existing policies on pharmaceutical handling in medical facilities.

5.3 Recommendation for further research

The findings of this study would act as a base for more research on pharmaceutical waste management in the study area. This study was not exhaustive and recommends further research on:

- i. The effects of unwanted pharmaceuticals disposal on soil, water and air.
- ii. Assessment of the impacts of unwanted pharmaceuticals disposal on terrestrial and aquatic ecosystems in Kenya.

REFERENCES

- Abay, S. & Amelo, W. (2010). Assesment of self-medication practices among medical, pharmacy, and health science students in Gonder University. Ethiopia. *Young Pharmacists*, 2(3), 306–310.
- Abula, T. & Worku, A. (2001). self medication in three towns of North west Ethiopia. *Ethiopian Journal of Health Development*, 15, 25–30.
- Anderson. C., Chan., Hadly.E.A., & Ramakrishnan.Y.L.(2007). Serial SimCoal: a population genetics model for data from multiple populations and points in time. *Bioinformatics*, 21:1733-1734.
- Arkaravichien, W., Ruchipiyarak, T. & Thawinwan, W.,& Benjawilaikul, S. (2014). Threat to the environment from practice of drug disposal in Thailand. *Environmental Asia*, 7(2), 13–18.
- Atul, K., Shitalkumar, P., Sachin, P., & Anil, T. (2016). Pharmaceutical Waste Management An Overview. *Indian Journal of Pharmacy Practice*, 3.
- Bain, K. (2010a). Public Health Implications of Household Pharmaceutical Waste in the United States. *Health Services Insights*, 21. <http://doi.org/10.4137/HSI.S4673>
- Bain, K. (2010b). Understanding the Public Health Implications of Household Pharmaceutical Waste in US-part two. *Medical Waste Management*, 5.
- Beckel, C., Garceau, C. & Miggels, A. (2011). *Pharmaceuticals in Water*. Worcester Polytechnic Institute. Retrived from <https://www.wpi.edu/pubs/E-project/Available/E-project-030811-213657/unrestricted/pharmaceuticals-in-water.pdf>
- Cormican, S., Furey, M., Vellinga, A. & Cormican M.(2010). *Public Awareness Regarding Safe Disposal of Unwanted Medicine in Galway city*. Retrieved from http://www.nuigalway.ie/health_from_environment/downloads/disposal_unwanted_medicines_study_2011.pdf
- Daughton, C. (2003). Cradle-to-Cradle Stewardship of Drugs for Minimizing Their Environmental Disposition While Promoting Human Health . *Environmental Health Perspectives*, 111(5), 775–785. Retrieved from www.ncbi.nlm.nih.gov/pmc/articles/PMC11241487/
- Dharmender, G., Anari, N., Ahmed, Q. & Ashutosh, G. (2013). patients opinion and practice toward unused medication disposal. *Pharmaceuticals and Scientific Innovation*, 2(5), 47–50. <http://doi.org/10.7897/2277-4572.02574>. Retrieved from www.jpsonline.com/admin/php/uploads/261-pdf.pdf
- EPA, United States. (2010). *Draft Guidance Document : Best Management Practices for Unused Pharmaceuticals at Health Care Facilities*. Retrieved from <http://water.epa.gov/scitech/wastetech/guide/upload/unuseddraft.pdf>

- Fraenkel, R. & Wallen, E. (1990). *How to design and evaluate research in education*. New York, NY: McGraw Hill Publishing Co.
- Glassmeyer, S., Hinchey, E., Boehme, S., Doughton, C., Ruhoy, I., Conerly, O., *et al.* (2008) *Disposal practices for unwanted residential medications in the United States. Environmental International*, 35(2009), 56-572. Retrieved from http://researchgate.net/publication/222422034-Disposal-practices_for_unwanted-residential-medications-in-the-United-States-Environ-Int.
- Government of Kenya. (1999). *Environmental Management and Coordination Act (1999)*. Government printer; Nairobi, Kenya. Retrieved from kenyalaw.org/kl/fileadmin/pdfdownloads/AmendmentActs/2015/EnvironmentlManagementCo-ordination-Amendment-Act-2015No5of2015-pdf
- Government of Kenya. (2009). *Population Census*. Nairobi: Kenya National Bureau of Statistics
- Government of Kenya. (2012). *Public Health Act*. National Council for Law Reporting. Retrieved from www.kenyalaw.org
- Government of Kenya. (2002). Water Act Law of Kenya. *Kenya Gazette Supplements*, 107(act no 9). Retrieved from <http://www.water.go.ke/downloads/wateract2002.pdf>
- Government of Kenya. (2010). *Constitution of Kenya (Revised ED)*. National Council for Law Reporting. Retrieved from <https://www.kenyaembassy.com/pdfs/The%20Constitution%20of%20Kenya.pdf>
- Government of Kenya. (2012). *Food , Drugs and Chemical Substances Act 254* (Revised ed). National Council for Law Reporting. Retrieved from www.kenya.org
- Gray R, Hogerzeil H, Prüs A, Rushbrook P. 1999. Guidelines for Safe Disposal of Unwanted Pharmaceuticals in and after Emergencies. World Health Organization, (1930154), 19. Retrieved from http://www.who.int/water_sanitation_health/medicalwaste/unwantpharm.pdf
- Griffith, S. (1990). A review of the factors associated with patient compliance and the taking of prescribed medicines. *Br J Gen Pract*, 40(332), 114-116.
- Hoboy, S. (2011). *pharmaceutical waste update on handling and disposal*. Retrieved from http://www.astswmo.org/Files/Meetings/2010/2010hazardouswaste/Seline_Hoboy-Pharmaceuticles.pdf
- Holloway, K. (2011). Combating inappropriate use of medicines. *Expert Review of Clinical Pharmacology*, 4(3), 335–348. <http://doi.org/10.1586/ecp.11-14>
- Jasim, M. (2010). In-home Drug Storage and Self-medication with Antimicrobial Drugs in Basrah, Iraq. *Oman Medical Journal*, 25(2), 79–871. <http://doi.org/10.5001/omj2010.25>

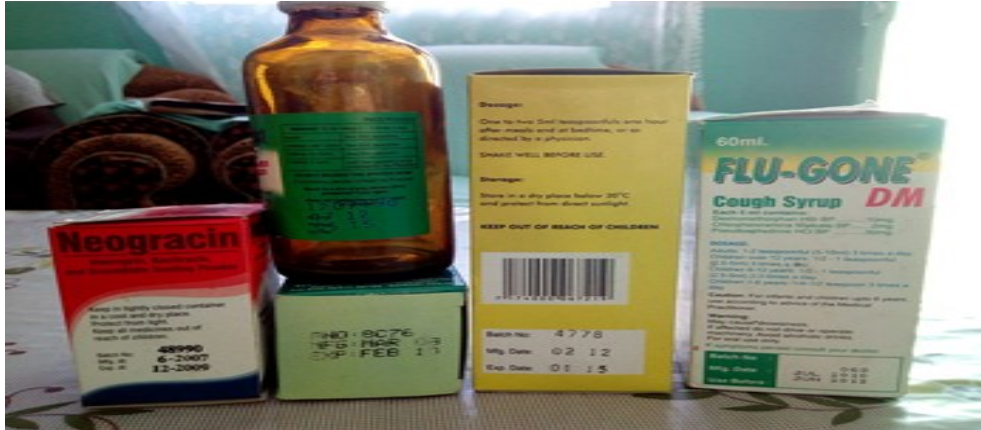
- Kahenda, M., & Wagem, A. (2016, April 26th Tuesday). Retrieved from <https://www.stahardmedia.co.ke/health/article/200199602/six-private-Kenyan-hospitals-on-spot-over-medical-waste-disposal>.
- Kathuri, N. & Pals, D. (1993). *Introduction to Education Research*. Njoro: Education Media Centre, Egerton University, Kenya
- Kheir, N., El Hajj, M. S., Wilbur, K., Kaissi, R. M. L., & Yousif, A. (2011). An exploratory study on medications in Qatar homes. *Drug Healthc Patient Saf*, 3, 99-106.
- Kheir N., El H., Wilber K., Kaissi R. & Yousif A. (2011). An exploratory study on medications in Qatar homes. *Drugs, Health and patient Safety* 3: 99-106
- Kiyangi K. & Lauwo J. (1993). Drugs in the home: danger and waste. *World Health Forum* 14: 381-384
- Kumar, R. (2005). *Research methodology: A step-by-step guide for beginners* Frenchs Forest: Pearson Education.
- Lagishetty, R., Nagarajan, P., & Ponniah, T. *World Journal of Pharmaceutical Sciences*. Siler, S., and Brown R. (2009). Safe Disposal of Unused Controlled Substances. *King Pharmaceuticals*. Retrieved from <http://www.ncdoi.com/OSFM/safekids/Documents/OMD/SafeDisposalOfUnusedControlledSubstancesReport.pdf>
- Law, A. V., Sakharkar, P., Zargarzadeh, A., Tai, B. W. B., Hess, K., Hata, M., ... & Park, T. J. (2015). Taking stock of medication wastage: unused medications in US households. *Research in Social and Administrative Pharmacy*, 11(4), 571-578.
- Mamady, K. (2016). Factors Influencing Attitude, Safety Behavior, and Knowledge regarding Household Waste Management in Guinea: A Cross-Sectional Study. *Journal of environmental and public health*, 2016.
- Mekonnen, T., & Fentie, M. (2014). Unused Medications Disposal Practice : The case of Patients Visiting University of Gondar Ethiopia. *International Journal of Pharma Sciences and Research*, 5(12), 999–1005. Retrieved from www.ijpsi.info/docs/IJPSR1405-12-039-pdf
- Mwangi, S. W. (2000). Partnerships in urban environmental management: an approach to solving environmental problems in Nakuru, Kenya. *Environment and Urbanization*, 12(2), 77-92.
- NEMA. (2006a). *The Environment Management and Co-ordination (Water Quality) Regulations*, 4–8. Retrieved from <http://kenyalaw.org>
- NEMA. (2006b). Waste Management Regulations. *Kenya Gazette Supplements*, 69(37), 4–6. Retrieved from http://www.unep.org/urban_environment/PDFs/ISWM2_WasteManagementRegulations.pdf

- NEMA. (2008). *Air Quality Regulation*. Retrieved from https://www.environment.gov.za/sites/default/files/legislations/nemaqa_pollutionpreventionplans_g37421gn171.pdf
- Njonjo, S. (2013). Exploring Kenya's Inequality: Pulling Apart of Pooling Together. *Abrided Report*
- Nursing theories, (2013). *Health Belief Model*. Retrieved from http://currentnursing.com/nursing_theory/health_belief_model.html
- Obonyo, E. & Mutai, C. (2014). Assessment of pharmaceutical waste management practice in Embakasi Division, Kenya: a case study in community pharmacies. *African Health Sciences*, 27(1), 81.
- Radhakrishna, R. (2007). Tips for developing and testings questionnaire/instruments. *Journal of Extension*, 45(1):
- Ruhoy, S. & Daughton, G. (2007). Types and quantities of leftover drugs entering the environment via disposal to sewage—revealed by coroner records. *Science of the total environment*, 388(1), 137-148.
- Siler, S., & Brown R. (2009). Safe Disposal of Unused Controlled Substances. King Pharmaceuticals. Retrieved from <http://www.ncdoi.com/OSFM/safekidedSubstancesReport.pdf>
- Simons, T. (2010). Drug Take-back Programs: Safe Disposal of Unused, Expired, or Unwanted Medications in North Carolina. *Coastal Coalition for Substance Abuse Prevention*. Retrieved from <http://www.ncdoi.com/OSFM/Safekids/Documents/OMCWhitePaper.pdf>
- Temu, M., Kaale E. & Marawiti, M. (2006). Storage of antimalarials at household level and associated factors in Kiromo ward, Bagamoyo Tanzania. *African Health Sciences*, 6(1): 43-48. Retrieved from <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC183>
- Wasserfallen, B., Bourgeois, R., Büla, C., Yersin, B., & Buclin, T. (2003). Composition and cost of drugs stored at home by elderly patients. *Annals of Pharmacotherapy*, 37(5), 731-737.
- WHO. (1999). *Guidelines for Safe Disposal of Unwanted Pharmaceuticals in and after Emergencies Interagency guidelines*. World Health Organization: Geneva. Switzerland.
- WHO. (2003). *Adherence to Long-term Therapies: Evidence for Action*, World Health Organization, Geneva Switzerland.
- Wilcox, E. (2013). *Pharmaceuticals in the Environment: review of current disposal practices for medications and the public perception on environment risks*, 23-25. Retrived from <http://repository.lib.ncsu.edu/dr/bitstream/1840.4/8271/1/wilcox,+Elizabeth+ final.pdf>.

Wu, M., Atchley, D., Greer, L., Janssen, S., Rosenberg, D. & Sass, J. (2009). *Dosed Without Prescription Preventing Pharmaceuticals Contamination of our Nation,s Drinking water*.white paper. Retrieved from http://docs.nrdc.org/health/files/hea_10012001a.pdf

APPENDICES

Appendix 1: Some of the pharmaceuticals found in one of the households at the time of the visit



Appendix 2:

Research Permit

COUNTY GOVERNMENT OF NAKURU Health Department



County Public Health Office
P. O BOX 2870 -20100
NAKURU

Our Ref: CGN/PH/GC/20/5/2016

DATE: 20th May, 2016

The Sub County Public Health Officers
Nakuru County

Dear Sir,

RE: RESEARCH AUTHORISATION – CLARE NYABOKE ORINA

The above scholar is desirous of carrying out a research on “Assessment of disposal practices of pharmaceutical waste among households within Nakuru Town” in Nakuru County.

Her study requires close working relationship with members of the community by collecting data from the households.

Accord her the necessary assistance may she choose to come to your sub county for the study.


COUNTY PUBLIC HEALTH
OFFICER
NAKURU

MOSES OBIERO
FOR/COUNTY PUBLIC HEALTH OFFICER
NAKURU COUNTY

Appendix 3:

QUESTIONNAIRE FOR HOUSEHOLDS

Hallo, my name is Clare Nyaboke Orina; I am a student from Egerton University. I am conducting this study as a partial fulfilment for the A ward of Master Degree of Science in Environmental and Occupational Health. This questionnaire was drafted in assessing the disposal practices of pharmaceutical waste among households in Nakuru town, Nakuru County. Please answer all questions with honest. The information you will give is purely academic and it will be treated with a lot of confidentiality. I am kindly requesting you to participate in this study by responding to the following questions

Date..... Code No.....

Data collector's name/initials.....

SECTION 1: DEMOGRAPHIC DATA

Age of respondent (years):

Gender of the respondent: Male Female

Education level: None Primary Secondary Tertiary

Total Income:

Including yourself, how many people living in your household?

Number of children under 5 living in the respondent's households:

Do you own a pet in your household?

Yes No

If yes which ones.....

Area of residence of the respondent: Milimani Free Area Kaptembwo

SECTION 2: SOURCES OF PHARMACEUTICAL WASTE

A: Pharmaceuticals for Human

1. Do you have any medicines in the house that you/family member are not using?

Yes No

2. Do you have any medicines in the house that were prescribed by a doctor or were bought over the counter?

Yes No

3. If yes to question 2 indicate in the table below the form and category of that medicine

Prescribed	Over the counter	How long have you kept the medication?
Tablets 1. 2. 3.		
Syrups 1. 2. 3.		
Injectables 1. 2. 3.		
Creams and ointments 1. 2. 3.		

4. If yes to any of question 2 above, why do you keep unused medication?

- Do not want to waste them
- I don't keep them, i dispose of them
- For future use
- Not sure how to dispose them
- To give them away
- To keep a stockpile in case of shortages
- Others (specify)

5. How many different prescription/over the counter medications do you currently have?

– Kindly produce them to be counted.

Prescribed

Over the counter

6. When can you say your medication is expired?

- After the labelled date of expiration
- A week after opening
- Six months after opening
- Medicine does not expire
- Date indicated by the doctor
- Don't know
- Any other (specify)

7. Do you have any expired medicines stored in your home?

- Yes No don't know

If yes

Which ones	For how long	Reasons

B: Pharmaceuticals for pets

8. Do you have any medicines in the house that your pets are not using?

- Yes No

9. Do you have any medicines in the house that were prescribed by a veterinary or were bought over the counter?

- Yes No

10. If yes to question 2 indicate in the table below the form and category of that medicine

Prescribed	Over the counter	How long have you kept the medication?
Tablets		
1.		
2.		
3.		
Syrups		
1.		
2.		

3.		
Injectables 1. 2. 3.		
Creams, powder and ointments 1. 2. 3.		

11. If yes to any of question 2 above, why do you keep unused medication?

- Do not want to waste them
- I don't keep them, i dispose them off
- For future use
- Not sure how to dispose them
- To give them away
- To keep a stockpile in case of shortages
- Others (specify)

12. How many different prescription/over the counter medications do you currently have?

– Kindly produce them to be counted.

Prescribed

Over the counter

13. When can you say the pet's medication is expired?

- After the labelled date of expiration
- A week after opening
- Six months after opening
- Medicine does not expire
- Date indicated by the doctor
- Don't know
- Any other (specify)

14. Do you have any expired medicines stored in your home?

- Yes No don't know

If yes

Which ones	For how long	Reasons

SECTION 3: CURRENT METHODS OF DISPOSAL

15. In the table below list how you dispose of your unused medicine?

Liquid medication	Tablets/capsules	Ointment/cream	Injectables	Others (specify)

--	--	--	--	--

To be filled by the researcher

Where does the respondent dispose to?

Returns to medical facility

Finish dose

Store in the house

Into the environment

SECTION 4: THE COMMONLY DISPOSED PHARMACEUTICALS

16. In the table below list medication that you / member of your family or your pet may have within the last six months stored in your house or disposed of

Stored	Disposed of

17. How often do you dispose your unwanted pharmaceuticals?

18. In average in the table below indicate how much you dispose in a month

Form of pharmaceutical	Average amount disposed in a month
Syrups	
Injectibles	

Tablets/capsules	
Creams and ointments	
Others (specify)	

SECTION 5: FACTORS THAT INFLUENCE PHARMACEUTICAL WASTE DISPOSAL AMONG HOUSEHOLDS.

19. a) Do you know about pharmaceutical waste

Yes No

b) If yes what is pharmaceutical waste?

Advanced knowledge

Moderate knowledge

Low knowledge

No knowledge

20. Are you aware of any risks associated with storing unwanted pharmaceuticals in the house?

Yes No

21. If yes to question 20 list in the table below the risks

Risk	Type

Advanced knowledge

Moderate knowledge

Low knowledge

No knowledge

22. How do you think pharmaceuticals should be disposed of among household?

23. In your opinion list the best ways to properly dispose of unwanted pharmaceuticals

24. In your opinion list ways in which you think pharmaceuticals should not be disposed and reason why

Method of disposal	Reasons

25. Have you and your family ever received any information about safe way of disposing of unwanted pharmaceutical?

Yes

No

26. Have you ever received any information about how to dispose of unwanted pharmaceuticals?

- Yes
- No
- Don't know
- Refused

27. If yes in question above where did you receive the information or who provided you with the information? -----

28. Have you ever used a medication that a doctor prescribed for someone else?

- Used
- Never used
- Don't know
- Refused

29. Have you ever given anyone else your prescription or your pet medication to use?

- Yes
- No
- Don't know
- Refused

30. If yes to either question 23 or 24 or both above why?

- Lack of money to buy your dose
- Medical facility is far
- Was an emergency
- Had more than I needed

31. Do you own a medical cover?

- Yes

No

Don't know

Refused

32. If yes to question 25 above, is prescription drug coverage included as part of your medical insurance?

Yes

No

Don't know

Refused

33. How far do you get your medication from?

Less than 1km

(1-5) km

More than 5km

Don't know

Refused

Others (specify)

SECTION 6: FEASIBLE SAFE DISPOSAL STRATEGIES THAT CAN BE USED TO MANAGE PHARMACEUTICAL WASTE AMONG HOUSEHOLDS.

29. In the table below (tick) feasible strategies that can be used in Kenya to safely dispose off unwanted pharmaceuticals among households

Feasible strategies	Yes	No	Give reasons
Mail back programmes			
Drop off models			
Take back programmes			
Return to pharmacy			
Others (specify)			

34. If there was a convenient location where you could drop off unwanted pharmaceuticals for disposal, how willing would you be to use this method to get rid of such medication?

- Very willing
- Somewhat willing
- Neither willing nor unwilling
- Not sure
- Don't know

35. If unwilling, list why you say that you are unwilling?

36. If collection locations were available, please tell me whether you would be likely to take your unwanted medication to that location for proper disposal. Would you take them?

Yes No Don't know

37. If yes to question 31 above list places where you would like to take your unwanted medication for proper disposal?

38. If no to question 31 above give reasons why you might not want to take your unwanted pharmaceuticals to a collection facility for proper disposal.

39. Will you be willing to pay any money to support a safe system to collect and to properly dispose of unwanted pharmaceuticals?

Yes No

40. If yes to question 31 above, how much extra money per prescription would you be willing to pay if that money would be used to support a safe system to collect and properly dispose of unwanted pharmaceuticals?

Less than 100 Kenyan shillings

Any amount required

Don't know

41. In the table below, list whose responsibility you think it should be to provide a safe way for people to dispose of unwanted medication and in what way?

Stakeholders responsible	In what way are they responsible

Appendix 4: TABLE FOR CHARACTERIZATION OF PHARMACEUTICALS

Name of pharmaceutical	Source/ prescribed or over the counter	Type e.g syrup, tablets	Active Ingredient(s)	Classification e.g. Antibiotic

Appendix 5: QUESTIONNAIRE FOR KEY STAKEHOLDERS

Date.....

Code No.....

Data collector's name/initials.....

SECTION 1: DEMOGRAPHIC DATA

Qualification:

Gender of respondent?

Male

Female

How long have you been practising as a medical practitioner?

Location of your work place

Milimani

Free Area

Kaptembwa

SECTION 2

1. Do you see patients on chronic treatment?

Yes

No

2. Do you see patients who come before their scheduled appointments?

Yes

No

3. If yes to question 2 above, do you confirm their remaining medicine before refilling the prescription?

Yes

No

4. If yes to question 3 above, is medicine refilled based on the remaining quantity available?

Yes

No

5. a Do you encounter patients who self-medicate?

Yes

No

b. If yes to a above, what are the common medicine that patients ask for?

Antibiotics

Blood pressure medication

Cholesterol lowering medication

Hormone replacements

Oral contraceptives

Prescription pain medications

Anti-seizure medications

Over the counter pain medication

Cold cough or flu medications

Antacids

Vitamins

Any other medication (specify)

c. Have you encountered patients who report intolerance/side effects to previously prescribed/self-medicated medicines?

Yes

No

d. If yes to c above, what action did you take with the intolerable medicine?

Nothing

Withdrawn

Took them back to the clinic/hospital/pharmacy

Advised the patient on how to dispose them

6. What is your opinion on quantities of standardized medicine packs e.g for (syrups, creams, ointments and suspensions)

Are sufficient

Excess

Insufficient

Not sure

7. Have you come across pharmaceutical waste/unused/leftover medicines from households

Yes

No

8. Do you think pharmaceutical waste should be disposed of differently from other household waste?

Yes

No

Not sure

9. In your opinion, what is the best way to safely dispose of pharmaceutical waste among households?

In the toilet

- Keep for future use
- In the rubbish
- Give it away
- Take it back to pharmacy
- In the sink
- Don't know
- Others specify

10. Will you be willing to provide a location where the public can drop off their unwanted pharmaceuticals for disposal?

- Very willing
- Somewhat willing
- Neither willing nor unwilling
- Not sure
- Don't know

11. If unwilling, why do you say that you are unwilling?

- Time wasting
- Financially costly
- May be accused of resale
- (Others) specify
- Don't know
- Don't have storage for that waste
- Lack of personnel to handle that

12. List the best practices strategies that can be used in managing pharmaceuticals among households in Kenya?

13. Do you think Kenya needs a national medicines disposal scheme accessible to all households across the country?

Yes

No

14. If yes to question 12, who should fund a country run medicine disposal and destruction system and why?

Patients

County government

Community pharmacies

Pharmaceutical companies

Others (specify)

Reason.....
.....
.....

15. If No to question 12 above, why

Reason.....
.....
.....

Appendix 6: Likert Scale

Knowledge

(Ranked from 4 to 1 according to the number of questions the respondent is able to answer correctly)

1. Knowledge on pharmaceutical waste

(Ranked from 4 to 1 according to the kind of answer given by the respondent. if the respondent is able to give correct definition of pharmaceutical waste as; all type of drugs, which are no long in use for the initial intended purpose, unsealed and those not stored in the recommended conditions. if she/he 3 it is advanced, 2 it is moderate and if 1 has low knowledge and if none then he/she has no knowledge)

- a. Do you know about pharmaceutical waste?
- b. If yes, what is pharmaceutical waste?

2. Knowledge on risks associated with storing unwanted pharmaceuticals in the house

- a. Are you aware of any risks associated with storing unwanted pharmaceuticals in the house? If Yes, list those risks

(it is ranked on from 4 to 1, if she/he mentions 4 risks then it is advanced knowledge,3 she/he has moderate knowledge,1- 2 low knowledge and if she does not list any safe way then it is no knowledge.