International Journal for Multidisciplinary Research (IJFMR)
E-ISSN: 2582-2160 ● Website: www.ijfmr.com ● Email: editor@ijfmr.com

Assessment of Knowledge and Awareness of Safe Disposal of Unused and Expired Medications Among Stakeholders

Adnan Hussain[1], Mahendra Kumar Betur Jayappa[2], Anupama Lakshmidevi Kanthappa[3], Shaeeb Mehreen[4]

[1,3,4]PharmD Student, Farooqia College of Pharmacy, Mysore.
[2]Professor, Farooqia College of Pharmacy, Mysore.

ABSTRACT:
Medicines play a crucial role in treating many diseases and medical conditions. Most of the medicine users are unaware of disposal practices of unused/expired medicines. These are potentially toxic substances that should be managed effectively to avoid accidental consumption and possible environmental hazards. The study conducted across Mysuru city aimed to explore the knowledge, attitude, and practice towards the disposal of unused and expired medicines among stakeholders such as pharmacy students, doctors, nursing students, professors, housekeeping staffs and general population. A total of 150 participants have completed the survey. According to the survey, 70.38% of the general public, 60% of doctors, and 76.5% of students were unaware of proper drug disposal methods. Out of 150 responders, 90 (91.83%) students, 10 (100%) physicians, 14 (93.33%) academics, and 24 (88.89%) members of the general public agreed that inappropriate medicine disposal affected both human health and the environment. Majority of the stakeholders had leftover/unused medications at home. The most common reason for drug accumulation was improved health. The most common drug disposal practice was throwing in trash bin followed by distributing them to friends and family. 85.2% of stakeholders agreed that a drug take-back program should be introduced and 94% agreed that consumer education is necessary for safe disposal of unused medicines. The results showed poor knowledge and awareness about proper disposal methods leading to drug accumulation.

Keywords: Expired medicines, unused medicines, drug disposal, stakeholders, cross-sectional study.

INTRODUCTION:

Medicines are essential for maintaining health, managing chronic conditions, and improving physical and mental health.[1] However, their impact on the environment is not fully understood, leading to complex and long-term effects. Eco pharmacovigilance (EPV) aims to detect, evaluate, and prevent adverse effects of pharmaceuticals, especially when exposed to environmental media.[2] However, treating pharmaceuticals as a group of substances could lead to significant resource waste.[3] Unused medications, which are no longer consumed by the intended user or patient, are often stored due to excessive prescribing or poor patient adherence. The COVID-19 pandemic has increased self-medication consumption, posing a serious problem.[4]

Various drugs, including hydroxychloroquine, azithromycin, remdesivir, ceftaroline fosamil, ceftolozane tazobactam, cefditoren, ceftriaxone, colistin, doxycycline, linezolid, and Ivermectin, have been used to treat various health issues, including COVID-19.The other reasons include: unnecessary storage of OTC medications, development of adverse effects, alteration of dosage, improvement of patient's medical condition, change in the treatment, medications reaching the expiration date, change in the physician's prescribing patterns, oversupply of medicines from multiple centres, bulk purchase of medicines etcetera.[5,6,7]

Consequences of keeping unused medicines at household include: accidental consumption by toddlers and children that could be lethal; intentional misuse by teens causing serious side effects such as drug abuse and dependency; sharing of leftover medicines with other patient having similar symptoms.[8]

It is the usual tendency to throw the unused and expired medicines in the household trash, which is either collected by municipal waste collectors or thrown into the vacant plots in the neighbourhood or on the streets.

But this approach of disposal of drugs is hazardous to the environment and is threatening to life. Proper disposal of medication is crucial for household safety and the environment, as children and teens often access adult medications for pain, anxiety, or attention deficit disorder.[9] The public lacks knowledge on proper disposal of expired and unutilized pharmaceuticals, leading to contamination in groundwaters, surface waters, soils, and sludges, and landfills.[10] There is a chance that these medicines are accidently exposed to waste pickers and children. Also, there could be a hypothetical risk of these medicines being recycled back into the market.[11] Poor medical waste disposal poses significant health risks, including infection, trauma, and exposure to chemicals and radiation, affecting healthcare staff, patients, and causing environmental contamination.[12]

Pharmaceuticals pose a growing environmental risk due to inefficiency in conventional wastewater treatment technologies, raising public and scientific alarm.[13] The improper medication disposal methods include flushing in toilets/sink, burning and throwing outside or into the dustbins that results in environmental contamination and pollution.

Household garbage usually ends up in landfills thereby contaminating surface water. The drugs being flushed down the sewage system leads to direct surface water contamination thereby harming humans, animals and aquatic life.[7,14]

Drug use in humans and veterinary populations is increasing, with 100,000 tons of antimicrobials consumed annually and 30 billion NSAID doses in the US. Pharmaceuticals are detected in the environment, but most households dispose of them in garbage or sinks, creating a stockpile for accidental or deliberate ingestions.[15]

Eco-directed sustainable prescribing [EDSP], a method to reduce the environmental impact of active pharmaceutical ingredients (APIs), is crucial in the Eco pharmacovigilance program. Recent polls show most physicians are concerned about the environmental impact of API residues and support EDSP's effectiveness in reducing exposure.

Pharmaceutical companies' industrial waste contributes to drug contamination in the environment, despite sewage treatment processes being obsolete.[16]

Majority of active pharmaceutical ingredients (APIs) are polar compounds also referred to as "small molecules". These small molecules are part of the compounds called "micropollutants", because they are often found in mg/ng range in aquatic environment.

Micropollutants released into the nature have serious effect on the environment, whose accumulation in water bodies contributes to increase antibiotic resistance in humans and exposure of drugs to aquatic animals. Their entry into the food chain via personal care products being discarded, pesticides used in fields maximizes the introduction of APIs in the environment, thereby disturbing the whole ecosystem e.g., indirect exposure to diclofenac leads to substantial decline in the vulture population in Indian subcontinent. Another example is of estrogens and their effects on fishes i.e., feminization and De-masculinization of male fish; renal tubular damage due to expired tetracyclines.[5,17] Non-biodegradable disinfectants, antineoplastics, and antibiotics are used to kill bacteria in sewage treatment, affecting organic degradation processes, nitrification, and denitrification.[18] Microbial resistance is a significant concern due to environmental exposure to drugs, with low doses in drinking water potentially causing it, and declining pharmaceutical companies' focus on lifestyle drugs.[19] Unused medications in cabinets pose a danger to humans, environment, and wildlife, while discarded medicines in waterways and drinking water have gained national and international attention.[20]

The conventional drug disposal methods and the type of pharmaceuticals being discarded are:[14]

1. Return to donor or manufacturer; all bulk waste pharmaceuticals, particularly antineoplastics.
2. Landfills:
   Highly engineered sanitary landfill; limited quantities of untreated solids, semi- solids and powders. PVC plastics.
   Engineered landfill; waste solids, semi-solids and powders, preferably after immobilization.
   Open uncontrolled non engineered dump; untreated solids, semi-solids, powders.
3. Waste immobilization: encapsulation; solids, semi-solids, powders, liquids, antineoplastics, controlled substances.
4. Waste immobilization: inertization; solids, semi-solids, powders, antineoplastics, controlled substances.
5. Sewer (fast-flowing watercourse); diluted liquids, syrups, intravenous fluids, small quantities of diluted disinfectants (supervised).
6. Burning in open containers; packaging, paper, cardboard.
7. Medium temperature incineration with two chamber incinerators with minimum temperature of 850°C; solids, semi-solids, powders, controlled substances.
8. High temperature incineration with temperatures greatly in excess of 1200oC; solids, semi-solids, powders, antineoplastics, controlled substances.
9. Chemical decomposition.

Convenience to perform drug disposal, reducing the risk of diversion, should be deprived of any financial burden and should not harm environment; are the feasible methods of drug disposal.

The global scenario of drug disposal across various developed countries such as United States include National prescription drug take-back events for safe disposal of unused medicines.

Canada: The various pharmaceutical disposal methods used by the Canadians include returning to the donor, discarding in landfills, waste immobilization, burning in open containers, high temperature incineration and chemical decomposition. Health product stewardship association (HPSA) provides information regarding locations and processes for safe drug disposal in every Canadian province. It also administers medication return programs for participating pharmacies in British Columbia, Manitoba, Ontario, and Prince Edward Island. Annual campaigning is done in order to encourage De-cluttering of medicine cabinets and returning of unwanted and expired medicines to the pharmacy.

USA: The presence of chemicals in drinking water and environment has raised public's growing concern and awareness from past two decades.

The first federal guidance for consumers was issued in the year 2007 which recommends disposing of unused pharmaceuticals to household trash, after mixing with an inert substance and concealing the contents. The various collecting points such as pharmacies, collects the unused medicines for eventual destruction. This keeps a check on introduction of these pharmaceuticals into the environment.

Australia: The National Return and Disposal of Unwanted Medicines programme offers safe and free method for disposing/discarding expired and unwanted medicines thereby reducing the dumping of drugs in waterways and landfills. A survey conducted showed over 600 tonnes of unwanted medicines are being returned, this data helps in assessing decision making about the supply and use of medicines at National level, it also aids in designing the campaigns facilitating quality use. Data revealed salbutamol, insulin and frusemide were the most common discarded medicines. Over $2 million of economy is wasted behind these unused medicines. This problem can be controlled by educating the patients regarding importance of adherence to prescribed treatment. Health professionals should discourage the accumulation of medicines, should prescribe required quantity of medicines. Patient compliance should be assessed with prescribing minimal quantity of drug at the start of respective therapy.

Nigeria: Hoarding of medicines because of self-medication is the common problem in Nigeria. Drugs are stored either for the purpose of re-use or are shared with the individuals having same problems. Analgesics, antibiotics and nutrition/blood preparations were the common classes of drugs found.

Due to lack of basic education among Nigerians, complaints of dumping in the soil, groundwater and drinking water are reported. Therefore, public awareness regarding safe disposal practices is encouraged to help overcome environmental contamination.

New Zealand: The reason for leftover medicines is either improved or resolved medical condition. Based on the type of pharmaceutical i.e., tablets, capsules and liquids, the former two are returned to pharmacies and latter one is added to water systems. Preventing over prescribing, proper education regarding safe disposal etcetera helps in reducing the potential impact on environment.

Thailand: The accumulation of neuromuscular drugs was commonly found. Thai villagers stored medicines and did not use them completely. Further the stored medicines were thrown into the garbage causing potential harm to environment. Poor education, career and income are the causes for negligence.

India: India produces 4,057 tonnes of medical waste daily, with treated wastewater containing dangerous levels of antibiotics. Ciprofloxacin and 21 other drugs were thrown into water, potentially treating 90,000 people and harming plants and aquatic life. Drugs are necessary to treat various diseases and are being released every day to promote health among growing Indian population.

The reasons for accumulation of expired or unused drugs are non-adherence, excessive storage of OTC medicines or disuse of drugs. India's common medicine disposal practices include direct disposal in the environment, burning, and incineration. Many municipalities lack facilities, and people and healthcare professionals are unaware of the consequences. The narcotics department prioritizes controlling addiction-causing medicines, not disposal.[21]

The USFDA started 'drug take back programme' in order to avoid entry of such medications into the environment. But it is unfunctional in India. The improper drug disposal methods are leading to development of numerous problems, the unconventional disposal methods such as flushing into the toilet/sink, burning and throwing in the landfills or into the waste basket is leading to contamination of environment, water bodies, pollution and harm to local resources used by community and wildlife. This

leads to increased incidence of accidental poisonings, drug abuse, serious environmental and health hazards such as toxicity, development of drug resistance and eventually death. Implementing different drug disposal programs and spreading awareness regarding the proper disposal of unused and expired pharmaceuticals should be improved in India.[20]

India lacks strict regulations for safe medicine disposal, and drug take-back programs are ineffective. The National Formulary provides guidelines, but many are unaware of their importance. An Indian study recommends improving awareness among dental students about safe disposal methods of expired and leftover medicines.[22] Future healthcare professionals should be knowledgeable about proper medicine disposal procedures and Eco pharmacovigilance to prevent wastage of medicines. Pharmacy, Medical and dental students play a crucial role in educating the public on safe medication use and disposal practices.[23] Proper medicine storage and disposal are crucial for quality, patient safety, and the environment, with pharmacists playing a vital role in public education on these practices.[24]

MATERIALS AND METHODS:

- **Study design:** This is a cross-sectional survey.
- **Study site:** The study will be conducted in the CSI Holdsworth Memorial (Mission) Hospital Mysore, Farooqia College of Pharmacy, few selected Community Pharmacies and localities across Mysore city, Karnataka.
- **Study period:** This study will be conducted over a period of 6 months from March 2023 to August 2023.
- **Study approval:** Approval awaited from the Institutional Ethics Committee of Farooqia College of Pharmacy, Mysore.
- **Study materials:** Self- structured questionnaire for knowledge, posters on safe disposal of drugs, safe disposal of drug devices.
- **Study analysis:** All the required data will be collected and the same will be documented in a suitably designed data collection form. The data will then be entered in Microsoft Excel sheet for easy storage, retrieval, and analysis of data.
- **Feedback form:** a self-structured questionnaire was prepared to receive the feedbacks about the posters displayed in various stakeholder premises.

RESULTS:

A total of 150 responses were recorded through a survey conducted at Farooqia College of Pharmacy, Mysuru; CSI Holdsworth Memorial Hospital, Mysuru; few selected Community Pharmacies and areas across Mysuru city, over a period of six months; from March 2023- September 2023. The study was carried out to assess the knowledge, attitude and practice towards safe disposal of unused/expired medications

Demographics Data: In this survey, the demographic data included was Age, Gender, Occupation and Qualification.

1. Age:

The participants were grouped into different categories based on age of the participants. Among them 117 (78%) participants in age group between 18 to 29, 19 (12.67%) were in the age group between 30 to 39, 8 (5.33%) were in the age group between 40 to 49 and 6 (4%) participants were above 50 years of age.

2. **Gender:**

Among 150 participants, 69 (46%) were males and 81 (54%) were females.

3. **Occupation:**

Among 150 participants, 98 (65.33%) participants were Students, 10 (6.67%) were Doctors, 15 (10%) were professors and 27 (18%) participants were from various other work field.

KNOWLEDGE AND ATTITUDE REGARDING SAFE DISPOSAL OF UNUSED/ EXPIRED MEDICINES AMONG STAKEHOLDERS

1. **Information on proper Drug Disposal Methods:**

Among 98 Students, 22 (22.45%) Students had information on proper Drug Disposal Methods; 4 (40%) out of 10 Doctors were aware; 12 (86.67%) out of 15 Professors were aware and 8 (29.62%) out of 27 respondents of General public had information on proper drug disposal methods. **Hence, after conducting the survey we came into a conclusion that 76 (77.56%) Students, 6 (60%) Doctors and 19 (70.38%) respondents of General population were unaware.**

2. **Received instructions on Medicine Disposal Methods:**

Among 98 Students, 31(31.63%) Students had received instructions on Medicine Disposal Methods; 2 (20%) out of 10 Doctors received instructions; 7 (46.67%) Professors out of 15 & 8 (29.62%) of General population received instructions on Medicine disposal methods. Hence, after conducting the survey we came to a conclusion that 67 (68.37%) students, 8 (80%) Doctors, 8 (53.33%) Professors & 19 (70.38%) Respondents of general population Did not receive information on Medicine Disposal Methods.

3. **Improper disposal affects environment and health:**

Among 98 Students, 90 (91.83%) Students agreed that improper disposal will affect environment and health; 10 (100%) out of 10 Doctors agreed; 14 (93.33%) out of 15 Professors agreed; 24 (88.89%) out of 27 of General population agreed that improper disposal affects environments and health. **Hence, from the above data we can conclude that all the stakeholders agreed that improper disposal of medicines affects environment and health.**

4. **Unused/leftover Drugs at home:**

Among 98 Students, 60 (61.22%) Students had unused/leftover drugs at home; 5 (50%) out of 10 Doctors; 8 (53.33%) out of 15 Professors and 25 (92.59%) out of 27 of General population had unused/leftover drugs at home. **Based on the data collected, it can be concluded that all the stakeholders had Unused/leftover drugs at home.**

5. **Reasons for accumulation:**

1. **Improvement in health-** Among 98 Students, 40 (40.81%) Students; 2 (20%) out of 10 Doctors; 3 (20%) out of 15 Professors and 21 (77.78%) out of 27 General population had accumulation of drugs due to improvement in health.
2. **Expiry date-** Among 98 Students, 45 (45.91%) Students; 3 (30%) out of 10 Doctors; 3 (20%) out of 15 Professors and 20 (74.07%) out of 27 General population had accumulation of drugs due to medications reaching expiry date.
3. **Bulk purchase-** Among 98 Students, 24 (24.48%) Students; 1(10%) out of 10 Doctors; 2 (13.33%) out of 15 Professors and 7 (25.92%) out of 27 General Population had unused/leftover drugs due to bulk purchasing.

4. **Side effects-** Among 98 Students, 15 (15.30%) Students; 1 (6.67%) out of 15 Professors and 4 (14.81%) out of 27 General population had unused/ leftover medicines due to development of side effects.

From the above data, it can be concluded that medications reaching expiry date is the major reason for drug accumulation among Students, Doctors and Professors. In General population, the most common reason of accumulation was found to be improvement in health.

PRACTICE TOWARDS SAFE DISPOSAL OF UNUSED/ EXPIRED MEDICINES AMONG STAKEHOLDERS

1. **Disposal practices of leftover/unused medicines:**

1. **Throwing in dustbin-** Among 98 Students, 55 (56.12%) Students; 3 (30%) out of 10 Doctors; 5 (33.33%) out of 15 Professors and 23 (85.18%) out of 27 General population were disposing the drugs directly into dustbins.
2. **Giving away to friends/relatives-** Among 98 Students, 11 (11.22%) Students; 1 (10%) out of 10 Doctors and 15 (55.56%) out of 27 General population were giving away their unused/ leftover medications to friends/relatives.
3. **Returning to pharmacies-** Among 98 Students, 11 (11.22%) Students; 2 (20%) out of 10 Doctors; 3 (20%) out of 15 Professors and 2 (7.41%) out of 27 General population were returning the leftover/unused medicines to pharmacies.
4. **Rinsing down the sink-** Among 98 Students, 5 (5.12%) Students and 1(3.70%) out of 27 General population were rinsing unused/leftover/expired medicines down the sink.

Based on the data collected, we can conclude that, throwing in dustbin was the major drug disposal practice among all the stakeholders which is followed by giving away to friends/relatives among Students and General population.

2. **Need for "Drug take-back program":**

Among 98 Students, 74 (75.51%) Students; 9 (90%) out of 10 Doctors; 13 (86.67%) out of 15 Professors and 27 (100%) out of 27 General population agreed that there is a need for Drug take-back program. Hence, 85.2% of stakeholders agreed that a "Drug take-back program" should be introduced.

3. **Need for Consumers awareness program:**

Among 98 Students, 85 (86.73%) Students, 10 (100%) out of 10 Doctors, 14 (93.33%) out of 15 Professors and 26 (96.30%) out of 27 General population agreed that there is need for consumers awareness programs. Hence, 94% of the stakeholders agreed that consumers education is necessary as a part of spreading awareness regarding safe disposal of unused/expired medicines.

4. **Measures to improve awareness:**

1. **Patient education-** Among 98 Students, 64 (65.30%) Students; 9 (90%) out of 10 Doctors; 10 (66.67%) out of 15 Professors and 22 (81.48%) out of 27 General population voted for patient education as a measure to spread awareness to consumers.
2. **Awareness program by the government-** Among 98 Students, 55 (56.12%) Students; 7 (70%) out of 10 Doctors; 7 (46.67%) out of 15 Professors and 20 (74.07%) out of 27 General population said that awareness program should be carried out by the government.
3. Information via newspaper, TV, Posters and social media- Among 98 Students, 49 (50%) Students; 8 (80%) out of 10 Doctors; 5 (33.33%) out of 15 Professors and 19 (70.37%) out of 27 General

population suggested that information via newspaper, TV, 85Posters and social media can help in improving consumers awareness.

4. **Written instructions on medicines-** Among 98 Students, 45 (45.91%) Students; 6 (60%) out of 10 Doctors; 9 (60%) out of 15 Professors and 14 (51.85%) out of 27 General population said that written instructions on medicines will be helpful in improving consumers awareness.

Table 1: Overview of demographics of respondents

Variables	Demographic parameters	Number of responses (n=150)	Percentage of responses
Gender	*Male*	69	46%
	Female	81	54%
Age	18-29	117	78%
	30-39	19	12.67%
	40-49	08	5.33%
	50 and above	06	4%
Occupation:			
1) Student (n=98)			
a) Pharmacy	PharmD	75	50%
	BPharm	10	6.66%
b) Nursing	BSc Nursing	11	7.3%
c) Others	BBA, BDS	02	1.33%
2) Doctors (n=10)	MBBS	03	2%
	MBBS, MS	04	2.67%
	MBBS, DNB	03	2%
3) Lecturers (n=15)	PharmD	05	3.33%
	MPharm	06	4%
	MPharm, PhD	03	2%
4) General Public (n=27)	Graduate	13	8.67%
	Undergraduate	14	9.33%

n= number

Table 2: Respondent's knowledge and attitude regarding medicine disposal methods

Knowledge and attitude regarding Medicine Disposal Methods	Students (n=98)	Doctors (n=10)	Lecturers (n=15)	General Public (n=27)
Information on proper Drug Disposal methods	22 (22.45%)	04 (40%)	12 (86.67%)	08 (29.62%)
Received Instruction on Medicine disposal	31 (31.63%)	02 (20%)	07 (46.67%)	08 (29.62%)

Improper Disposal affects Environment and health	90 (91.83%)	10 (100%)	14 (93.33%)	24 (88.89%)
Have unused/leftover drugs at home	60 (61.22%)	05 (50%)	08 (53.33%)	25 (92.59%)
Accumulation due to:				
i. Health condition Improved	40 (40.81%)	2 (20%)	3 (20%)	21 (77.78%)
ii. Expiry Date	45 (45.91%)	3 (30%)	3 (20%)	20 (74.07%)
iii. Bulk purchase	24 (24.48%)	1 (10%)	2 (13.33%)	7 (25.92%)
iv. Side effects	15 (15.30%)	0 (0%)	1 (6.67%)	4 (14.81%)

n= number

Table 3: Respondent's practice towards medicine disposal methods

Practice towards Medicine Disposal Methods	Students (n=98)	Doctors (n=10)	Lecturers (n=15)	General Public (n=27)
Throwing in Dustbin	55 (56.12%)	3 (30%)	5 (33.33%)	23 (85.18%)
Giving away to friends/relatives	11 (11.22%)	1 (10%)	0 (0%)	15 (55.56%)
Returning to Pharmacies	11 (11.22%)	2 (20%)	3 (20%)	2 (7.41%)
Rinsing down the sink	5 (5.12%)	0 (0%)	0 (0%)	1 (3.70%)
Need for drug take back programme	74 (75.51%)	9 (90%)	13 (86.67%)	27 (100%)
Should consumers be made aware about methods of safe disposal	85 (86.73%)	10 (100%)	14 (93.33%)	26 (96.30%)
Measures to improve awareness:				
i. Patient education	64 (65.30%)	9 (90%)	10 (66.67%)	22 (81.48%)
ii. Awareness program by government	55 (56.12%)	7 (70%)	7 (46.67%)	20 (74.07%)
iii. Providing information via	49 (50%)	8 (80%)	5 (33.33%)	19 (70.37%)

	newspaper, TV and social media				
iv.	Written instructions on medicines	45 (45.91%)	6 (60%)	9 (60%)	14 (51.85%)

n= number

DISCUSSION:

After conducting the survey, we came into a conclusion that 76 (77.56%) Students, 6 (60%) Doctors and 19 (70.38%) respondents of general population were unaware of the information on proper drug disposal methods. 67 (68.37%) students, 8 (80%) Doctors, 8 (53.33%) Professors & 19 (70.38%) Respondents of general population Did not receive information on medicine disposal methods. All the stakeholders agreed that improper disposal of medicines affects environment and health. It is concluded that all the stakeholders had unused/ leftover drugs at home. Medications reaching expiry date is the major reason for drug accumulation among Students, Doctors and Professors. In General population, the most common reason of accumulation was found to be improvement in health. Throwing in dustbin was the major drug disposal practice among all the stakeholders which is followed by, Giving away to friends/relatives among students and general population. 85.2% of stakeholders agreed that a "Drug take-back program" should be introduced. 94% of the stakeholders agreed that consumers education is necessary as a part of spreading awareness regarding safe disposal of unused/expired medicines.

The posters were displayed and the feedback for the posters were collected by the self-structured, pre-validated "poster feed-back form" (Annexure 3). We collected 20 responses based on design, colour, content, font, background, size and thickness of the posters. Out of 20 responses, 19 (95%) voted 'very good' and 1 (5%) voted for 'good', All the 20 respondents (100%) voted "very good", Out of 20 respondents, 16 (80%) voted "very good" and remaining 4 (20%) voted "good", Out of 20 responses, 16 (80%) voted "very good" and remaining 4 (20%) voted "good", All the respondents (100%) were satisfied with the posters prepared.

Medbin/ Drug disposal box (model) was designed it is a rectangular box comprising a triangular lid and a rectangular body. The body comprises 3 inner compartments each for solid medications (Tablets, capsules, pills, etc.); liquid medications (syrups, lotions, ointments, solutions, etc.) and powder dosage forms respectively. The triangular lid provides an opening through which these expired/ unused medications can be dumped in. The lid is joined to the body at one side providing access for the removal of medications. The box is affixed on a stiff base which provides stability. The walls of the box are illustrated with different educational posters emphasising safe drug disposal practices. This medbin can be introduced for commercial use for example, at hospitals, pharmacies and industries. The Disposal Med-bags were introduced, these bags can be used for domestic purpose. Solid unused/ expired medications such as tablets, capsules, pills, etc. can be periodically discarded using these bags.

Medications to be disposed of should be placed in the bag, tightly sealed off and should be handed over to the municipal waste collectors separately. An awareness can be created among municipal workers educating them that green bags contain unused/ expired medicines. An awareness program should be run for general public emphasising use of green medbags for disposal of unused/ expired medications.

CONCLUSION:

The purpose of this study was to assess the knowledge, attitude and practice regarding safe disposal of unused/expired medications among stakeholders. The knowledge assessed regarding safe drug disposal was poor. Most of the respondents did not receive any information on proper drug disposal methods and they agreed that improper drug disposal will affect the environment and health. Medications reaching expiry date and improvement in health were the major reasons for drug accumulation. The common practice of drug disposal was throwing in dustbins which was not appropriate. The respondents had poor knowledge and no awareness regarding safe drug disposal methods.

The study came out with four posters on spreading awareness regarding safe drug disposal. Four posters were designed in English language and were translated into Kannada language. The posters were evaluated for its content, design, pictograms and found to be satisfactory. The designed posters were displayed at Pharmacy Practice lab of Farooqia College of Pharmacy, Mysuru; Clinical pharmacy department of CSI Holdsworth Memorial Hospital, Mysuru and three community pharmacies across Mysuru city.

We designed two drug disposal devices i.e., 'Drug disposal box' (model) and 'Disposal bag'. The feedback on various parameters including design, size, shape and colour was found to be satisfactory.

REFERENCES:

1. ZalpuriR, Sharma JK, Singh R, Rawat L. Disposal practices and awareness of medicine waste management among general population of Delhi-National Capital Region, India. J Appl Pharm Sci, 2022; 12(01):078–083.
2. Begum MM, Rivu SF, Hasan MMA, Nova TT, Rahman MM, Alim MA, Uddin MS, Islam A, Nurnahar, Tabassum N, Moni MMR, Roselin R, Das M, Begum R, Rahman MS. Disposal Practices of Unused and Leftover Medicines in the Households of Dhaka Metropolis. Pharmacy (Basel). 2021 May 20;9(2):103. doi: 10.3390/pharmacy9020103. PMID: 34065255; PMCID: PMC8162525.
3. Esseku YY, Mante PK, Dodoo ANO, Woode E. Drug Disposal and Ecopharmacovigilance Practices in the Krowor Municipality, Ghana. J Toxicol. 2022 Dec 30;2022:7674701. doi: 10.1155/2022/7674701. PMID: 36619292; PMCID: PMC9822764.
4. Rogowska J, Zimmermann A. Household Pharmaceutical Waste Disposal as a Global Problem-A Review. Int J Environ Res Public Health. 2022 Nov 27;19(23):15798. doi: 10.3390/ijerph192315798. PMID: 36497873; PMCID: PMC9737308.
5. Shivaraju PT, Gangadhar M. Knowledge and awareness of disposal of unused and expired medications among medical undergraduates of A Tertiary Care Teaching Hospital at B G Nagar: A cross-sectional observational study. Natl J Physiol Pharm Pharmacol 2017;7(11):1268-1273.
6. Bashaar M, Thawani V, Hassali MA, Saleem F. Disposal practices of unused and expired pharmaceuticals among general public in Kabul. BMC Public Health. 2017 Jan 7;17(1):45. doi: 10.1186/s12889-016-3975-z. Erratum in: BMC Public Health. 2017 Mar 6;17 (1):231. PMID: 28061902; PMCID: PMC5219664
7. Wang LS, Aziz Z, Chik Z. Disposal practice and factors associated with unused medicines in Malaysia: a cross-sectional study. BMC Public Health. 2021 Sep 16;21(1):1695. doi: 10.1186/s12889-021-11676-x. PMID: 34530791; PMCID: PMC8447783.
8. Partnership for Drug-free Kids. 2015. Safe Drug Disposal: A Guide for Communities Seeking Solutions. Washington, DC: Office of Community oriented Policing Services.

9. Aryal A, Anuba PA, Arun GR, Sarumathy S, Kumar RN. A review on status of drug disposal practice of unused and expired drugs among different countries. J Appl Pharm Sci, 2023; 13(04):045–052. https://doi.org/10.7324/JAPS.2023.32158.
10. Munshi R, Dhiman A, Maurya M. A cross-sectional survey to assess the drug disposal practices of unused and expired medicines among lay public visiting a tertiary care hospital in an urban metropolis. Indian J Physio Pharmacol 2023;67:29-35.
11. Agarwal K K. Safe disposal of expired and unused medicines: https://ww.healthysoch.com/morning-medtalks/safe-disposal-of-expired-and-unused-medicines/amp/.
12. Medhi B, Sewal RK. Ecopharmacovigilance: an issue urgently to be addressed. Indian J Pharmacol. 2012 Sep-Oct;44(5):547-9. doi: 10.4103/0253-7613.100363. PMID: 23112410; PMCID: PMC3480781.
13. Kumar LS, Logeshwaran, Rani NV, Thennarasu P, Keerthana M, Lavanya M. Assessment of Knowledge and Awareness on the Disposal of Expired and Unused Medicines among Medication Consumers. J Young Pharm. 2019;11(4):410-6.
14. Prakash D, Sudhakaran S and Shabaraya AR. Global Scenario of Drug Disposal: A Review of Literature. J Basic Clin Pharma. 2020; 11:01-04.
15. Dutta A, Banerjee A, Chaudhry S. Ecopharmacovigilance: Need of the hour. Indian J Pharm Pharmacol 2022;9(2):77-80.
16. Efrain Merma Chacca D, Maldonado I and Vilca FZ (2022) Environmental and ecotoxicological effects of drugs used for the treatment of COVID 19. Front. Environ. Sci. 10:940975. doi: 10.3389/fenvs.2022.940975.
17. Kaur K, Bansal N. Knowledge, attitude and practice on safe disposal of medicines among medical personnel. IP Int J Comprehensive Adv Pharmacol 2021;6(2):79-82.
18. David Muriithi Nyagah et.al. (2020) Pharmaceutical waste: overview, management and impact of improper disposal, Journal of PeerScientist 3(2): e1000028.
19. Jha N, Shankar PR, Palaian S. Knowledge and Practice on Ecopharmacovigilance and Medicine Storage Amongst Medical and Dental Students in Lalitpur, Nepal. Risk Manag Health Policy. 2021 Feb 25;14:793-802. doi: 10.2147/RMHP.S291025. PMID: 33658875; PMCID: PMC7920617.
20. Sarla, G.S. Efficacy and disposal of drugs after the expiry date. Egypt J Intern Med 31, 431–434 (2019). https://doi.org/10.4103/ejim.ejim_110_19
21. Althagafi A, Alshibani M, Alshehri S, Noor A, Baglagel A, Almeleebia T. Assessment of knowledge and awareness of safe disposal of unused or expired medication in Saudi Arabia: A cross-sectional study. Saudi Pharm J. 2022 Nov;30(11):1672-1678. doi: 10.1016/j.jsps.2022.09.012. Epub 2022 Sep 30. PMID: 36465848; PMCID: PMC9715641.
22. Fernandes MR, Figueiredo RC, Silva LGRD, Rocha RS, Baldoni AO. Storage and disposal of expired medicines in home pharmacies: emerging public health problems. Einstein (Sao Paulo). 2020 Feb 17;18:eAO5066. doi: 10.31744/Einstein journal/2020AO5066. PMID: 32074222; PMCID: PMC7018094.
23. Vidhi Gautam, Y P Sahni, Sachin Kumar Jain and Arpita Shrivastav. Ecopharmacovigilance: An environment safety issue. The Pharma Innovation Journal 2018; 7(5): 234-239.
24. Muppa. L., Thenmozhi. G., Priyadharshini. V., Meenatchi R. and Rajmahizhan, T. (2022) "Assessment of Knowledge, Attitude and Practice of Safe Disposal of Unused and Expired

Pharmaceutical Products among Pharmacy Students", Journal of Pharmaceutical Research International, 34(63), pp. 12–26. doi: 10.9734/jpri/2022/v34i637285.

25. Petro Karungamye a,b, ∗, Anita Rugaika b , Kelvin Mtei b , Revocatus Machunda b. The pharmaceutical disposal practices and environmental contamination: A review in East African countries. HydroResearch 5 (2022) 99-107.