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Storage, Disposal, and Misuse of Unused and Expired Pharmaceuticals in Households amongst Staff Working at Dakshinapaya Ministry Complex, Labuduwa, Galle Region: A Qualitative Phenomenological Study

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Abstract: (1) Background: Although Sri Lanka is a developing country and boasts of having a well-established healthcare system along with good healthcare indices, we are still lagging in certain aspects of healthcare. One such aspect is the deficiencies in guidelines and practices related to the handling of pharmaceutical waste. (2) Methods: This was a qualitative study performed using in-depth interviews with the help of a semi-structured questionnaire conducted among staff who are working at a ministry complex in Galle, Sri Lanka. Data analysis was performed using thematic analysis, (3) Results: There were 40 participants which included 29 (72.5%) females. Three main themes were identified, namely, (I) current knowledge, (II) perceptions, and (III) practices towards storage, disposal, and misuse of pharmaceutical waste. The death of the patient, forgetting, relieving symptoms, and adverse effects were some reasons for the accumulation of unused pharmaceuticals at home. Most of the participants did not believe that the reuse of unused medications can cause various health hazards. Moreover, all participants practiced unsafe methods such as flushing down toilets, pouring into a sink, burning, etc. (4) Conclusions: The incorrect practices and poor knowledge in the handling of pharmaceutical waste and less concern for the environment highlight the need for awareness programs to the general public and establishing proper medication waste management such drug take-back systems.

Keywords: disposal; expired medicine; unused medicine; pharmaceutical waste; knowledge



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1. Introduction

Expired, unused, damaged, or contaminated pharmaceutical items that are no longer needed are referred to as pharmaceutical waste (PW). The World Health Organization (WHO) advises that unused and expired medicines should never be used on humans or animals and need standard procedures to dispose of them safely [1]. With time, the usage and production of pharmaceuticals have increased widely in the community [2], and people tend to reuse medicines inappropriately for themselves and others due to the accumulation of unused medicines in their households, hence leading to misuse of unused medicines [3].

However, despite the negative consequences, correct household practices for expired and unwanted pharmaceuticals are not observed in many underdeveloped nations [4]. Although Sri Lanka is a developing country, we boast of having a well-established healthcare system. However, the unfortunate situation is that Sri Lanka is not different from other underdeveloped countries with regard to handling PW. One such aspect is the deficiencies in guidelines and practices related to the disposal of drugs. To make matters worse, there is a knowledge gap as well as a low perception towards storage, disposal, and misuse of

unused and expired medicines among the community in developing countries [5,6]. The only existing guidelines found in the literature review were the guidelines published by the National Medicine Regulatory Authority (NMRA), Sri Lanka, for the safe disposal of expired and unwanted pharmaceuticals in community pharmacies, health centers, industrial firms, and hospitals in Sri Lanka [7].

In developing countries, self-medication and the use of over-the-counter (OTC) medicines are widely practiced for minor illnesses compared to developed countries [8]. Except for serious illnesses, society would like to get health services from the Outpatient Department (OPD), clinics of public hospitals, and private hospitals. In clinic settings, patients used to receive large volumes of medicines during the COVID-19 pandemic (enough for one to three months). Moreover, with the increase in the number of pharmaceutical industries, various medications are available in the market following the gradual increase in the consumption of medications in the community in an ad hoc manner without proper instructions [9–11]. For those reasons, the consumption of pharmaceuticals is increased in the community, along with the parallel increase of generation of PW as patients did not consume all the medications that they purchased or received. This leads to large quantities of unused and expired medications remaining at home, resulting in irrational use of medications in the community as well as improper storage and disposal practices [12]. In addition, it creates a lot of health hazards for patients and their family members, especially for children, psychiatrically ill patients, and pregnant women. It may also lead to the wastage of resources, increasing resistance by pathogens, exposure to cytotoxic and mutagenic medications, adverse effects for wild animals, and contamination of water systems [13].

Households need to grasp the proper methods for using, storing, and disposing of unused or expired products, as well as understand the correct ways to dispose of pharmaceutical waste (PW) to prevent unsafe and environmentally harmful practices such as flushing down the toilet, tossing into household garbage bins, or pouring down sinks [14]. For example, previous research had shown an effect on renal functions in vultures as a result of ingestion of carrion from cattle treated with diclofenac, and the study found a reduction in the population of vultures in their ecosystem [15]. Another research study carried out in the United Kingdom (UK) showed that the water drainages contained medications like acetaminophen, verapamil, antibiotics, and estradiol residues, and it was shown that ethinyl estradiol, an active compound in Oral Contraceptive Pills (OCPs), is found in water systems, which may have led to a reduction in sexual development and feminization of the fish living in such water systems [16], and the antibiotics can have ill effects on the water systems [17] and also the soil system [18]. Recent research [19] has also shown that vast disposal of antibiotics in waterways may cause antibiotic resistance and prolonged exposure may lead to genetic effects in mankind and marine life and it also elaborated the bad effects on renal tubules by exposing expired tetracycline-like drugs.

In a way that relates to the whole world, safe storage of unused and expired pharmaceuticals at home until disposed of and then following proper disposal methods for medication waste (MW) are of high concern. Thus, most developed countries in the West such as the UK, Sweden, Canada, and Australia have followed a drug take-back system and awareness programs nationally to prevent misuse and manage the safe disposal of unnecessary medications by involving their state and pharmaceutical industries [2].

According to NMRA's statement, "PW should not be kept under general waste for avoiding unnecessary serious health hazards in the community and environmental contaminations" [7]. In Sri Lanka, the health sector is still not practicing drug take-back programs and there are no special guidelines for household management of the PW. Furthermore, the health system and other responsible parties have paid little attention to PW generated in resident places. There is a lack of awareness programs regarding misuse, safe storage, disposal methods, and practices of PW at home. Therefore, it is important to study the gaps in knowledge, perceptions, and practices towards storage, safe disposal, and misuse of unused and expired medicines in households as it will help health policymakers

to identify weaknesses and establish recommendations for further improvements in the healthcare sector [20].

2. Materials and Methods

2.1. Research Question

Do the participants have proper knowledge, perceptions, and practices towards storage, disposal, and misuse of unwanted and expired pharmaceuticals in their households?

2.2. Objectives

2.2.1. General Objective

To describe knowledge, perceptions, and practices towards storage, disposal, and misuse of unused and expired pharmaceuticals in households among staff members at Dakshinapaya Ministry Complex (DMC), Labuduwa, Galle.

2.2.2. Specific Objectives

To describe current knowledge towards storage, disposal, and misuse of unused and expired pharmaceuticals in households among staff at DMC.

To describe current perceptions towards storage, disposal, and misuse of unused and expired pharmaceuticals in households among staff at DMC.

To describe current practices towards storage, disposal, and misuse of unused and expired pharmaceuticals in households among staff at DMC.

2.3. Study Method

This was a qualitative phenomenological descriptive cross-sectional study conducted using a semi-structured questionnaire through in-depth interviews (IDIs).

2.4. Study Sample

This study was conducted in DMC, Labuduwa, and Galle, Sri Lanka. The volunteers of staff members in each Ministry at DMC were taken as the study sample as household members for this study by using the snowball sampling technique. Supportive/minor staff members were excluded to minimize heterogeneity of the sample based on educational level. Data were collected until no new information was obtained (until saturated) by performing interviews. Therefore, it was not possible to predict the sample size. It was estimated that at least over 300 employees were available in the DMC as possible participants.

2.5. Study Instrument

The semi-structured questionnaire was adapted from previous studies and modified according to our requirements [5,13,21,22], and it consists of four sections. Section 1 is about the participant's demographic details including residence area, age, gender, occupation, financial state, educational level, and details of family members to obtain an overall idea regarding the study population. Section 3 consists of questions related to assessing knowledge about storage, disposal, and misuse of unused and expired pharmaceuticals, and Sections 2 and 4, respectively, include questions related to assessing perceptions and practices towards storage, disposal, and misuse of unused and expired pharmaceuticals among households. The questionnaire was translated into the native language (Sinhala) and back-translated to ensure consistency and reliability of the translation procedure. The semi-structured questionnaire was prepared after a pilot test, which was distributed among 10 people, and modifications were made based on their preferences.

2.6. Data Analysis Method

Thematic analysis was used as a method for analyzing the qualitative data obtained from the study. Themes were identified and generated by qualitative analysis of data obtained from IDIs in an observational manner. All interview sessions were audio-recorded with participant permission. Sessions in Sinhala were translated into English by the

principal investigator. Then, all audio recordings of the interviews were transcribed verbatim using the exact words of the interviewees. Translations were compared and re-examined with interview sessions by supervisors. All transcripts were individually read and developed for analysis in qualitatively and generalized descriptions concerning study questions [23,24].

Themes and sub-themes about participants' experiences with knowledge, perceptions, and practices towards the storage, disposal, and misuse of unused and expired pharmaceuticals were identified and used for descriptions according to principles of thematic analysis using the following six steps: (1) familiarization with the study data; (2) assigning initial codes to the study data to define the information; (3) examining identified codes across the different interviews for searching themes; (4) themes found in step three are reviewed and defined; (5) enumerating and explaining each of the themes found in earlier steps; and (6) generating descriptions related to our research questions based on sections concerning knowledge, perceptions, and practices regarding the storage, disposal, and misuse of unused and expired pharmaceuticals [23,25]. It was decided that the data collection had reached saturation point when no new information was generated from the last three interviews conducted.

3. Results

In total, 11 (27.5%) males and 29 (72.5%) females participated in this study. Demographic characteristics of the study population are described below [Table 1].

Table 1. Demographic characteristics of participants.

Parameters	Male (%)	Female (%)
Gender	11 (27.5%)	29 (72.5%)
Age range		
18–29	3 (7.5%)	3 (7.5%)
30–41	5 (12.5%)	17 (42.5%)
42–53	2 (5%)	8 (20%)
54–65	1 (2.5%)	1 (2.5%)
65<	0 (0%)	0 (0%)
Education qualification		
Up to Ordinary level	0 (0%)	1 (2.5%)
Up to Advanced level	7 (17.5%)	11 (27.5%)
Higher education	4 (10%)	17 (42.5%)
Material status		
Married	6 (15%)	23 (57.5%)
Unmarried	5 (12.5%)	6 (15%)
Financial conditions		
<30,000	3 (7.5%)	4 (10%)
30,000–39,999	5 (12.5%)	5 (12.5%)
40,000–49,999	1 (2.5%)	11 (27.5%)
>50,000	2 (5%)	9 (22.5%)
Presence of children		
<5 years old	3 (7.5%)	11 (27.5%)
Presence of elder people		
>65 years old	4 (10%)	15 (37.5%)
Presence of healthcare workers	4 (10%)	5 (12.5%)

The significant themes, sub-themes, and, below that, sub-topics were extracted from the qualitative analysis of the study data with quotations from participants and mentioned below. Based on the in-depth interviews three main themes were identified:

Section 3.1. The current knowledge of storage, disposal, and misuse of unused and expired pharmaceuticals.

Section 3.2. The current perceptions towards storage, disposal, and misuse of unused and expired pharmaceuticals.

Section 3.3. The current practices towards storage, disposal, and misuse of unused and expired pharmaceuticals.

Under each main theme, sub-themes were developed. Summarizations of potential main themes and sub-themes are illustrated below [Table 2].

Table 2. Summary of potential main themes and sub-themes.

Main Themes	Sub-Themes
Section 3.1. The current knowledge of storage, disposal, and misuse of unused and expired pharmaceuticals	<p>Section 3.1.1. Knowledge regarding “pharmaceutical/medication waste”</p> <p>Section 3.1.2. Lack of proper instructions on storage, disposal, and misuse of medication waste at home through a healthcare provider</p> <p>Section 3.1.3. Not knowing about the drug take-back system</p> <p>Section 3.1.4. Improper storage of unused and expired medicines is leading to various harms to humans</p> <p>Section 3.1.5. Ways of causing harm to humans by the use of improper storage</p> <p>Section 3.1.6. Improper disposal of unused and expired medicines is leading to various harms to humans and the environment</p> <p>Section 3.1.7. Reasons for remaining the medications among households</p> <p>Section 3.1.8. Reuse of unused medications</p> <p>Section 3.1.9. Solutions for minimizing the hazardous effect of unused and expired pharmaceuticals among households</p> <p>Section 3.1.10. Responsibility for creating public awareness</p>
Section 3.2. The current perceptions of storage, disposal, and misuse of unused and expired pharmaceuticals	<p>Section 3.2.1. Keeping unused and expired pharmaceuticals in the home is a high risk</p> <p>Section 3.2.2. Children are the most vulnerable group</p> <p>Section 3.2.3. Lack of adequate information</p> <p>Section 3.2.4. Requiring a drug take-back program</p> <p>Section 3.2.5. Having a separate safe place at home</p> <p>Section 3.2.6. Reuse of remaining medications has no risk</p> <p>Section 3.2.7. No effect on the environment</p>
Section 3.3. The current practices of storage, disposal, and misuse of unused and expired pharmaceuticals	<p>Section 3.3.1. Checking expiry dates of medicines</p> <p>Section 3.3.2. Things that are done for the unused medicines</p> <p>Section 3.3.3. Storage place for unused medicines until disposal in households</p> <p>Section 3.3.4. Things that are done for expired medicines until disposal in households</p> <p>Section 3.3.5. Ways of disposal of unused and expired medications</p>

3.1. The Current Knowledge of Storage, Disposal, and Misuse of Unused and Expired Pharmaceuticals

3.1.1. Knowledge Regarding “Pharmaceutical/Medication Waste”

Most of the participants had never heard the term “medication/pharmaceutical waste”. Moreover, some noted that they have no idea about “what it is”.

“No, I never heard and I have no idea about that.” (Participant quotation)

Some household members mentioned that they were waste removed from the hospital/community pharmacy level.

“Those are expired medications disposed from hospitals and pharmacies. And also we can get medicines that are left over from being used in homes.” (Participant)

A few participants noted that they never heard of it before, but they gave their ideas regarding medication waste as they thought.

“I haven’t heard before, but when we get waste, as I think, we can get expired medications and waste which are disposed from hospitals considered as medication waste.” (Participant)

“I haven’t heard but I think, we can get expired medicines, leftover syrups, creams and medicines which are chemically changed and some have changes in appearance like the color.” (Participant)

Participants also explained pharmaceutical waste was packages of medicines that were left over after using medicines in addition to expired medicines.

“As I think, those are packages, covers, tubes of cream, bottles, and inhalers remained after the treatment.” (Participant)

3.1.2. Lack of Proper Instructions on Storage, Disposal, and Misuse of Medication Waste at Home through a Healthcare Provider

Less knowledge was shown regarding the basis that most of the participants mentioned that any instructions based on storage, disposal, and misuse of medication waste among households were not heard from anyone or any place.

“No, I didn’t hear. No one has ever given me advice like that, even a doctor or person who is in the pharmacy. They have advised about only “how to store” and “how to use” such kinds of things like Augmentin syrup should be kept in a fridge.” (Participant)

“When we take medicines from a doctor or pharmacy, they tell us some information. They tell how to use and how to store like details. Other than that, I haven’t heard how to dispose of or what want to do for expired or unused ones.” (Participant)

3.1.3. Not Knowing about the Drug Take-Back System

None of the participants in this study could provide an exact idea about the drug take-back system. However, they also mentioned some experiences with returning medicines that were in good condition and quality to the pharmacies. Instead of that, the majority of participants did not know of the drug take-back system.

“No, I didn’t hear that kind of system. As I think, we haven’t such a system in our country. I don’t know about that. My brother has a pharmacy. So when I talk with him I have heard that some people are brought their remaining medicines to the pharmacy before expiry, if it is a bulk amount or expensive drugs like cancer drugs.” (Participant)

“I haven’t heard about that kind of system. But I have returned some medicines to the pharmacy. After the bypass of my father, some medicines that were given from the hospital remained. So I returned most of the medicines to the pharmacy and got money for that.” (Participant)

Participants also noted that they had no idea about the handover of expired medicines to pharmacies or hospitals.

“We can return medications to the pharmacies if it is not open or not damaged to packages. But I haven’t heard drug take-back system in our country for expired medications.” (Participant)

3.1.4. Improper Storage of Unused and Expired Medicines Is Leading to Various Harms to Humans

- Having risk for children and elderly people

Participants believed improper or unsafe storage can cause various health hazards for human health.

“If it is not stored properly or safely, it can be taken unintentionally or accidentally, especially by children. So, it has a risk for children and also elderly.” (Participant)

- No risk for adult

Some participants noted that there was no risk for adults with remaining unused medicines at home.

“It can happen when we are having small children in our home, otherwise I don’t think there is any risk.” (Participant)

“No, I don’t think so my medicines come up with a well-covered package. So I don’t think it is unsafe for someone. Sometimes, if we have small children, it can be unsafe. My children now are young. So they can think now.” (Participant)

- Accumulation in large quantity

Participants also mentioned that improper storage can cause harm if it is only accumulated in large quantities at home.

“I don’t think so, if those are in large amounts it can be harmful. Otherwise, I don’t think those can cause any harm.” (Participant)

3.1.5. Ways of Causing Harm to Humans by the Use of Improper Storage

Participants gave a lot of their thoughts related to ways of causing harm to humans according to their knowledge about medication usage.

- Unintentionally taking medicines

Participants noted that unsafe storage can lead to taking medicines unintentionally and harm our health.

“Even if it is cured our diseases, it is also dangerous to keep unused drugs at home as our children can be taken unintentionally. They put anything in their mouth if we don’t keep away them from children. Also... even we, not only children, can take expired ones without knowing it. Then, we can’t get exact results of them and also it can cause a lot of adverse effects and it can be poison to us.” (Participant)

- Mixing with usable, unexpired medicines

Participants mentioned that improper storage methods can mix usable and unexpired medicines with previously used medicines and cause harm to our health.

“If we store all are in one place, those can mix up those with good medicines. There are different, different medicines for the same disease according to the patient’s condition. If those are mixed, it may not cure disease.” (Participant)

“Sometimes, my father takes medicines by mistake. We bring him to a specialist every three or two months. But sometimes, he also goes to another doctor who is in our village. One day, he took both medications by mistake. He kept leftover medications that were given by the doctor in our village with other medications.” (Participant)

- Suicidal ideation

The participants also expressed the use of leftover medicines for self-harming as one of the consequences of improper storing of unused and expired medicines at home.

“If we keep new or old medicines everywhere at home, it may affect the patients who are having mental depression and suicidal thoughts, they don’t think twice to take it when they have a suicidal idea.” (Participant)

- Emitting harmful rays from expired medications

Some participants believed that harmful rays emitted from expired medication could cause harm to humans.

“I think, some rays may be released from expired medicines. So, when we store unsafely, it can cause damages to us.” (Participant)

3.1.6. Improper Disposal of Unused and Expired Medicines Is Leading to Various Harms to Humans and the Environment

- Knowledge about effects on the environment

Participants had a general idea about the effects on humans, but they had no perfect idea about the effects on the environment.

“As I think, if it is thrown out somewhere, a child can take it and eat it. Children can play with them. But, when, we think about environmental damage, it may happen, but I don’t have much idea about the effects on our environment. I haven’t felt like that before. Sometimes, packages of medicines are not as good for the environment as other garbage.” (Participant)

- **Causing no harm**

Some participants did not believe that the disposal of unused and expired medicines causes irreversible damage to the environment.

“I don’t think so. We get medications for curing diseases. Therefore, I don’t think, there is some kind of damage to animals or the environment.” (Participant)

3.1.7. Reasons for the Medications Remaining among Households

- **Due to forgetfulness**

Forgetfulness was one of the reasons for leftover medicines being at home as participants who were elderly had difficulties taking medicines according to the correct schedule.

“I bring medicines from my clinics for one or two months. Because of the corona, they have had medicines for 3 months for the last 2 or 3 years. Sometimes, I have forgotten to take my medicines. Now I often forget things, I think, it is with my age. So there some amount of medicines are left at end of the month.” (Participant)

“When I bring medicines for a fever or a cough, I take the first 2 or 3 doses correctly. But with my busy life, I forget to bring those to my office and I miss the doses. After that, I stopped taking it because it is not useful when I miss doses. So, most of the time those medicines are remained at home.” (Participant)

- **Discontinuation**

Some household people noted discontinuation of treatment as another major reason for medicines remaining at home.

“Before a few months ago, I checked my cholesterol level, and the doctor gave me cholesterol drugs for 3 months and he said to check my cholesterol level again after three months. I took those for only four or five days and after I couldn’t get them. So those medicines have been left at home.” (Participant)

- **Death of patient**

Participants also mentioned that the death of a family member caused the remaining medications at home.

“One year before, my father died. The medicines used by him are still present at home. I keep those as I thought it would be useful to someone.” (Participant)

- **Not admitting to taking medicines based on unwillingness to accept the illness**

Some participants were unwilling to accept that they had a disease, and they did not follow the instructions given by the physicians.

“My father did a blood sugar test 3 months ago and it showed that his sugar level had increased. So the doctor gave some medicines to him. But he didn’t believe that and He always said to me, he hasn’t any disease and he doesn’t want any treatment. Therefore, he didn’t take it.” (Participant)

- **Relieving symptoms of disease condition**

Household members mentioned that they terminated the treatments after the symptoms disappeared based on their judgments.

“When we are having a fever or cold, we may take medicines but after two or three doses we stop taking the rest of the medicines after relieving the symptoms.” (Participant)

- Resulting adverse effects

Participants expressed their unpleasant experiences with medicines, and this was manifested as one of the reasons for the remaining medications to be unused and expired among the households.

“Sometimes, my mother stops taking some medications due to worsening her gastritis condition and due to feeling of uncomfortableness. She refuses to take inhalers and medicines prescribed for wheezing. In that case, we go to another doctor. Therefore, previous medicines are left over at home.” (Participant)

“The doctor gave me a pill for thyroxin last year. That was allergic to me, and I was hospitalized. After recovering, they gave me medicines for 3 months and I was discharged and came home. But I didn’t feel any better, so I went for a specialized doctor, he changed my all medicines. So previous medications that were given from the hospital have remained. I still have those medicines in our home.” (Participant)

- Providing medicines in excess

Some participants noted that hospitals and dispensaries were providing medications in excess amounts and that was a reason for leftover medicines to be unused and expired at home. The “syrups” were the main preparation left over at home in excess quantity as per the expressions received from mothers who had babies under 5 years old.

“Whatever, the diseases we have, they often give paracetamol for 3 or 5 days in the hospital clinics. Mostly, we don’t take it, unless we are having a fever or pain. So, those syrups are remaining at home.” (Participant)

“Most of the time, there is panadol syrup, cough syrup, and gripe mixture, in addition to that doctor gives syrup to my baby to facilitate discharge of stools which were brought for fever and cold of my children. Those have excess amounts than the prescribed doses, therefore, they leftover until expired.” (Participant)

- Worsening disease condition

One of the other reasons was the worsening of the disease conditions. In that case, physicians changed the treatment and medications of the patient. Hence, that impact had a chance for the medications to be unused in the household.

“After putting POP (Plaster of Paris) on my leg, the below part of my foot turned black. From the hospital they told me that “it is an infection” and they gave me a lot of medicines. But I felt a worsening after taking them and then I channeled a specialist and he changed my all medicines and gave me other treatments, so previously taken medicines were left in my home.” (Participant)

“My father is a heart patient. A few months ago, the doctor found he had a kidney problem and they quickly changed some medicines. At that time, there were a considerable amount of medicines that had been bought earlier. So we had to keep those away.” (Participant)

- Short shelf life of some medications

Some preparations can only be used for a short time after the opening of packages. Participants expressed difficulties in finishing the product before the given periods, and it was a reason for the to remain in the home.

“I use a nasal spray for blocking of the nose. It can be used for only three months. I use it only if I have a nose block and sometimes, I forget to use it. So that is left as expired at home.” (Participant)

- Reluctance of Western medications

Some participants doubted Western medicines, and they showed reluctance to take medicines.

“My mother doesn’t like to take English medicines, always she wants to use Ayurveda medicines. But, one or 2 months ago, I brought her to a doctor due to the worsening of her leg pains. As I remember, I had bought that medicine list for 1 or 3 months and there were vitamins and others. But, when I checked her medicine box, she didn’t take even one dose.” (Participant)

“I usually take Western medicines only if I have a serious disease and if I haven’t another choice. I only take one or two doses and the rest are remaining. I know that there are some bad effects of taking medicines for a long time. Because Western medicines are artificial preparations and all are some chemicals. So I often go for Sinhala medicines (traditional medicines).” (Participant)

- Abrupt physician change

Some participants noted that changing their physicians frequently was one of the reasons for leftover pharmaceuticals at home.

“My mom always goes to several doctors to get medicines, but she doesn’t take those properly until it is over. She stops taking medicines within 2 or 3 days and some medicines which are taken from another doctor keep without taking.” (Participant)

- Improper storage and packaging practices

In our country, hospitals, pharmacies, and small dispensaries are provided medications in paper covers or bags. Therefore, it requires good storage practices to store medicines properly. That would be a reason for the medications to become low-quality or damaged products. Participants expressed the above concept as one reason for presenting leftover medications amongst households.

“They give medicines by putting them into paper bags. Those can’t be used again after a few days, if not stored properly. Mostly I forget to keep it closed.” (Participant)

Household people also presented less practice toward storage of medications and less concern about that. Hence, that was also a consequence of collecting unwanted medicines at home.

“One day, our doctor prescribed syrup for my baby. As I remember, they told me to keep it in the fridge after opening it. But actually, I forgot to keep it in the fridge. After a few days, it got color changes. Then I didn’t use it further.” (Participant)

- Keeping medication for future usage

Some participants purchased medications for future usage and sometimes they bought medicines in excess when they were having even minor illnesses.

“We buy some medicines in excess for use in the future like panadol, cetirizine, piriton, and amoxicillin. Especially, if amoxicillin-like drugs remain in some amount after use, we take them and keep them for further use. But, if we are not getting any illness shortly, those are leftover or expired.” (Participant)

3.1.8. Reuse of Unused Medications

Participants expressed a positive view on the reuse of unused medicines and noted that it minimized the wastage of medications.

- For the same illness

Participants mentioned that unused medicines can be reused for the same illnesses that were presented before.

“Normally, I know that “What are the medications? And “what for it?”, so if there are leftover medications at home, I get those if I’m having the same illness by looking at those details. Otherwise, it is a waste of medicines or our money.” (Participant)

“I use them for my illness or others. I think it does not have a risk if it is the same one. My baby has a blockage in her nose. When I meet the doctor, the doctor writes the same

drops for her. So, I know what medicines are used for that issue. Then, I used the same drops, but after checking the expiry. If it is expired, I buy a new one. I don't think, the reuse of unused medicines has a problem." (Participant)

- Assuming the persistence of good quality

Moreover, participants also explained that unused medicines that were in good condition could be reused until they expired and there was no issue with that.

"If they are still having good quality, it is okay to reuse. Also if it is not expired or if those packages are not damaged and if it is stored properly, I think, the reuse of unused medicines has not any problem. We can use it until expires if we store it correctly." (Participant)

3.1.9. Solutions for Minimizing the Hazardous Effect of Unused and Expired Pharmaceuticals among Households

Participants suggested various solutions according to their current knowledge for minimizing and controlling the hazardous effects of improper storage, disposal, and misuse of unused and expired pharmaceuticals among households.

- Taking medicines only as much as needed

Participants noted purchasing medicines for the neediness to relieve the symptoms may prevent remaining medicines at home.

"We want to take medicines only as much as needed from the pharmacy even doctor prescribes more than 3 days. We normally know, after 3 or 5 doses, we get better. So, no need to take a whole amount of medicines, and we can buy only for 3 days. Then, the medicines are not left over at home. We can reduce the accumulation of drugs in our home." (Participant)

- Store safely

Participants also emphasized that safe storage methods can be used to eliminate risks from unused and expired medicines.

"Those must be kept at a higher place and it is not accessible to children and stored separately from other medicines. It is more preferred to lock in the cupboard." (Participant)

"We can make a first aid box to store unused medicines with labels or naming. Then, it can be prevented from being taken mistakenly." (Participant)

- Providing awareness programs

It requires awareness programs, and it can make people aware more and help to control harm towards humans regarding the handling of unused and expired medication.

"If we use medications for the child, most of the time, those are leftover like syrups. We don't know what to do with leftover medicines and also we don't know good safe methods for discarding the medications without causing any harm to the environment. And also we can wrongly use those. So if the awareness is given by anyone about that, it will be very good." (Participant)

- Dispose of the same place used by the hospitals

Participants suggested the same place that is used by hospitals to dispose of unwanted medications by collecting at the village level.

"If we can dispose of the medication waste in the same place where the hospital used it, it is better than we dispose of. This should be done in a good and orderly manner. And that is the best way to require for disposing of medication waste." (Participant)

- Handover to a garbage vehicle from the municipal council

Most participants noted that a very protective way for disposal of medication waste is collecting it from the municipal council rather than keeping and discarding it at home.

“If we give all the garbage including medicines to the garbage collection vehicle of the municipal council. I think it is better than we dispose at home.” (Participant)

- Discarding as much as quickly as possible after use

Some participants suggested that discarding leftover medicines as quickly as possible after the end of treatment is safer than keeping them until they expire, or for a longer time, at home.

“We should remove leftover medications from home after treatment is over. Keeping unused old medications and expired ones is not good for us, it poses a risk to our health. As I think, removing those as soon as possible is a safe way to prevent bad effects.” (Participant)

- Burning in a covered container

The participants responded that to prevent the emission of toxic fumes and rays from expired medicines, burning them in a covered container at home was the best way to dispose of them safely.

“We can burn those in a covered container. It can lead to preventing the emission of toxic fumes and harmful rays from expired medicines.” (Participant)

- Prevent issuing in large quantity

Most of the time, physicians and hospitals provide medications in large quantities. Thus, participants noted that diminishing the issue of medicines in large quantities can lead to preventing the hazardous effects of accumulating unwanted medications at home.

“The doctors or hospital can be issued only the required quantity without giving excess amount.” (Participant)

- Return to the pharmacy

It is better to return the remaining unwanted medicines to the pharmacy and minimize the damage from unused medicines at home.

“If it is not expired and in good quality, if we can return those to the pharmacy, I think it is good for us and also for the country. It can reduce the wastage of medications.” (Participant)

- Take until full treatment is over

Participants noted discontinuation is not good, and hence, taking medicines until all are over is one of the solutions for the prevention of hazardous effects from unused medications at home.

“Even, I don’t like to take medicines. I only use only two or three doses. I thought it was not good. So, if people take medicines, they should want to take until over without getting half. Then, we can reduce the accumulation of medicines at home and prevent harm for us.” (Participant)

3.1.10. Responsibility for Creating Public Awareness

Agreeing to the opinions of participants, they were given the responsibility of creating public awareness regarding the storage, disposal, and misuse of unused and expired medications by several parties in our country.

- Health-related people and institutions

Most of the participants mentioned that the health ministry, healthcare professionals who are working in hospitals and pharmacies, public health services, experts in medical fields, and authorized institutions can arrange awareness programs to disseminate knowledge to the community.

“Firstly, the responsibility should be taken from our health ministry through the government. They can launch awareness programs. Doctors or people who are in the pharmacy can’t always advise because there are limited times. Public health or health bureaus can give education to the community, and especially to the school. Homes with children need

to be very aware. So if the midwives can give such kind of information, it is good for us." (Participant)

"We often take medications from pharmacy or hospital, they can give information for us. If we take inhalers we don't know how to discard them. They tell us how to use it but they don't tell us how to discard it. Therefore, if they can give such information. Even I haven't seen that kind of practice in the private hospital too." (Participant)

"Nowadays, a famous communication method is social media. We don't know about medicines-related things. Some people are experts in medicine. They can aware people via social media and also if there is some authority for medicines, they can do it." (Participant)

- Taking responsibility for themselves

Participants also volunteered to take responsibility by themselves to seek knowledge on that.

"We also have a fault, we can ask from the relevant people and take that the information. But we also don't think about that and don't do that." (Participant)

3.2. The Current Perceptions towards Storage, Disposal, and Misuse of Unused and Expired Pharmaceuticals

This section is mainly focused on finding out participants' perceptions based on the storage, disposal, and misuse of unused and expired pharmaceuticals.

3.2.1. Keeping Unused and Expired Pharmaceuticals in the Home Is a High Risk

Participants had a good comprehension of the high risk of keeping unwanted and expired medicines at home

"Due to its presence at home, it often tends to be used. Sometimes, we take expired ones without knowing, and also those may be used for another disease and it can cause a lot of problems. Also, some elder people have dementia. They can take the wrong medicines." (Participant)

3.2.2. Children Are the Most Vulnerable Group

Participants showed a better understanding of children as one of the risk groups with improper usage of leftover medications at home.

"Yes, definitely, a child of my friend was taking a few of the leftover medicines of his father which was used for a heart attack before his father passed away. The child was served because my friend saw it and took the child to the hospital quickly. Otherwise, the child would have died." (Participant)

3.2.3. Lack of Adequate Information

Almost all participants agreed on the low knowledge and perception among household members on safe storage, disposal, and misuse of unused and expired household medications.

"That's true. Most people throw the medications with good quality after getting half of the treatment. It is a waste of money for the people and also the content of medications can cause damage to the environment. We don't know how to dispose of it safely without harming our environment. And also some people use again leftover medications even without knowing expired or not. So most people don't know about that." (Participant)

3.2.4. Requiring a Drug Take-Back Program

Most participants emphasized the requirement of a drug take-back system for unused and expired medicines.

"Yes, of course, according to the current situation, that kind of system is more important because they say that there are not a lot of medicines in hospitals and the country. Nowadays, even the medicines that are used for small illnesses are very expensive.

Therefore it is better to return the unused medicines. And also after expiration, those can be very harmful to our health. We don't know how to dispose safely at home. So presenting that kind of system can measure and prevent wastage of drugs and also harmful effects on our health and environment. They can collect and dispose of it safely. So, as I think it is necessary.” (Participant)

3.2.5. Having a Separate Safe Place at Home

Participants also agreed that the home should have a separate safe place for storage of unused and expired medicines until safe disposal.

“Yes I agree with that but I don't keep a separate place in our home. Now I think it's good to have that without placing it everywhere. Because there can be a risk due to being mixed with other good medicines. We want to store expired medications in a separate place from currently used and unused medications. Also if any relevant institutions make a drug take-back system like one, the home should have a separate place to store to collect and hand over to it. If we can lock it, it is safer until disposed.” (Participant)

3.2.6. Reuse of Remaining Medications Has No Risk

Participants did not agree that the reuse of remaining medications in the home poses a risk to the health of people.

“If we get medicines, syrups which are brought for small illnesses like fever, cold or cough, and creams, we normally reuse until expired. It is not risky. We use panadol syrup and cough syrup. If we close it tightly, we can use it until expires. As I think, it hasn't a risk for reuse. It is a saving of our money because, most of the time, syrups which are brought for children have remained and also medicines which are brought for small illnesses are leftover widely.” (Participant)

3.2.7. No Effect on the Environment

Almost all of the participants had no better perceptions towards disposal by burning, flushing to the toilet, disposal to sink, burying, and throwing household garbage or municipality garbage as being harmful to the environment (water system) or wild animals.

“I don't think so. I haven't thought like that before. I also throw those into a garbage pit or garden like syrups those things. But I don't think, it has such effects on the environment.” (Participant)

“I don't have any idea. I also use those ways to discard medicines. Until today I didn't think about that.” (Participant)

3.3. The Current Practices towards Storage, Disposal, and Misuse of Unused and Expired Pharmaceuticals

3.3.1. Checking Expiry Dates of Medicines

- Less awareness and practices

Generally, participants presented low practices regarding checking expiry dates before administration. The majority of them directly mentioned that they had no habit of looking at expiry dates.

“I don't check the expiry date. Have we wanted to do it?” (Participant)

Some participants did not even know there was an expiry date on the label, and they had no idea why they needed to check that information.

“I haven't any idea about that. I didn't look date before taking it. Until today, I don't know that we want to check it for medicines as foods.” (Participant)

- Trust towards the healthcare professionals in pharmacies and hospitals

However, some showed a trustiness toward the healthcare professionals in pharmacies and hospitals, and they believed that they were providing good quality medicines.

"I often buy medicines from pharmacies. So I don't check it. They don't give us expired medicines." (Participant)

- No need to check for a solid dosage form

The participants explained that some medicines usually have a long shelf life, and therefore, expiry dates are unnecessary to check before administration.

"Normally, medicines like tablets can keep for longer. I don't frequently check expiry for tablets, or capsules because those can be kept for some longer than other medicines. So, I think, it is no need to check." (Participant)

- No details on loose packs

Participants noted that, sometimes, they received the medicines in loose packs without having details of dates.

"Mostly, some loose packages which are given from the hospitals or dispensaries haven't such information like expiry dates." (Participant)

3.3.2. Things That Are Done for the Unused Medicines

- Keeping for further use

Most participants kept unused medications in their homes for further use.

"According to my practices, I normally search names in Google, if I don't know what disease is used for. Some are I can't understand, some are I can understand like painkillers, vomiting, gastritis. . . Then I made some boxes with names and relevant conditions which are given. If there are some remained medications I put those medicines separately for further use. I keep those until they expire. If we need it again, we can use it. I normally do those for commonly used medicines like omeprazole, amoxicillin for drying wounds, piriton, domperidone. . .etc." (Participant)

"When we go to take medicines to the doctor, normally every doctor gives the same medicines for common illnesses like fever, cold, cough. So if there are leftover medicines, I keep those to use in the future and we know most of the medicines, like what to use. So, those are known medications, we can use if we are having the same diseases." (Participant)

"Not every medicine. If we bring syrup for cough, we keep it for reuse, if we have again cough later. Sometimes, the doctor writes the same syrup or medicines for my child. Then, I check that there have previously bought one at home. In that case, I don't buy again that." (Participant)

- Offering to someone else

Participants gave unused medications to another person in their family or not, and that practice was mostly shown with medications for minor illnesses.

"If some medicines can be given to someone else or reused for me or family members, we keep those until they expire. Otherwise, it is a waste." (Participant)

"When I was infected by corona, my brother brought their remaining medications. I used them until it was over and I bought the insufficient amount from the pharmacy." (Participant)

"A few days ago, my friend called me and sent me to a medication chit that was given to her child and asked for some leftover syrup in the chit. I have a child with the same age as her child. Also, I normally keep the rest of the medicines like syrups for use in the future. Then I gave those for her to use her child." (Participant)

3.3.3. Storage Place for Unused Medicines until Disposal in Households

- No special separate place for unused medicines

Most participants stored unused medicines in the same places where currently used medicines were stored.

“There is no special place for unused medicines. We keep all our medicines in a cupboard. Everyone knows that’s the place where the medicines are. The medicine used and remaining medicines are all in the same place.” (Participant)

3.3.4. Things That Are Done for Expired Medicines until Disposal in Households

Almost all participants mentioned that, most of the time, there were expired medicines at home and they did not have a special separate place to keep expired medications until disposed of.

“I normally store medicines in a cupboard. Those often have expired, then I remove it from the cupboard and keep it separately somewhere by putting it into a bag or box at home until discarded.” (Participant)

Participants did not regularly check expiry dates to find expired medicines and did not remove them from their currently used and unused medications.

“Sometimes, we forget to remove previously used medicines. We didn’t check routinely. If we find an expired one, we put it into a dustbin. There are some medicines like syrups that are present for a longer time at home. And also, after my father passed away. There remained a lot of his medicines. We have still those even after 1 or 2 years passed. I don’t know, those are expired.” (Participant)

Some participants mentioned that they practiced removing expired medicines at the same time that were found

“We haven’t a place to store expired medicines at home. When I saw an expired one, I put it in a dustbin at that time.” (Participant)

3.3.5. Ways of Disposal of Unused and Expired Medications

Participants noted various ways to dispose of unused and expired medications. There are currently used methods among the households mentioned below.

- Flushing down the toilet

Flushing the pharmaceuticals down the toilet is one of the ways to dispose of medicines like syrups, other liquid preparations, and also tablets and capsules.

“If it is syrup or liquid, I mostly put it into the commode and flush it. Rarely, sometimes, I flush the other medicines also like tablets, capsules in that way.” (Participant)

- Pouring into a sink

Participants also presented pouring the drugs into a sink, especially for liquid preparations.

“Syrups like liquid medicines, we pour into the sink and wash the bottle. We use those bottles for storing the coconut oil or Ayurveda oil given for my mom.” (Participant)

- Burning

Generally, most participants showed burning their medication with other garbage as a practice of disposing of the medicines.

“In our area, a municipal council garbage vehicle is not coming, so normally we burn all garbage collected at home. All medications like tablets, capsules, plastic drop bottles, eye drops, inhalers, and creams we burn with other garbage. Syrup bottles keep using for in future if it is plastics we burn those.” (Participant)

- Putting it into a compost bin

Some mentioned that they have a compost bin in their homes for putting degradable waste. Participants have put medications in that bin to degrade with time.

“Syrups, tablets, and capsules like medicines we put into a compost bin when we dispose of, we remove packages and then only powder, tablets and rest of syrups without bottle throw into that bin and those are degraded with times.” (Participant)

- Handover to municipality garbage

Participants also practice handover to garbage collection vehicles of the municipal council.

"In our area, once a week, a municipality garbage vehicle comes. So we collect all the garbage in a dustbin and hand it over to that vehicle. We also hand over the medicines with that. But they don't get glass bottles. So if it is syrup we pour into rest into a dustbin and keep the glass bottles for other use." (Participant)

- Throwing into a garbage pit

Some noted that they have household garbage or garbage pits for disposal of all waste. Therefore, all medications were disposed into places with other waste.

"If it is a tablet or capsule we often throw it away into our garbage pit without burn. Also, the remaining liquid of syrup bottles, and creams is thrown in that way. Sometimes, if we burn those, strong smoke is coming. So I mostly throw away into our garbage pit." (Participant)

- Throwing into the garden by dissolving with water

Throwing into the garden by dissolving with water was used as a disposal practice of medications.

"Normally as I do, I put tablets, capsules, and syrups into a water bucket and dissolve them, then throw them into our garden. I burn other medicines that cannot be thrown away like that." (Participant)

- Putting into flower pots or gardens as fertilizer

Some household members noted that they use medications as fertilizers for plants and flowers in the garden.

"If it is tablets or capsules, I crush them and put them in flower pots. I have heard those can be used as fertilizer for rose flowering. If it is syrup, I also pour it into my flowers pots or garden and wash the bottle and keep it for further use." (Participant)

- Burying

Participants mentioned burying as one of the medication disposal ways.

"In our home, I collect all leftover medicines over the period and when there are considerable amounts, I bury those at once. Usually, those are Inhalers, tablets, and capsules like medicines." (Participant)

- Keeping without disposing

Some participants expressed difficulties with the disposal of pharmaceuticals due to less knowledge of that and not having proper systems to do that in our country. Thus, some kept some medicines without disposing of them.

"My child had a wheeze since her 10 years old. He gets inhalers. I don't know what to do after using those, I have to collect them in fertilizer bags and keep them behind the house. There are a lot of inhalers in my home. In our area, garbage vehicles are not coming. Those don't get from any person who is collecting the bottle and paper. So, I can't burn those due to plastics." (Participant).

4. Discussion

There is neither a set policy nor a procedure or a system in place in Sri Lanka for the disposal of pharmaceutical waste and also less knowledge and poor practices towards handling unused and expired medications among the general public [7,20]. This study mainly described, qualitatively, the genuine current knowledge, perceptions, and practices towards storage, disposal, and misuse of unused and expired pharmaceuticals in households by using working staff at DMC, Labuduwa, Galle, to obtain overall comprehension of medication waste management in the community.

Almost all participants noted that accumulating unused medications in households happens normally, a phenomenon also noted by the authors of a recent study conducted to find out medication waste disposal practices among patients in Sri Lanka [26]. Another study has also shown that there are incorrect behaviors and practices of people towards PW management as well as the amount of negligence of the healthcare professionals towards handling unused medications among households [27]. As a unique finding from this study, participants expressed positive thoughts about the reuse of unused medications by themselves or for someone else based on having the same illness and the availability of remaining good quality medicines. It could be a major reason for complications with antibiotics and other medicines [3,28]. Therefore, it is compulsory to progress practices and behaviors among household members and healthcare professionals based on accurate usage of medication waste in the community [29].

Moreover, there was hardly any participant who remembered instructions for safe storage, disposal methods, and prevention of misuse of unused and expired medicines. This is the main barrier to setting effective storage and disposal practices for unused and expired medicines expected from the general public [30]. In addition to that, none of those in the study population knew or heard about “medication waste” and the “drug take-back system”. Establishing such a system can help to effectively manage PW in the community in Sri Lanka. Participants mentioned ways of causing harm due to unsafe storage practices, unintentional ingestion by children or elderly people, mixing with good medicines, and or providing a tool for suicide. But when concerned about real practices, they demonstrated less regard for the storage of unused and expired medicines. They had no separate places to store unused and expired medicines. The situation was not healthy as they showed practices of storing unused medicines with currently used medicines. Thus, more attention is needed by health-related institutions to advance practices in the community [31].

Indeed, storing and accumulating unused medications in households is a common occurrence as proven by a recent study conducted to find out medication waste disposal practices among patients in Sri Lanka [26]. According to the results of the study, the study sample had poor practices for checking the expiry dates of medications, which can lead to various health hazards to humans by consuming expired medications. The reasons for accumulation of PW in households include discontinuation of treatment, death of the patient, forgetting to take the medicine, relief from symptoms, adverse effects, receiving large quantities, changing the doctor, improper storage and packaging practices, worsening of disease condition, changing medicines by doctors, keeping medications for future use at home, the short shelf life of some medication, and low trust on western medicines. Similar to this study, a study has shown that the wrong behavior and practices of people and also healthcare professionals play a main role in unused medications among households in the world [2,4,9,28]. Therefore, it is compulsory to promote good practices and behaviors among household members and healthcare professionals on the accurate handling of medication waste in the community.

The investigators in this study also focused on some statements relating to storage, disposal, and misuse of PW to describe perceptions of the study population. Participants understood that there is a risk of keeping PW in the home, and they explained that the increasing availability of PW tends to be misused and could cause harm to humans. Moreover, participants identified children as a widely exposed group to the health hazards of PW. The majority of the study sample mentioned that they did not have adequate information and that they were not provided any advice by healthcare workers regarding the management of unused and expired medicines. The finding of this study should arouse concern by the health authorities of Sri Lanka to initiate public awareness programs on PW management.

Participants expressed their opinions on the importance and requirements of starting a PW management system. They also showed a positive view on establishing drug take-back programs in Sri Lanka. Further, based on their knowledge, they also suggested various other solutions to control the hazardous effects of improper storage, disposal, and misuse of PW. Several of them are taking medicines only as much as needed, storing them safely,

providing awareness programs, disposing of them in the same place used by the hospitals, handing them over to a municipal council garbage vehicle, and discarding them as quickly as possible after use. However, almost all participants were unable to give solutions for preventing damage to the environment due to improper disposal of PW. As another similar study showed, there was a substantial gap between knowledge and actual practices among the general public regarding PW handling in their homes [8,20,21,32,33].

Importantly, the study population had very little knowledge regarding the effects of improper disposal on animals and the environment. Some participants mentioned they did not agree that the disposal of unused or expired medication can cause any kind of damage to animals or the environment. However, participants showed relatively better knowledge and perception towards the harmful consequences of unsafe disposal on humans than the environment. Going along with the findings of recent studies, this study also found that people are currently practicing methods unsafe to water and soil systems as well as plants and animals by disposing of PW [16,19]. As stated by the study results, disposal methods of the people were as follows: flushing down toilets, pouring into a sink, burning, putting into compost bins, using as fertilizer for flowering, burying, and throwing into garbage pits and gardens by dissolving with water. Therefore, a proper policy, procedure, or system should be introduced in the waste management plan for the disposal of medications in a safe way among households, as done for other garbage in the country.

World Health Organization (WHO) guidelines were already established for the safe disposal of unwanted medications around the world [1]. The United States Environmental Protection Agency has also published separate drug disposal guidelines that encourage the public to use the drug take-back system or to follow the guidelines for household disposal of medicines issued by them [33]. In 2004, the European Union introduced a mandatory regulation to make sure that adequate collecting systems are in place for PW [34]. Moreover, Extended Producer Responsibility (EPR) has been included in the legislation in India and Indonesia like Southeast countries for pharmaceuticals [35]. In Sri Lanka, the health system should pay more attention and concern to develop a policy and regulations on improving knowledge, perceptions, and practices on safe storage, proper disposal practices, and preventing misuse of PW among the public.

5. Conclusions

This study conducted a qualitative analysis of data gathered from employees at DMC, which were treated as household representatives in the Galle region. The findings revealed a widespread prevalence of unsafe disposal practices for unused and expired pharmaceuticals among the surveyed individuals. Additionally, minimal involvement of healthcare professionals was observed in raising awareness about pharmaceutical waste management within the community. This study also highlighted the common practice of reusing unused medications among the participants. It underscored the pressing need for awareness and educational initiatives at both local and national levels, alongside the implementation of clear policies. Despite these challenges, there was a favorable attitude toward establishing a drug take-back program for medication waste, indicating a willingness to take action to prevent the unnecessary wastage of medicines. This study emphasized the importance of introducing proper waste management strategies and programs to bridge the gap between knowledge, perceptions, and actual practices concerning the safe storage, disposal, and misuse of unused and expired pharmaceuticals among the general public.

6. Limitations

This study was carried out among working staff at the DMC by using them as household members. When the data collection process was performed, participants faced difficulties with limited time with their working conditions. Therefore, some participants could not participate efficiently. In the general public, medication-related knowledge is at a minor level. Therefore, it was difficult to conduct the research and to gather data on key points according to the research question expected to be investigated. The study population

was selected from working staff at DMC, Galle, presenting as household members in the general public. Thus, it may not reflect household members in the whole community. The study sample may not be a true reflection of real knowledge, perceptions, and practices due to negligible variations in the educational and financial levels of participants.

7. Recommendations

The government and relevant regulatory authorities should introduce standard rules and regulations or policies focused on handling medication waste in households. Proper intervention should be needed via national health institutions and the government to increase awareness in public. Thus, the Ministry of Health and Central Environment Authority should be highly involved in medication waste management in Sri Lanka.

Mass awareness programs suggest increasing knowledge of correct practices of storage, disposal, and use of unused and expired medications among the general public.

Community pharmacies are the main places for purchasing medicines; therefore, it is suggested to develop posters and videos to be demonstrated in pharmacies, providing hand leaflets with their medications and a simple notice and pictures on packages to practice the safe disposal methods among household members until a proper take-back system is established. Pharmaceutical manufacturers can include information on labels and cartons in preferable language to minimize the gap between knowledge and real practices of accurate usage of unused and expired medicines in the community.

Researchers can perform further research based on this area and influence the implementation of standard policies by relevant governing authorities for medication waste management among households.

In community pharmacies and hospitals, separated waste bins or containers can be placed to put medication waste that is accumulated in homes into, and thus, people can bring and discard them into those bins or containers without taking a risk at home.

By helping with the economic drop in the country, good quality unused medications can be used for patients after intermediate quality checking procedures under the supervision of qualified healthcare professionals to minimize the wastage of medicines in our country.

Globally, most of the developed countries have considerable levels of management systems for pharmaceutical waste management and they are critically involved via using rules, regulations, and policies. We can explore globally and introduce novel systems in Asian countries to emit hazardous effects for humans and the environment.

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Abbreviations

DMC: Dhakshinapaya Ministry Complex; EPR: Extended Producer Responsibility; US-FDA: United State Food and Drug Administration; IDI: In-Depth Interview; MW: Medication Waste; NMRA: National Medicine Regulatory Authority; OCP: Oral Contraceptives; OPD: Out-Patient-Department; OTC: Over The Counter; PW: Pharmaceutical Waste; UK: United Kingdom; WHO: World Health Organization.

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