ASSESSMENT OF KNOWLEDGE, ATTITUDE AND PRACTICE OF SAFE DISPOSAL OF UNUSED AND EXPIRED PHARMACEUTICAL PRODUCTS AMONG PHARMACY STUDENTS

ABSTRACT

Pharmaceuticals are produced and consumed in greater quantities every year. Unfortunately, not all medicines given to patients are used up; significant amounts are left unused or expired. The accumulation of medications in the home and the improper Disposal of unused medications can result in inappropriate medication sharing, unintentional childhood poisonings, and the diversion of medicines for illegal use.

Aims: To evaluate the knowledge, attitude and practice on safe Disposal of unused and expired pharmaceutical products among pharmacy students, and to assess the most common categories of drug products that are kept unused at home, the reasons for stocking up and the most preferred ways to dispose of them.

Study design: A Descriptive Cross-sectional study.

Place and Duration of Study: Pharmacy students during the period of March 2022 to August 2022.

Methodology: We included 402 students (209 male, 193 females; age range 18-25 years) from different pharmacy departments (D. Pharm, B, Pharm and Pharm. D). Data were collected using a pre-structured questionnaire and analyzed using SPSS version 20 software. Descriptive statistics including frequencies, mean, standard deviation and percentages were used to summarize the data.

Results: A total of 402 pharmacy students participated in the study. Among the study participants, approximately 81% of the respondents had leftover medicines at home and the most common types of medicines kept in households were NSAIDS (29.89%) followed by antibiotics (24.06%). The most preferred ways of disposing of both unused and expired medicines among the study population were throwing them away in household garbage (55.5%) and disposing of them in their original package and dosage form (22.60%).

Conclusion: The majority of the students were aware of the adverse effects of unsafe Disposal of leftover medicines and they mentioned the need for schemes like drug takeback programs to encourage safe Disposal. Though respondents had good knowledge, the right attitude toward and practice of safe Disposal of medicines were lacking.

Keywords: Knowledge, attitude and practice, medicine disposal, unused medicines, leftover medications.

1. INTRODUCTION

Active pharmaceutical ingredients (APIs) are typically polar molecules. Such APIs are frequently referred to as "micropollutants" since they are typically present in the mg or ng

range aquatic environments. Even though there are various physical and biological reactions occurring in aquatic ecosystems, the presence of trace amounts of human and veterinary pharmaceutical compounds along with their metabolites are detected in water surface areas due to the threshold of pharmaceutical components reaching the environment. These can be considered environmental contaminants.[1] Because of this, the living organisms present in the air, soil and water are affected which further destroys nature.[2] For example, the impact of estrogen, testosterone and progesterone have high damage once they entered the environment such as impotence, genital deformities, hormonally triggered cancers (breast cancer, prostate cancer) and amplification of neurological disorders.[3] Proper pharmaceutical waste management is a complex bush in environmental management. It is the responsibility of people in working conditions to be aware of how to handle, store and dispose of pharmaceutical compounds.[4] Thus, a lack of knowledge on how to dispose of unused and expired pharmaceuticals leads to improper disposal activities that result in accidental poisoning, increased healthcare costs, environmental pollution, antimicrobial resistance and death.[5] Hence this study was conducted among pharmacy students to assess their baseline knowledge, attitude and practice on the safe disposal of unused and expired pharmaceutical products.

Occurrence, fate & effects of the pharmaceutical substance in the Environment

Pharmaceutical-related environmental contamination is a massive issue. Worldwide, human medicine makes use of pharmaceuticals from a wide range of therapeutic classifications.

The majority of pharmaceuticals are taken orally. Some medications are metabolized after administration, while others are left unaltered before being eliminated. As a result, a mixture of medications and their metabolites will enter sewage treatment facilities and municipal sewage.[6]

There was little information about pharmaceuticals released into the environment until recently, but today there is various research available.[7] The measured environmental concentrations (MEC) for human and veterinary substances are reported in various water streams such as surface water, tap/drinking water groundwater, manure, soil and other environmental patterns. Pharmaceuticals or their transformation products have been found in the environments of 71 nations across all continents. The 5 regions recognized by the United Nations were then formed from these nations (UN). Over the detection limit of the specific analytical procedures used, 631 different medicinal compounds were discovered at MECs, indicating distinct regional patterns. There were 16 chemicals found in each of the 5 UN areas. For example, Diclofenac, an anti-inflammatory medication, has been found in environmental matrices in 50 different nations and quantities there have exceeded that expected to have no effects in a number of those locations.[8] Antibiotics, analgesics and estrogens are the therapeutic classes of drugs that are most frequently examined. Priorities and preferences for regional monitoring are immediately obvious; for instance, estrogens are preferred in Africa, analgesics are preferred in Eastern Europe and a variety of various pharmacological groups are preferred in Western Europe and other Groups.[9]

There are multiple sources of the emigration of medications. When humans or animals are administered medication, a certain amount of the substance or metabolites is excreted whereas the remaining are transported to sewage treatment plants (STPs) by the drainage system. Compounds that are not removed in STPs enter rivers, lakes, streams and delta. Also, the major source of aquatic contamination is the disposal of unused or expired medications that are poured directly into the toilet, dustbin, or drain. Medications can also be present in ground and surface water drinking water.[10]

Drug disposal in India

According to statistics, India is a breeding ground for the majority of multi-drug-resistant microbes because of widespread medication use and improper disposal into the environment. To raise awareness of the lack of protocols and the disposal of unused and expired medications, the Indian Pharmaceutical Association (IPA) has requested that the government establish stringent rules and policies for the disposal of pharmaceutical products.

According to the Central Pollution Control Board, 4,057 tonnes of medical waste are produced daily by registered healthcare facilities in India. Treated wastewater samples from South Indian industrial areas were found to contain dangerous levels of antibiotics, despite India being a major producer of pharmaceuticals.

Ciprofloxacin was being thrown into this water along with 21 other drugs at a rate that could have treated 90,000 people while also being extremely harmful to plants and aquatic life.

In India, the general public lacks awareness regarding how to dispose of expired and unused medications. A conceptual framework for discarding unwanted and expired medications has been developed. Patients visiting these pharmacies would be requested to register with the pharmacy and return any unused or expired medication to participating pharmacies after identifying the pharmacies interested in the scheme.

By engaging volunteers, the unused and date-expired medications gathered in pharmacies will be divided into numerous types. Different dosage forms and packing materials would be separated. The collected contents will be delivered to a specialized business that employs particular techniques to recycle the salvageable parts and safely dispose of the chemical parts under guidelines. The recyclable parts must be gathered and properly prepared for reuse.[11]

Drug disposal awareness programs

DDAP clarifies Some of the problems associated with improperly discarding expired medications including the risk of contaminating drinking water sources or supplies because leachate from the disposal site can enter the water supply system.

The sewage system may get infected if non-biodegradable antibiotics, antineoplastic and disinfectants are disposed of away there. Anti-neoplastic may harm aquatic life or contaminate drinking water when they are flushed into water resources.

Large-scale undiluted disinfectant discharges into sewage systems or water resources may also result in a similar predicament.

When expired medications are burned at low temperatures or in exposed containers, hazardous air pollutants are released. Ideally, this ought to be prevented.

The recycling of outdated medications may result from ineffective and unsafe disposal. This is especially true if they are thrown away in their original containers. Before disposal, it is necessary to separate the expired medications into several groups that call for various disposal techniques or according to dose forms. They can be divided into three categories in general based on dose forms: liquids, aerosol cans, solids, semi-solids and powders.

However, prohibited compounds including narcotics and psychiatric pharmaceuticals, anti-infective medications, antineoplastic, antiseptics, disinfectants, etc. must be disposed of with extra care.

WHO and USFDA used to provide clear guidelines for the disposal of medicine. Through landfill, waste immobilization, monetization and flushing, in case of improperly disposed of unused and expired medicines cause contamination in soil and water then they manipulate agricultural and drinking water, which tends to bio magnificent in aquatic, wildlife and humans too.

To reduce this Mr. Sacheen Gandhi Ji and Dr. Sidharth Mehan area actively participate in this Drug disposal awareness program with the following motto:

- ✔ Establishing an appropriate legal framework and procedure to ensure that expired medications are disposed of properly

- ✔ To make sealed boxes available, as well as community centers or pharmacies, for the effective weekly or monthly collection of expired medications for processing and disposal.

- ✔ Holding recurrent awareness campaigns in communities regarding the effects of expired medications on human health and the environment. DDAP states that in India the common people are lacking awareness of the disposal of unused and expired medicine, though the expired medicine is toxic or not, which legally and ethically should not be used in India, for-profit purposes, they were get recycled for the new label for freshly prepared manufacturers and expiry details, even though the expired medicines doesn't cause a very serious hazard to the public and for the environment but the improper disposal of them cause more serious bio magnificent.

Role of pharmacist in the safe disposal of pharmaceutical

There is evidence to suggest that pharmacists should take some ownership in altering the entire medication-use process to reduce the environmental impact of pharmaceuticals. reduction in the release of metabolic waste into the environment across the entire process of prescribing, dispensing, pharmaceutical care and disposal of unneeded medications. There is a wider opportunity for the field of pharmacy and pharmacist practitioners to take a significant leadership role in resolving the environmental problems associated with pharmaceutical usage.[12]

The pharmacy practitioner has the chance to introduce saner prescribing, which would lower the number of unused medications. This would also lessen possible environmental dangers. Pharmacists are at the forefront of addressing issues of responsible drug disposal techniques to end users of drug products because they are regarded, trusted and the most accessible drug information resources. Medication abuse, poor prescription adherence, therapeutic modifications, complex medication regimens, polypharmacy and patient death are a few causes for which pharmaceuticals may accumulate. Prescription drug addiction, accidental overdose and environmental effects are among the risks posed by unused or undesired pharmaceuticals to our communities. Pharmacists can contribute to the solution to the issue of medication waste by working with drug-disposal programs and pharmaceutical collecting events. Pharmacists serve as drug-information providers for effective medication disposal. Pharmacists are making a difference in the communities they serve, whether they

decide to start a Sharps Take-away Environmental Return System program at the drugstore, participate in a DEA National Take Back Day event, or just give consumers knowledge regarding proper medicine disposal.[13]

All pharmacists should get aware of the medication disposal options available in their area so they can recommend them to their patients. If we examine the situation in India, fundamental changes in pharmaceutical education are urgently needed. Curriculum reform should include the dissemination of information about proper drug disposal; environmental aspects of medication, use in their practice curriculum provides a good basic understanding of medicines metabolism and toxicology, which can help to provide an understanding of how medicines and related substances can react in nature and what environmental effects. Effective eco-friendly pharmaceutical and healthcare waste management programs involve cross-sector collaboration and interaction at all levels.[14]

According to a few studies, proper patient counseling regarding safe medicine disposal can significantly improve public health and the environment.[15]

To raise awareness of the risks connected to the careless disposal of unused/expired pharmaceutical products and rising environmental problems continuous education and training are preferred at all levels.[16]

Background:
There is evidence to suggest that pharmacists should take some ownership in altering the entire medication-use process to reduce the environmental impact of pharmaceuticals, reduction in the release of metabolic waste into the environment across the entire process of prescribing, dispensing, pharmaceutical care, and disposal of unneeded medications. There is a wider opportunity for the field of pharmacy and pharmacist practitioners to take a significant leadership role in resolving the environmental problems associated with pharmaceutical usage. Pharmacists serve as drug-information providers for effective medication disposal. Pharmacists are making a difference in the community by contact with both the health care providers and the general public. Considering this, we aim to perform this study to explore the knowledge , attitude and Perception of pharmacy students.

2. MATERIAL AND METHODS

2.1 Study Design and Participants

Our study is a cross-sectional study conducted for a period of 6months involving 402 Pharmacy students (March 2022- September 2022). The study was conducted among in a Pharmacy college (Chennai)

2.2 Eligibility criteria

2.2.1 Inclusion criteria Both male and female pharmacy students of age above 18 years old were included in our study.

2.2.2 Inclusion criteria The non-pharmacy students and those who were not willing to participate were excluded.

2.3 Data collection

The study was carried out with a structured pre-validated questionnaire consisting of four sections designed to address demographic characteristics, knowledge, attitude and practice of participants towards disposal of unused medications. There were 9 questions about

knowledge, 5 on attitude (Likert scale) and 10 about the practice of disposal of unused and expired medications. A pilot test was conducted on the study population and important modifications to the questionnaire were made accordingly. The purpose of the study was explained to the students and their confidentiality was ensured. Study participants were given a maximum of 10 min to complete the questionnaire without being given any assistance to fill it. A total of 402 responses were collected during the study period.

2.4 Statistical analysis

After the completion of data collection, the consistency and completeness of each questionnaire were assessed and coded before data entry into the software system. Descriptive statistics were used to describe the study findings. Data were analyzed using SPSS version 26.00.

3. RESULTS AND DISCUSSION

Medicines are essential for saving lives, but they can also have detrimental effects if used improperly. People's access to pharmaceuticals has dramatically grown as a result of subsequent improvements in healthcare systems, such as the practice of dispensing OTC medications and an increase in the filling/ re-filling of prescriptions. Due to easier access, it is now the role of healthcare professionals to consider how capable a person is to handle unused and expired medical products.

It is widely acknowledged that one of the primary sources of pharmaceutical residues in the environment is improper disposal practices can have negative effects on the environment and public health.

WHO and USFDA have established standards for the correct disposal of unused, leftover, and expired medications. The national formulary for India regarding the disposal of the drug was released in 2011. Medicine disposal habits are influenced by environmental awareness, availability of official state guidelines, dosage forms, and social and cultural attitudes Although the FDA has issued certain guidelines for proper disposal but still people are not that aware.

Our study gives an insight into knowledge, attitude, and practice of self-medication among of disposal of unused and expired medicine among pharmacy students.

A total of 402 students have participated of which 209 (52%) are male and 193 (48%) are female students. Figure (1) illustrates that the majority of students were between the age of 18-19 years (208 (51.74%)) followed by the ages 20-21 years (138 (34.33%)), 22-23 years (52 (12.94%)) and 24-25 years (4(1.0%)) respectively.

Figure 1: Percentage distribution of age (n=402)

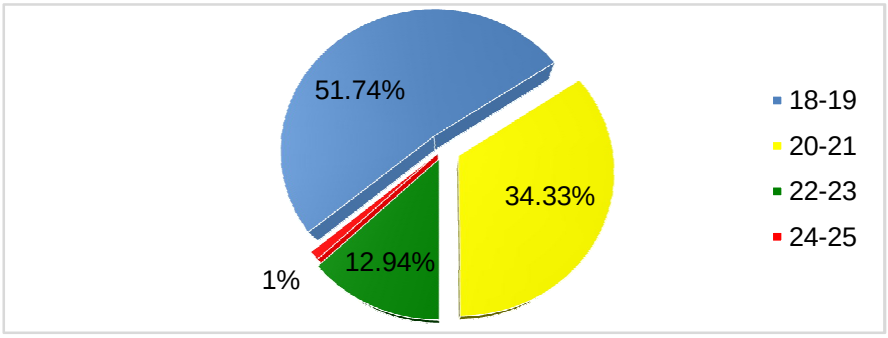
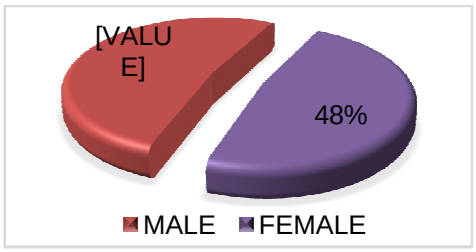


Figure (2) illustrates that about 209 (52%) were male students and 193 (48%) were female students with a mean age of about 19.7±1.46 (years).

Figure 2: Percentage distribution of gender



The majority of the respondents are from B pharm (43.3%), followed by Pharm D (30.6%) and D pharm (26.1%) as given in figure (3).

Figure 3: Percentage distribution of education of the participants

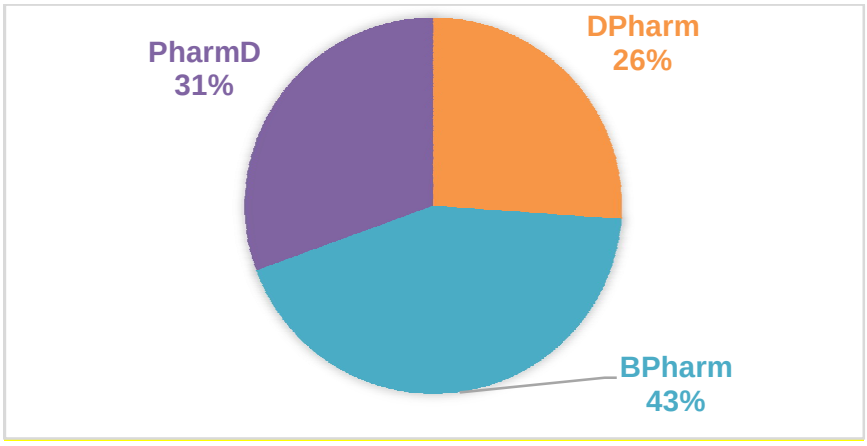


Figure 4: Percentage distribution of respondent's knowledge concerning unused and expired pharmaceutical disposal

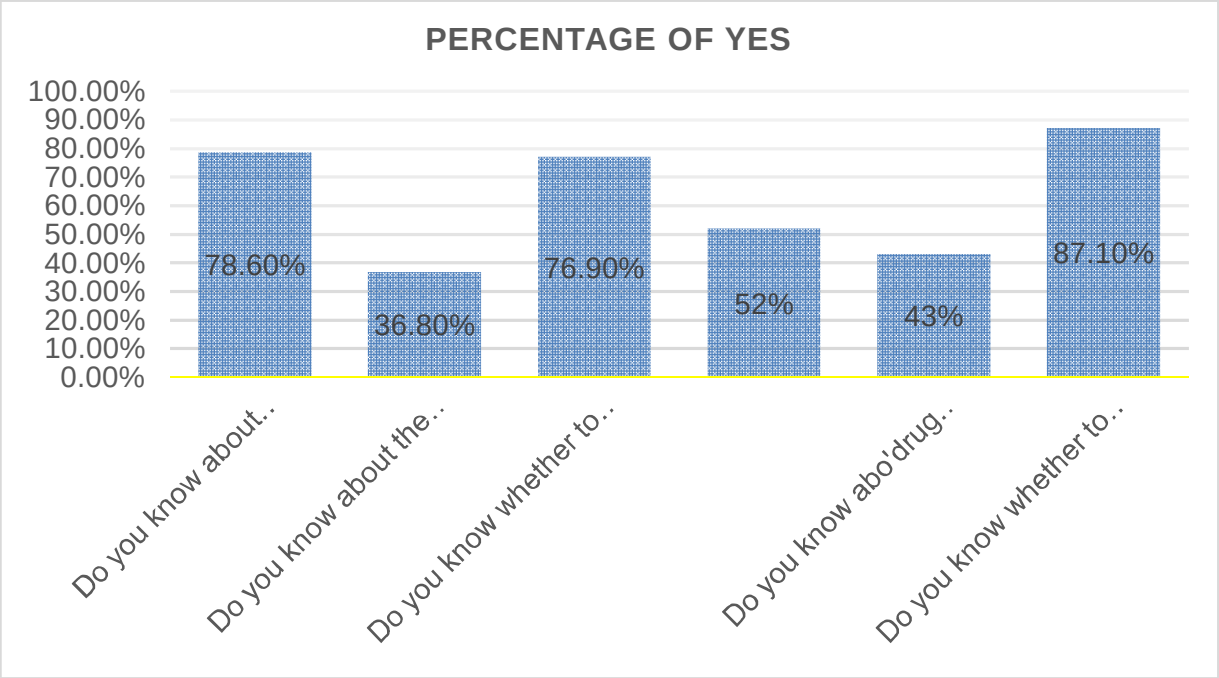


Figure 5: Descriptive analysis of respondent's knowledge regarding proper ways of discarding medication

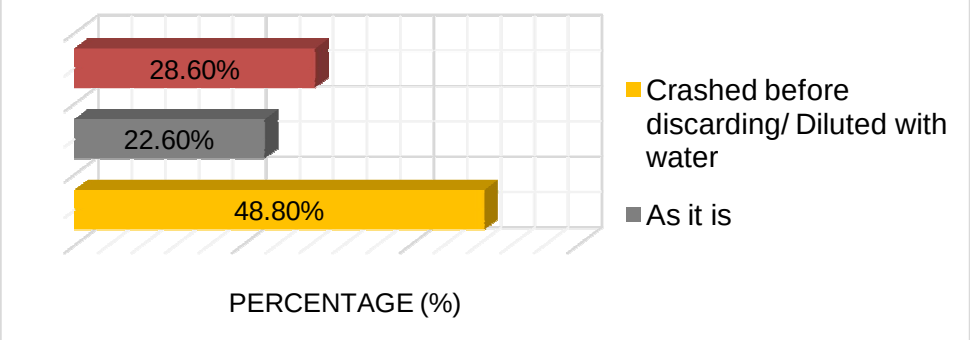


Figure 6: Percentage distribution of respondent's knowledge of ways of controlling the hazardous effect of unused and expired medicines

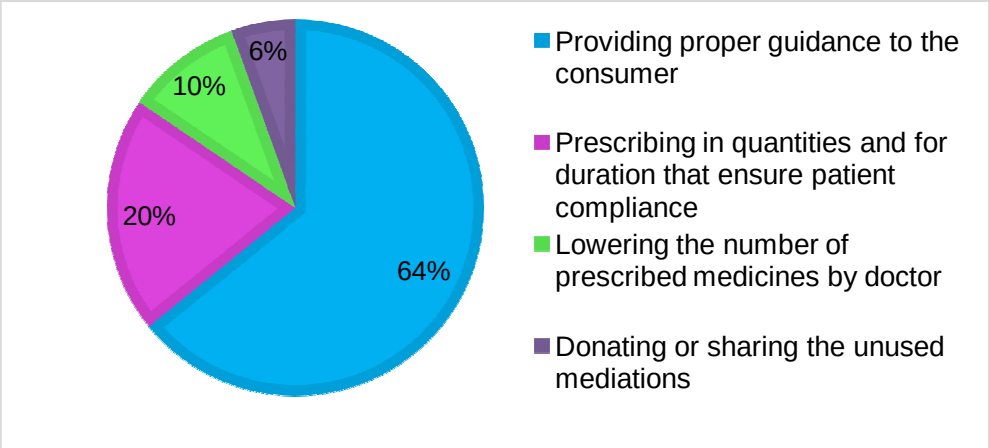


Figure 7: Percentage distribution of stockholders for creating awareness among the community about proper disposal

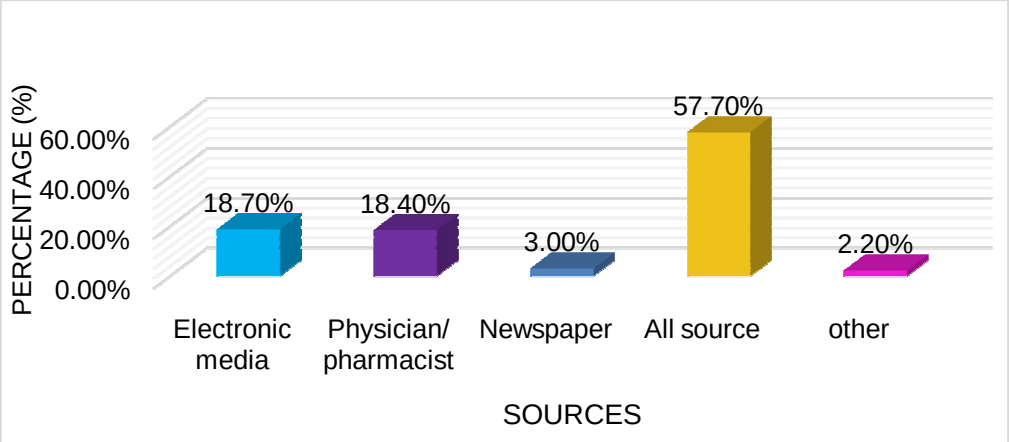


Figure 8: Percentage distribution of respondent's attitudes toward risk associated with unused and expired household medicines

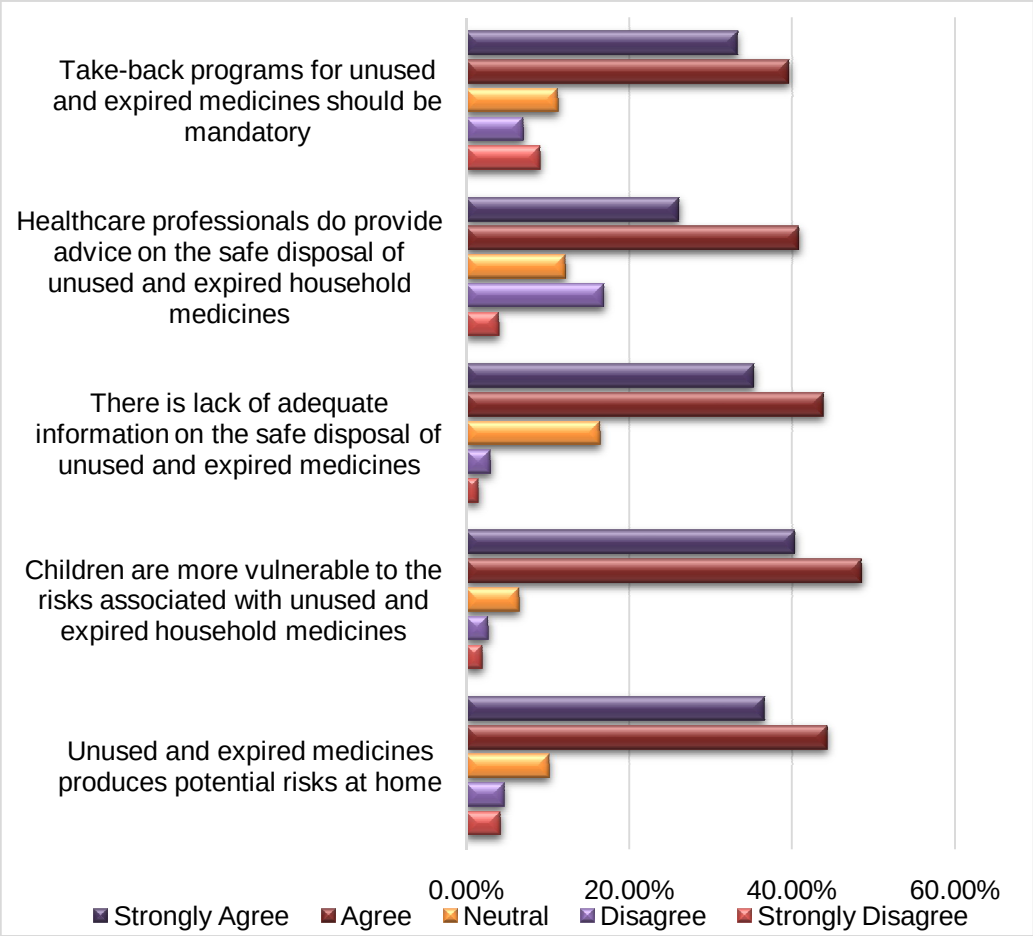


Figure 9: Percentage distribution of respondent's practice on completing the full course of medication

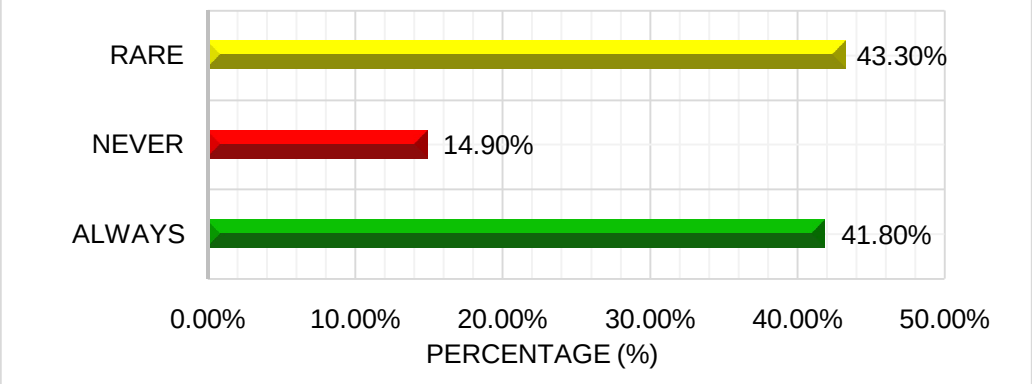


Figure 10: Percentage distribution of reasons given by respondents for having leftover or unused medications

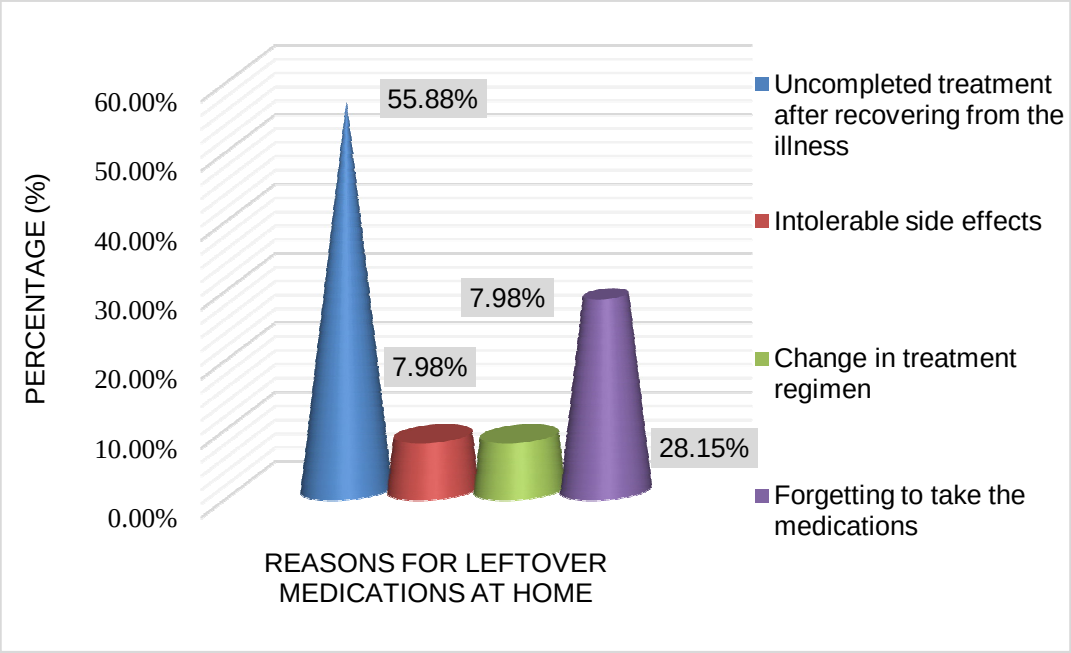


Figure 11: Percentage distribution of leftover medication at home

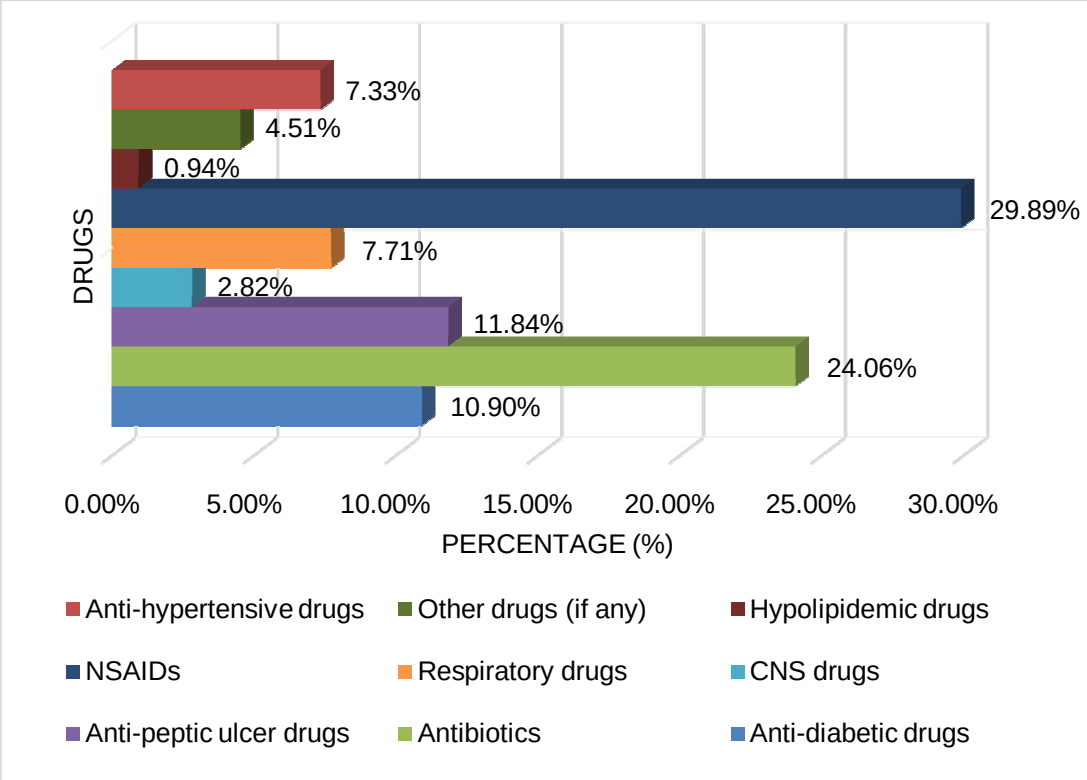


Figure 12: Percentage distribution of leftover formulations at home

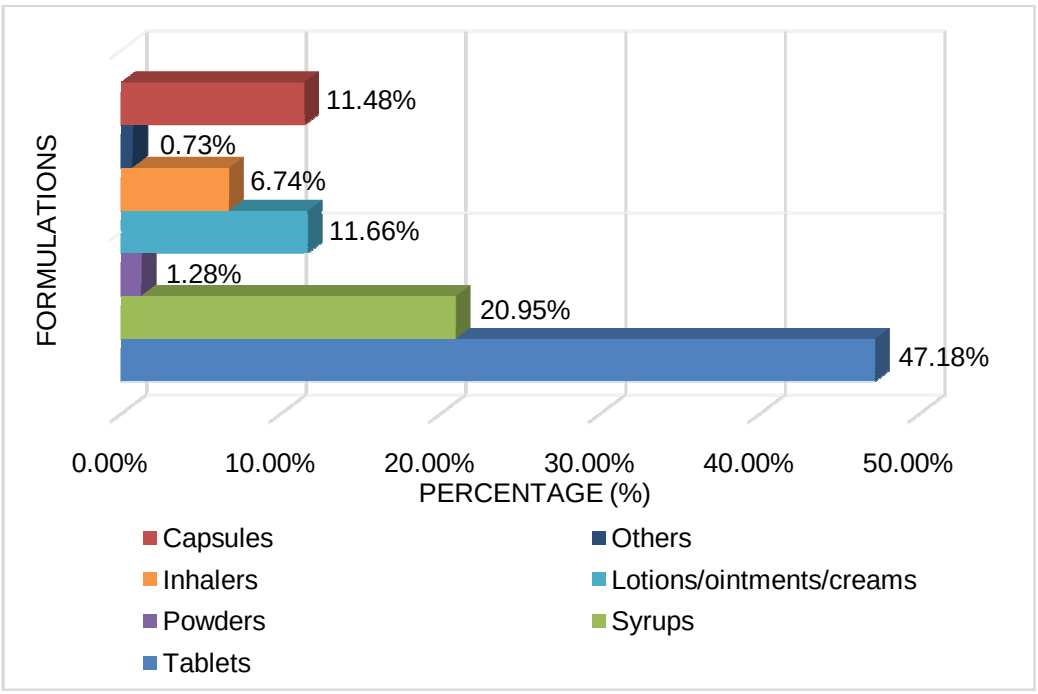


Figure 13: Percentage distribution of respondent's practice of storing medication at home

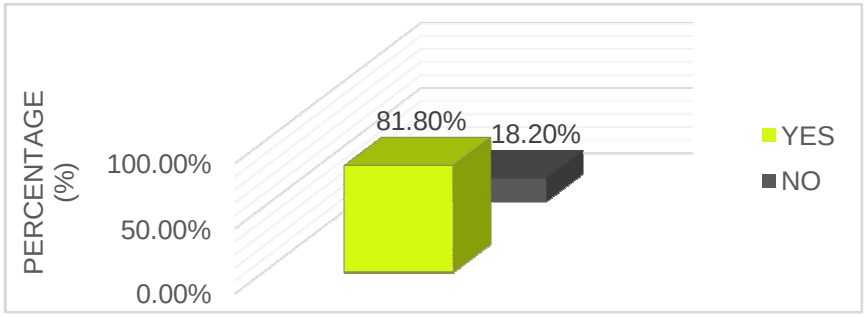


Figure 14: Percentage distribution of respondent's practice in common places for storing unused or leftover medication at home

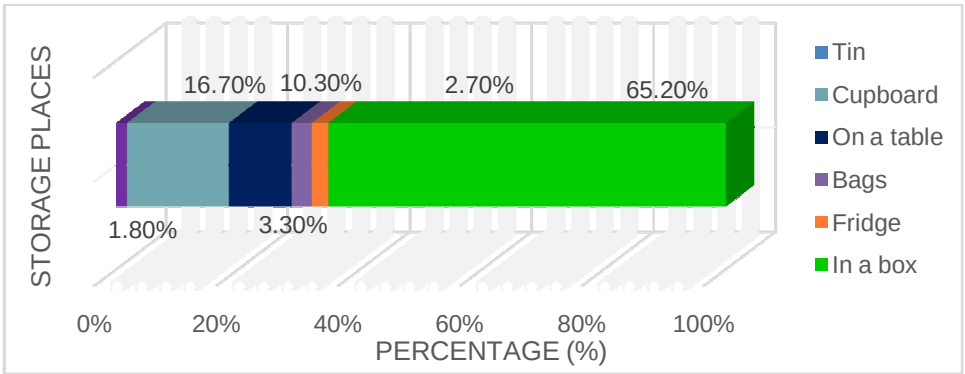


Figure 15: Percentage distribution of respondents' practice of checking the expiry date before using the leftover medication

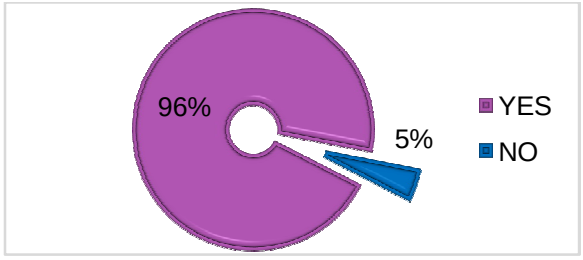


Figure 16: Percentage distribution of respondents' practice of discarding unused medication

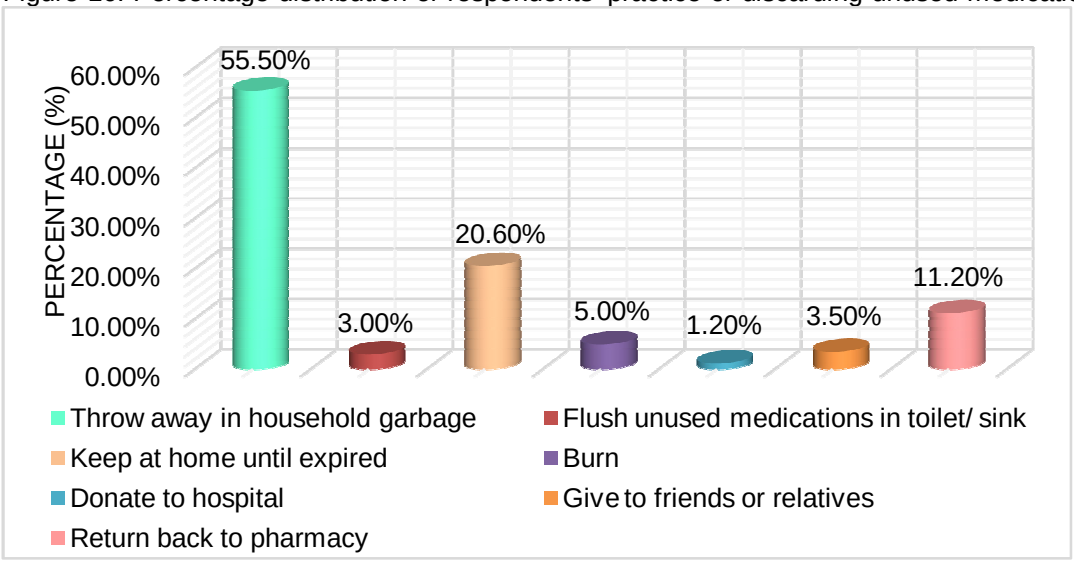
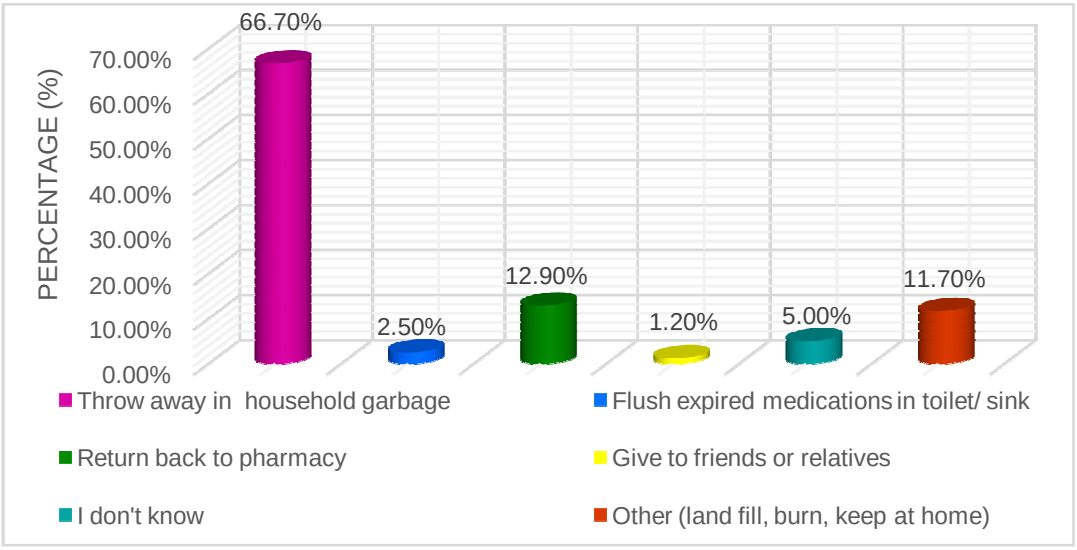


Figure 17: Percentage distribution of respondent's practice of discarding expired medication



3.1 Knowledge of unused and expired pharmaceutical disposal

In the present study, Awareness of the concept of eco-pharmacovigilance (EPV) was not very much evident among students, because only 36.8% (254) knew about the term eco-pharmacovigilance, which is defined as “the science and activities associated with the detection, evaluation, understanding and prevention of adverse effects of pharmaceuticals in the environment and it was quite surprising that not much pharmacy students knew about EPV.

Most of the students 316 (78.6%) in our study, were aware of medication waste and also the majority of the respondents (87.1%) felt that improper disposal of unused and expired medicines hurts the environment and health. This finding was similar to the study conducted by Yohanes Ayele et al (2018) were approximately 73% of the study participants strongly believed that improper disposal practices of medication waste can have negative effects on the environment and public health.

In this present study, half of the participants 56.9% were having poor knowledge of the drug take-back system. Although this result is much more encouraging when compared to the study done by Md. Abul Kalam Azad et al., (2012) where 93.5% of participants don’t know about the drug take-back system. The legislative bodies also contribute significantly by promoting and encouraging "drug take-back" initiatives.

These programs are community efforts where members of the public are permitted to bring their used medications to a facility that supports environmentally friendly disposal, this positive outlook on the medicine take-back program may be a good opportunity to reduce the harmful effects of improper pharmaceutical disposal.

In the present study, about 76.9% of the respondents know to dispose of unused and expired medication and 52% of the participants are having little understanding and information regarding appropriate unused and expired medicine disposal instructions. This is relatively similar to a study conducted by Susi Ari Kristina et al., (2018) where 44.75% of the participants receives information concerning the correct disposal instruction. Campaigns and programs to raise awareness about safe medication disposal can help with this.

In our study proper way of discarding medication by participants was crashed before discarding/ diluting with water about 48.76%.

According to the WHO guidelines, the proper way of discarding medication was,

1. Take unused, unneeded, or expired prescription drugs out of their original containers and throw them in the trash.

2. Mixing prescription drugs with an undesirable substance, such as used coffee grounds or kitty litter and putting them in impermeable, non-descript containers (such as empty cans or sealable bags) will further ensure the drugs are not diverted.

3. Flush prescription drugs down the toilet only if the label or accompanying patient information specifically instructs in doing so.

About two-thirds of participants (64.18%) in the current study recommended providing proper guidance to the consumer on how to dispose of unused and expired medication, while a smaller percentage of the participants (9.95%) supported lowering the number of prescribed medicines by the doctor. This outcome conflicts with a study carried out by Ahsaan Ahmed

et al., (2013) says that to minimize the entry of pharmaceuticals into the environment the majority of respondents said that physicians are the best source who can play their role by prescribing a smaller number of drugs and in low quantities.

In our study only, a small proportion of the participants about (5.47%) said that they shared or donated unused medicines with friends. Hisham S. Abou-Auda's (2002) study suggested that around 20% of patients shared medicines with relatives or friends. Sharing or borrowing a prescription drug has Several risk factors, including polypharmacy and multiple chronic comorbidities, however, this attitude was hardly ever seen among the study's participants.

In our study, about 57.71% of the respondents said creating awareness on drug disposal of unused and expired medications through all the sources including electronic media, pharmacists/physicians and newspapers. Education by physicians, pharmacists and nurses could hint toward the faith of consumers in these health professionals. Similar recommendations were put forth by respondents in a study conducted by Lagishetty et al., (2013).

Educating and empowering audiences utilizing leaflets, advertisements and talk shows on media, especially social are more popular these days and tend to be more successful, possibly because the intervention is considered as having more authority.

3.2 Attitude of unused and expired pharmaceutical disposal

In this study, 44.3% of participants agree and 36.6% of participants strongly agree that unused and expired drug produces potential risks at home. Almost 80% of people agreed that children are more vulnerable to the risks associated with unused and expired household medications.

More than three-fourths of the participants in this study agreed (43.5%) and strongly agreed (35.3%) that there wasn't enough information available about how to safely dispose of used and expired medications. This study is consistent with the study conducted by Kristina S A (2018).

Almost 60% of the participants felt that there should be a campaign to raise awareness about how to properly dispose of used and expired medications. They claimed that informing the public about the correct disposal of used and expired medications is on the shoulders of the pharmaceutical industry, doctors and pharmacists.

According to the surveys, medical personnel was not providing their patients with information about how to properly dispose of used and expired medications and the majority of participants wanted more awareness-raising campaigns. All of this points to the necessity of launching a campaign to raise awareness of correct medication disposal techniques using suitable media.

In the present study, nearly 39.6% agreed and 33.3% of participants strongly agreed on the need to have mandatory medicine take-back programs. This is consistent with the study conducted by Mst. Marium Begum et al., (2018). If the government takes the initiative to develop the system, this positive outlook on the drug take-back program may be a good opportunity to reduce the adverse effect of improper medicine disposal.

3.3 Practice of unused and expired pharmaceutical disposal

In our study, only 41.79% of participants take their full course of medication prescribed by the doctor. The reason for leftover medications is recovery from illness (55.9%), intolerable side effects (8%), change in the treatment regimen (8%) and forgetfulness (28.2%). This is similar to the study conducted by Law et al., (2015) about two out of every three prescription drugs were not used. They weren't used because of disease/condition improvement (42.4%), forgetfulness (5.8%) and side effects (6.5%). This behavior not only results in the overstocking of medications but also shows that consumers are unaware of the significance of finishing their treatment.

The most frequent left-over medication found in the home according to the responders of our study was NSAIDS (29.89%). This is similar to the study conducted by Javeria Shamim (2018) where analgesics accompany 26.9%. Antibiotics are the second most commonly leftover drug in this study (24.06%), while Bashaar M et al., (2017) study reported 46.5%. The reason for the antibiotic's exposure may be the easy availability of the OTC drug and non-adherent with the treatment. Al-Shareef F et al., (2016) state that inappropriate antibiotic use is the cause of unused or expired medicines in the household. When sharing antibiotics with family or friends, few people were concerned about antibiotic resistance or treatment failure. Public health campaigns emphasize the improper use of antibiotics in viral diseases including colds and the flu since microbial resistance is a major public health concern. The other medications that were found to be kept at home were cough syrups, anti-diabetics, anti-hypertensives, aspirin, anti-histamines, etc. which are similar to the findings of a previous study conducted by Swaroop et al., (2015)

The present study reveals that respondents possess around 47.18% of leftover drugs in tablet form in the majority of cases since it was the least expensive, safest, most convenient and preferable route: Which is then followed by liquid oral preparation, syrup about 20.95%. Abruquah AA et al., (2014) conducted a study that showed the most common dosage form was liquid dosage form.

In our study majority of the respondents (81.84%) had stored unused and expired medicine at home and agree they produce potential risk and are more vulnerable to children. Other studies have also reported a high proportion of storage of unused and expired drugs about 88.3%, which is concluded by Martin Kampamba et al., (2021). This is higher compared to studies conducted by Yohanes Ayeleet al., (2018) (29%) and Javeria Shamim et al., (2018) (35.3%). The difference in storage might be related to differences in medicine or information access across the studies.

In our study, almost 65.15% of respondents stored medication in a box. Other storage options like tin, bags, fridges, cupboards and tables secured the least percentage. The high level of unused and expired household medicine storage practice can be a source of accidental poisoning by young children and sources of inappropriate drug use and self-medication practice. And has the potential for abuse by adolescents especially when the medicines are habit-forming.

The majority (95.52%) of the participants used to check the expiry date before taking the leftover medicine which is a good practice whereas, a study by Mohammad Bashaar et al., (2017) showed that 97% of people checked the expiry date before administering them.

In our study half of the population, about 55.5% disposed of both unused and expired medication in the household garbage. This was consistent with a study conducted by AlAzmi A et al., (2017) that nearly 73% of the participants discarded leftover, expired, unwanted, or unused medications by throwing them in the garbage or trash. Kusturica MP et al., (2017) study also depicted that throwing them in the garbage was the most common practice in

many countries. Prescription drugs should be taken out of their original packaging together with the patient information, mixed with something unpleasant like sawdust, coffee grinds, or kitty litter and then put in a sealable plastic bag container before throwing it away.

Followed by 3% of the respondents who flushed both unused and expired medications down the toilet or sink which are similar to the practices followed by the people in Kuwait, the UK and the USA where it is the best practice for liquid medications.

In our study, about 20.65% of the participants keep the unused drug at home for future use until it expired which is a source of potential health threat. Mohammad K Bashaar et al., (2015) conducted a study where half of the interviewed population (52.2%) kept unused medication at home until expired.

This study also shows that (11%) of respondents considered returning unused and expired medicine to the pharmacy as an appropriate way of disposing of unused or expired medicines. The low percentage might be due to a lack of awareness about the proper disposal of medicines. This reasoning becomes more evident when compared with findings in studies conducted by Matilda Persson et al., (2009), Dias-Ferreira C et al., (2016), Braund R et al., (2009) and Kozak MA et al., (2016) where a majority of the participants returned unwanted medication to the pharmacy. The difference seen could be due to the existence of systems that encourage the proper disposal of unused medicines. All these approaches toward the safe disposal of leftover pharmaceuticals play a significant role in reducing the introduction of pharmaceuticals to the environment since they can cause environmental, human health and safety hazards. In our study, burning leftover medicines and landfills were the other means of disposing of expired household medicines as reported by 11.69%. The American Pharmacists Association recommends that unwanted medications be crushed or dissolved in water before mixing with the undesirable substance.

Community pharmacists can play a vital role by leading the way in advising and promoting appropriate knowledge and awareness among the public. Therefore, it is equally important that they have an up-to-date, thorough and correct understanding of how to properly dispose of medications. currently, 20% of pharmacists claim to have learned about pharmaceutical disposal in pharmacy school. To instruct their clients on how to use and store pharmaceuticals safely, pharmacists have created an educational intervention brochure. Given that it has been established that free access to medications is linked to greater medication wastage, the government should concentrate on the medications that are provided free of cost at public hospitals.

4. CONCLUSION

The findings of the study revealed that approximately 81% of the respondents were having leftover medicines at home and the most common types of leftover medicines in households were NSAIDS (29.89%) followed by antibiotics (24.06%). The major reason for stocking up on drugs is due to early recovery from the illness (55.88%). The most preferred way of disposing of both unused and expired medicines among the study population was throwing them away in household garbage (55.5% & 66.7%).

The majority of the students were aware of the adverse effects of unsafe disposal of unused and expired medicines. Though study respondents had good knowledge, the right attitude toward and practice of safe disposal of medicines were lacking.

The study clearly describes the need for integrating pharmacovigilance education in healthcare curriculums to prepare them for real-world practices and at their workplaces.

Creating awareness and strong implementation of safe disposal guidelines and a planned system for gathering unused and expired medications are recommended.

CONSENT

Written consent was obtained from the students involved in the study.

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COMPETING INTERESTS

The authors have declared that no competing interests exist.

AUTHORS' CONTRIBUTIONS

Mrs. Leena Muppa designed the study, managed the analyses of the study and wrote the first draft of the manuscript. Rajmahizhan T, Meenatchi R and Priyadharshini V managed the process of data collection. All authors managed the literature searches and performed the data entry. Thenmozhi G performed the statistical analysis, and along with Priyadharshini V interpreted the data. All authors read and approved the final manuscript.

LIMITATIONS OF THE STUDY

The study has the relatively small sample sizes.
The study was conducted only on the pharmacy graduates of our institution.
The general public and other institution pharmacy graduates, who are equally important in ensuring the safe disposal of unwanted and expired medication, could not be included in this study.

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LIST OF ABBREVIATIONS

API - Active Pharmaceuticals Ingredients
DDA - Drug Disposal Awareness
DEA - Drug Enforcement Agency
EPV - Eco-Pharmacovigilance
FDA - Food and Drug Administration
IPA - Indian pharmaceutical Association
MEC - Measured Environmental Concentrations
NSAID - Non Steroidal Anti- Inflammatory Drug
OTC - Over The Counter
STP - Sewage Treatment Plants
UN - United Nations
UK - United Kingdom

USFDA - United States Food and Drug Administration
USA - United States of America
WHO - World Health Organization