

## Commonly disposed pharmaceuticals and current disposal practices of pharmaceutical wastes among households in Nakuru town, Nakuru County Kenya

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**Abstract:** *Pharmaceuticals have immense effects on non-target organisms both humans and aquatic life when they get exposed. Such as medicine resistance, increases in morbidity and mortality of the population due to unintentional poisoning. The non-target organisms get exposed when they are improperly disposed ending up in garbage collection centres and water purification systems which are not sufficiently equipped to manage the waste in Kenya. Pharmaceutical wastes occur when pharmaceuticals are no longer usable for intended purpose or are being discarded for other reasons such as contamination and expiration. There is growing public concern over presence of active pharmaceutical ingredients in water and the environment. This pharmaceutical waste includes antimicrobials which interfere with water treatment process since most depend on biodegradation. The study aimed at assessing the commonly disposed and current disposal practices of pharmaceutical waste among households. This was achieved through conducting a social survey. Data was processed and analysed using descriptive statistics. In a sample size of 384, antibiotics had 35.8% and pain killers with 14.4%. The most commonly used method of disposal was flushing in the toilet with 27.3% liquid dosage, 26.3% tablets and capsules and 8.59% creams and ointments. The study findings can be used by policy makers and relevant authorities to take appropriate measures on management of unwanted pharmaceuticals among households. The study provides database and baseline data for researchers interested in related studies.*

**Keywords:** *Pharmaceuticals, Disposal practices, commonly disposed and House-holds*

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### I. Introduction

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 [1].

The term waste according to Environmental Management and Co-ordination Act 1999 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' [2]. This waste can be hazardous waste, non-hazardous waste or controlled substance [3]. 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 [4]. 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 [5].

Unwanted pharmaceuticals are managed in a variety of ways, others keep them at home, others dump them in the trash, others rinse them in the sink, others flush them down the toilet and others take them back to the pharmacy for proper disposal [5]. 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 labeled in foreign language or may have been given in unwanted large quantities ending up as waste [4].

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 [6].

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 [7].

Recently researchers have found pharmaceuticals such as antibiotics, hormones and controlled substances almost everywhere they have conducted research on. There is enough evidence that pharmaceuticals harm aquatic life though there is no enough evidence on exact harm to humans. This raises a question on whether the nation should wait for scientists to come up with a stronger link between pharmaceutical waste and harmful effects on humans [1]. 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.

In study carried out in Kenya to assess pharmaceutical waste management practices in community pharmacies in Embakasi Division showed that even at the pharmacy level the waste generated is 36.2% solid followed by 24.6% liquid, 20% semisolid waste and powder waste with 19.2% [8]. There is inadequate data on current household pharmaceutical waste management and the extent of the problem. It is probable that 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 [9].

The methods of disposal of unwanted pharmaceuticals determine their presence in the environment and their potential to contaminate water. Households contribute a lot to this concern when they dispose the unwanted pharmaceuticals through sink, toilet or in a trash. All of these methods are undesirable. Globally the methods currently used are evident in various studies which have been conducted worldwide [6].

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, take back programme since 1996 which has been supported 93% by the pharmacies [7]. Lithuanian pharmacies are obliged to collect household medical waste, but Italian pharmacies collaborate voluntarily [10].

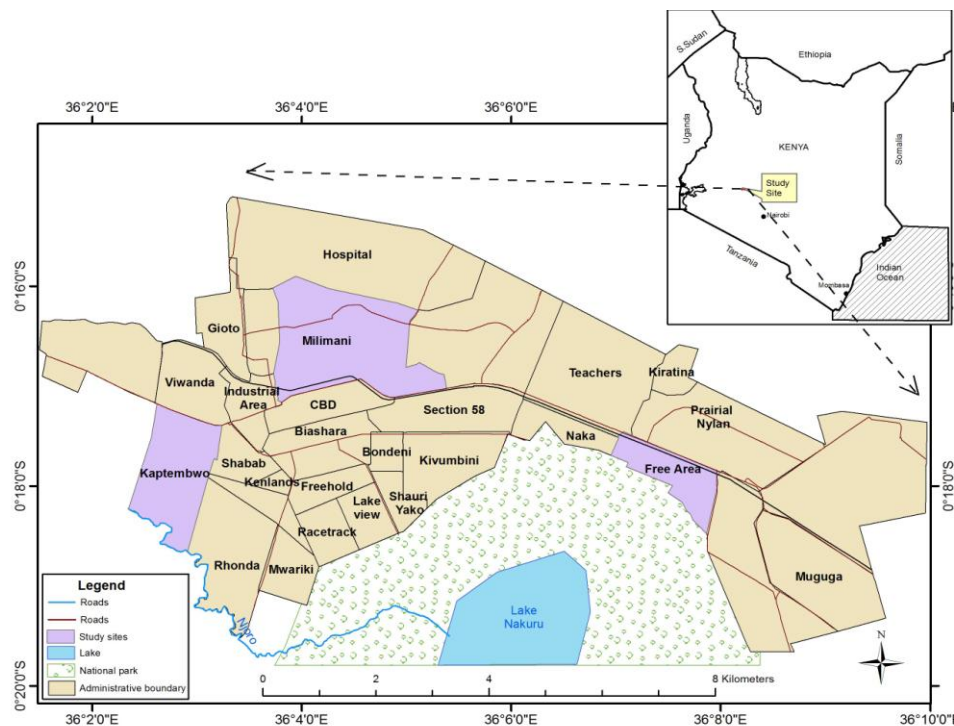
There exist safe methods of disposal of pharmaceuticals among households which are already practised by other countries this includes the take back programmes which provide safe and environmental friendly options for consumers. Other examples are mail back programmes where the consumers send their unused 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 [10].

Disposal of pharmaceutical waste among households is a global challenge especially in developing countries like Kenya. This study therefore aimed at documenting and characterizing the commonly disposed pharmaceutical waste and assessing the current pharmaceutical waste disposal practice. This can provide baseline data for further studies on their effects on the environment. Data on current methods of pharmaceutical disposal can help the relevant authorities in establishing proper methods of disposing unwanted pharmaceuticals among households.

## **II. Methods**

### **2.1 Description of Study area**

Nakuru Town is in Nakuru County which is located on the floor of the Rift Valley; it is Kenya's fourth largest town, the fastest growing town in Kenya and Africa and the fourth in the world [11]. According to 2009 census, the population of Nakuru town was 473,000 making it the largest centre in mid-west [12]. The increasing population in the town has led to an increase in generation of waste [11].



Source: Map modified from Nakuru County Integrated Development Plan 2013-2017

**Figure 1: Study area map**

Social survey study design was used in this study. Data was collected at a single point in time to examine relationship between two variables at one moment in time this allowed phenomena across a wide population to be drawn based on social economic status.

## 2.2 Data analysis

Descriptive statistics was used in this study to characterize the commonly disposed pharmaceuticals and to assess the current pharmaceutical waste disposal practice. Statistical Package for Social Sciences (SPSS) software and content data were employed resulting in tables, bar charts and percentages.

## III. Results and Discussion

### 3.1 Commonly disposed pharmaceutical wastes

#### 3.1.1 Percentage of disposed pharmaceuticals / commonly stored

The commonly disposed pharmaceuticals among households were antibiotics (35.8%), anti-malarial (18.1%) and pain killers (14.4%). The rest were below 10%. On the other hand the commonly stored were pain killers (28%), anti malarial (19.5%) and anti biotic (18%). Almost similar findings were found in a study carried in Basrah, Iraq by Mohsin, [13] which showed that commonly stored were antibiotics with 26.43%. Contrary findings were found in a study which was conducted in Thai land were neuromuscular drugs were the most common group stored in the house

In this study, out of 384 households visited 50.26% disposed syrup, 54.69% tablets, 1.04% cream and ointment

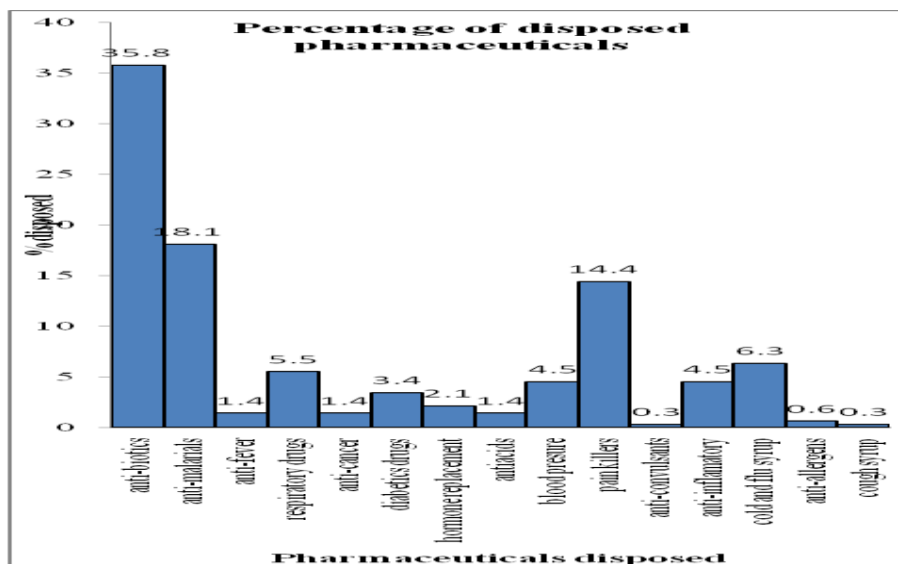


Figure 2: Percentage of disposed pharmaceuticals

### 3.1.2 Quantity Disposed

Table 1: Quantity disposed in a Month

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=180	47%
Not applicable	n=96	25%

Majority don't know the quantity they disposed and for those who know majority cannot estimate the quantity but they admit it is a lot. Similar studies in the United States estimate the quantity to be 2.8 million pounds which is nearly 45% of their medication is wasted [14].

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 excess, They were more than what a patient needed to use as prescribed. This contributes a lot to the availability of large quantities of pharmaceuticals which end up unwanted hence need to dispose.

Majority of the respondents 86.2% did not own any pet and for the few who owned a pet 7.6% owned a dog, 5.5% owned a cat and only 0.8% owned both. The commonly used medicines for pets were anti-biotic and de-wormers of which majority 93.2% had never bought medicine for their pets. Of those who have ever owned medication for pets, they said they finished dose.

## 1.2 Current pharmaceutical waste disposal practices

The study findings on current pharmaceutical wastes disposal practices in their different forms are shown in the Table 2 below.

Table 2: The study findings on pharmaceutical waste disposal practices

Type of pharmaceutical Disposal Methods wastes	Liquid medication n	Tablets and capsules	Ointments and Creams	Injectibles
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%
Flushing 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%

The most commonly used methods of disposal of all forms of medication was flushing in the toilet. Similar findings were found in a study conducted in Tacoma, Washington of which revealed that 35% flushed pharmaceuticals in toilet or sink. However [15] in a study conducted in Thailand found out that trashing them into the rubbish bin was the most commonly practiced method of disposal.

Flushing 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 [16].

#### IV. Conclusion

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.

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