Research Article

Assessing Eco-Pharmacovigilance Awareness and Responsible Drug Disposal Habits Among Community Pharmacy Patrons

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ABSTRACT

Improper disposal of unused and expired medicines poses significant environmental and public health risks. Eco-pharmacovigilance (EPV) focuses on identifying and preventing the adverse environmental effects of pharmaceutical products. This study assessed awareness of eco-pharmacovigilance and drug disposal practices among community pharmacy patrons in Kerala. About 360 participants in a four-month cross-sectional observational study were determined for their knowledge, attitudes, and practices on EPV using a validated questionnaire. The findings showed that over half of participants were not familiar with the term EPV, 93.3% of them were aware of the adverse health effects of inappropriate drug disposal. 59.7% of people disposed of their medications in domestic trash, while 63.3% did not. 84.7% supported government laws, 65.8% were prepared to participate in EPV awareness activities, while only 14.7% returned medications to pharmacies. The report highlights the importance of accessible take-back programs, pharmacist-led campaigns, and education.

Keywords: Eco-pharmacovigilance, Community Pharmacy Patrons, Rational Drug Use, EDSP, KAP.

INTRODUCTION

Pharmaceuticals play an important role in improving human and animal health, but their increasing use has also created a serious environmental concern. Unused, expired, and improperly disposed medicines can enter soil, rivers, and water systems, affect ecosystems and live organisms. Studies have found traces of drugs such as antibiotics, painkillers in drinking water and aquatic life [17,26,29]. Improper disposal of medicines by households, hospitals contribute significantly to pharmaceutical pollution. [7,18,27]

Importance of Eco pharmacovigilance (EPV)

• Environmental Protection

EPV helps to prevent pollution caused by pharmaceutical waste entering soil, water, and ecosystems.[22,26]

• Wildlife and Ecosystem Safety

Some medicines have been linked to serious ecological effects for example, diclofenac caused vulture deaths, and hormonal drugs disrupted fish reproduction.[17,22,29]

• Encourages Rational Drug Use

It advocates eco-directed sustainable prescribing (EDSP) of medicines reduces environmental pollution.[3,19]

•Awareness and Education

EPV emphasizes the need to educate healthcare workers, pharmacists, and the public about safe drug disposal and environmental responsibility .[4,5,12]

Improper disposal of unused and expired medicines is a widespread problem among community pharmacy patrons and represents a significant public health and environmental concern. Despite of increasing availability of information on safe medication use, inappropriate drug disposal practices prevail across different populations .[7,18,21]

The scope of this study extends the awareness, knowledge, attitudes, and practices related to Eco-pharmacovigilance (EPV) and the disposal of unused and expired medicines among healthcare students and the general public. It seeks to understand how individuals perceive the environmental impact of pharmaceuticals and how they manage expired drugs in their homes or workplaces. Improper disposal of medicines through household waste, flushing or open dumping has been identified as a growing environmental problem worldwide, leading to the contamination of soil, water and aquatic systems. Studies have shown that healthcare professionals, lack sufficient knowledge about safe disposal practices, resulting in increased pharmaceutical pollution.

This study aims to assess these knowledge gaps and promote awareness about the importance of EPV in preventing such pollution. Furthermore, it highlights the need to include environmental safety education in the curriculum for medical and pharmacy students. The study also covers the role of rational drug use and Eco-Directed Sustainable Prescribing (EDSP) in minimizing pharmaceutical residues released into the environment. It emphasizes the global and national need for strong policies, drug take-back programs, and regulatory systems that encourage safe waste management and reduce ecological harm. By assessing current awareness levels and behaviors, this study aims to provide valuable data that can guide public health authorities, educational institutions, and policymakers in designing effective EPV strategies. The

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scope of eco-pharmacovigilance is broad and multidisciplinary, encompassing environmental monitoring, public health protection, regulatory support, education, and sustainability initiatives. Its implementation is essential to ensure that pharmaceutical benefits are achieved without compromising environmental and ecological integrity.

MATERIALS AND METHODS

Study Period:

The study was conducted over a period of 4 months.

Study Population:

The study was conducted among 360 individuals from community pharmacy patrons.

Study Design:

It was a cross-sectional observational study conducted among community pharmacy patrons.

Study Tool:

A well-structured validated questionnaire was used for this study.

Statistical Method:

Statistical Package for the Social Sciences [SPSS]

Inclusion Criteria:

The inclusion criteria for the study included adults aged above 18years of both male and female, and have provided informed consent to participate in the study.

Exclusion Criteria:

The exclusion criteria for the study include medical professionals, Psychiatric patients and dementia patients.

Study Description:

A questionnaire was prepared based on the evidence from existing studies. The questionnaire consists of twenty-two questions. The first section of the questionnaire consists of four questions which is based on demographic details. Next section consisted of four questions which is a knowledge-based questions regarding safe disposal of medicines and EPV. The last coming section of five set of question is attitude-based questions toward medicine waste management and environmental impact. Last section of nine questions is practice-based questions regarding the disposal methods and participation in awareness activities.

Methodology:

The study follows cross-sectional observational designs conducted over the period of four months among 400 individuals from community pharmacy patrons from kerala. Participants aged above 18years of both male and female are selected using direct sampling through a structured questionnaire. The questionnaire is validated and data is collected on participants' knowledge, attitude, and practices (KAP) regarding drug disposal and ecopharmacovigilance. A total of 400 participants is determined as the required sample size. Exclusion criteria include medical professionals, psychiatric, and dementia patients. Data are recorded using a data collection form and analyzed.

Based on previous literature, 37% of respondents were reported to practice safe disposal of medicines.[30] With a 95% confidence level and an absolute precision of 5%, the required sample size was calculated to be 358 participants.

Formula

$$n = \frac{Z_\alpha{}^2 pq}{d^2}$$

p is the proportion of safe disposal of medicines was reported as 37%

q is 100-P = 63%

d is allowable error = 5%

Zα2 = 95% confidence interval = 1.96

N= (1.96 x 1.96 x 37 x 63)/ (5 x 5) =358 participants

RESULT

1.Demographics of the Participants

A total of 360 community patrons completed the questionnaire. Among the participants, the percentage of males and females was 162(45%) and 198(55%), respectively. The mean age of the participant was 31.8 years. The education level of the participants was 10th class (4.4%), 12th class (23.3%) and degree/above (72.2%), respectively.

Table 1: Demographics of the Participants

Variables	Category	n (%)
Age	18 – 29	225(62.5%)
	30 – 49	81(22.5%)
	Above 50	54(15%)
		Mean age =31.8
Gender	Male	162(45%)
	Female	198(55%)
Level of education	10th	16(4.4%)
	12th	84(23.3%)
	Degree/above	260(72.2%)
Employment status	Student	165(45.8%)
	Employed	149(41.4%)
	Unemployed	46(12.8%)

2. Knowledge of Community Pharmacy Patrons regarding the eco-pharmacovigilance awareness and responsible drug disposal habits

There were five questions to evaluate the knowledge regarding the eco-pharmacovigilance awareness and responsible drug disposal habits (Table 2). Among the

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respondents, a higher proportion (93.3%, n = 336) knew that improper disposal of drugs can cause effect on the health.

Awareness on improper medicine disposal can harm or affect the environment was reported by many participants, mainly through news or awareness campaigns (45.3%), educational institutions (26.4%) and through personal experience or observation (10.6%), while 17.8% were not aware previously. More than half of respondents (59.7%, n=215) have proper knowledge on safe disposal, whereas a considerable proportion have no knowledge (22.2%) or were unsure (18.1%) on proper disposal of medicine. They agreed to have observed instructions on proper medicine disposal obtained from medicine labels (30.3%), pharmacies or hospitals (17.5%), and government guidelines or posters (19.4%); however, one third of participants (32.8%) had not seen any instructions. Majority of participants 195(54.2%) never came across the term eco-pharmacovigilance.

2: Knowledge of Community Pharmacy Patrons regarding the eco-pharmacovigilance awareness and responsible drug disposal habits.

S. No	Questions	n (%)
1.	Are you aware that improper disposal of drugs can have effect on the health?	
	a) Yes	336(93.3%)
	b) No	15(4.2%)
	c) Do not know	9(2.5%)
2.	Are you aware that improper medicine disposal can harm the environment?	
	a) Yes, from news or awareness campaigns	163(45.3%)
	b) Yes, from educational institutions	95(26.4%)
	c) Yes, from personal experience or observation	38(10.6%)
	d) I was not aware before	64(17.8%)
3.	Do you have knowledge of proper methods for safe medicine disposal?	
	a) Yes	215(59.7%)
	b) No	80(22.2%)
	c) Do not know	65(18.1%)
4.	Have you ever read or followed instructions on proper medicine disposal?	
	a) Yes, from medicine labels	109(30.3%)
	b) Yes, from pharmacy or hospital	63(17.5%)
	c) Yes, from government guidelines or posters	70(19.4%)
	d) I have not seen any instructions	118(32.8%)
5.	Are you familiar with the term Eco-pharmacovigilance "(EPV)"?	
	a) I learned about it during my studies	57(15.8%)
	b) I heard it during awareness programs	42(11.7%)
	c) I saw it online or on social media	66(18.3%)
	d) I have never come across this term	195(54.2%)

3. Attitude of Community Pharmacy Patrons regarding the eco-pharmacovigilance awareness and responsible drug disposal habits

There were four questions to evaluate the attitude regarding the eco-pharmacovigilance awareness and responsible drug disposal habits (Table 3). Many respondents (66.7%, n=240) believed that both government and healthcare professionals are responsible to create awareness among society for proper disposal of unused medications, while smaller proportions felt it was the responsibility of the government alone (20.3%) or healthcare personnel alone (13.1%) to create awareness among society for proper disposal of unused medications. Disposal labeling on medicine packaging was supposed to have an influence on disposal practices by the majority of participants, with 44.4% reporting a moderate influence,40.3% reporting a high influence and only 15.3% shows no influence. Most people had a good view of government rules about getting rid of pharmaceutical waste. A majority supported (60.8%) or really supported (23.9%) these rules, while only a few were against them. Additionally, over half of the participants (65.8%, n=237) showed interest in joining eco-pharmacovigilance training or similar activities.

3: Attitude of Community Pharmacy Patrons regarding the eco-pharmacovigilance awareness and responsible drug disposal habits.

S. No	Questions	n (%)
1.	Whose responsibility is to create awareness among society for proper disposal of unused medications?	
	a) Government	73(20.3%)
	b) Health Care personal	47(13.1%)
	c) Both	240(66.7%)
2.	To what extent would disposal labeling on medicine packaging influence your disposal practice?	
	a) No influence	55(15.3%)
	b) Moderate influence	160(44.4%)
	c) High influence	145(40.3%)
3.	What is your level of support for government regulations on pharmaceutical waste disposal?	
	a) Strongly oppose	31(8.6%)
	b) Oppose	24(6.7%)
	c) Support	219(60.8%)
	d) Strongly support	86(23.9%)
4.	What is your level of interest in participating in EPV (Eco-pharmacovigilance) training or activities?	
	a) Yes	237(65.8%)
	b) No	37(10.3%)
	c) Do not know	86(23.9%)

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4. Practice of Community Pharmacy Patrons regarding the eco-pharmacovigilance awareness and responsible drug disposal habits

There were five questions to evaluate the attitude of people regarding the eco-pharmacovigilance awareness and responsible drug disposal habits (Table 4). When it comes to medication adherence, 43.3% of people said they sometimes stop taking their prescribed medication once they feel better, while 35% said they always finish the full course prescribed. After finishing treatment, over half of the people (50.3%) said they just dispose leftover medication at home, while 36.7% saved them for later, and only a small number (7.5%) return back to a pharmacy.

For getting rid of unused or expired medicines, the most common way was throwing them in the trash (63.3%), with 14.7% taking them to a pharmacy or collection point. A smaller group said they burned them (16.4%) or flushed them down the toilet or sink (5.6%). As for using human medicines for pets or farm animals, more than half (56.7%) said they didn't do that, but some admitted to using them sometimes. Most people (58.3%) said they check the expiry date of medicines before buying them, while others only do it sometimes or not at all. Overall, the results show that there are poor habits around using and getting rid of medicine, pointing out that we need better information and support to encourage safe and eco-friendly practices.

4: Practice of Community Pharmacy Patrons regarding the eco-pharmacovigilance awareness and responsible drug disposal habits

S.No	Questions	n (%)
1.	How often do you complete the full course of prescribed medication?	
	a) Always -I finish the full course	126(35%)
	b) Sometimes-I stop when I feel better	156(43.3%)
	c) Rarely- I stop early	51(14.2%)
	d) Never-I don't complete it	27(7.5%)
2.	What do you usually do with leftover medicines after completing treatment?	
	a) Keep them for future use	132(36.7%)
	b) Return them to a pharmacy/collection center	27(7.5%)
	c) Dispose of them at home	181(50.3%)
	d) Give them to someone else	20(5.6%)
3.	How do you usually dispose of unused or expired medicines?	
	a) Throw in household trash	228(63.3%)
	b) Take to a pharmacy/collection point	53(14.7%)
	c) Burn them	59(16.4%)
	d) Flush down toilet/sink	20(5.6%)
4.	Have you used human medicines for livestock or farm animals?	
	a) Yes, often	59(16.4%)
	b) Yes, rarely	97(26.9%)
	c) No	204(56.7%)
5.	Do you check expiry date of medicines before procuring?	
	a) Yes	210(58.3%)
	b) No	30(8.3%)
	c) Sometimes	120(33.3%)

SPSS ANALYSIS

INDEPENDENT T-TEST

Knowledge score vs Gender

T-Test

[DataSet1]

Group Statistics

	Gender	N	Mean	Std. Deviation	Std. Error Mean
Knowledge score	1	163	3.301	1.4913	.1168
	2	197	3.635	1.2851	.0916

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Knowledge score	Equal variances assumed	6.024	.015	-2.282	358	.023	-.3339	.1464	-.6217	-.0461
	Equal variances not assumed			-2.250	321.817	.025	-.3339	.1484	-.6259	-.0419

Comparison of Knowledge Score Between Genders

Gender	N	Mean ± SD	t-value	df	p-value
Male	163	3.301 ± 1.491	-2.250	321.817	0.025*
Female	197	3.635 ± 1.285			

*p < 0.05 indicates statistically significant difference

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Practice score vs Gender

T-Test

Group Statistics

	Gender	N	Mean	Std. Deviation	Std. Error Mean
Practice score	1	163	1.393	1.1409	.0894
	2	197	1.995	1.2101	.0862

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference Lower	Upper
Practice score	Equal variances assumed	.103	.748	-4.824	358	.000	-.6023	.1249	-.8478	-.3567
	Equal variances not assumed			-4.850	351.921	.000	-.6023	.1242	-.8465	-.3581

Comparison of Practice Score Between Genders

Gender	N	Mean ± SD	t-value	df	p-value
Male	163	1.393 ± 1.140	-4.824	358	<0.001*
Female	197	1.995 ± 1.210			

*Statistically highly significant

Attitude score vs Gender

T-Test

Group Statistics

	Gender	N	Mean	Std. Deviation	Std. Error Mean
Attitude score	1	163	15.724	3.0657	.2401
	2	197	15.848	3.1618	.2253

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference Lower	Upper
Attitude score	Equal variances assumed	.041	.840	-.375	358	.708	-.1238	.3302	-.7732	.5256
	Equal variances not assumed			-.376	349.122	.707	-.1238	.3293	-.7714	.5238

Comparison of Attitude Score Between Genders

Gender	N	Mean ± SD	t-value	df	p-value
Male	163	15.724 ± 3.066	-0.375	358	0.708
Female	197	15.848 ± 3.162			

Result:

Independent samples t-test revealed a statistically significant difference in knowledge (p = 0.025) and practice scores (p < 0.001) between males and females, with females demonstrating higher mean scores. However, no statistically significant difference was observed in attitude scores between genders (p = 0.708).

ANOVA test

Comparison of Knowledge Score Between Age Groups

ANOVA

Knowledge score

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.052	1	.052	.029	.864
Within Groups	544.444	304	1.791		
Total	544.497	305			

Result:

One-way ANOVA showed no statistically significant difference in knowledge scores between groups (F(1,304) = 0.029, p = 0.864).

Since p = 0.864 (> 0.05), the difference is not significant.

Comparison of Practice Score Between Groups

ANOVA

Practice score

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	52.599	1	52.599	41.725	.000
Within Groups	383.222	304	1.261		
Total	435.820	305			

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Result:

One-way ANOVA revealed a statistically highly significant difference in practice scores between groups ($F(1,304) = 41.725$, $p < 0.001$).

Since $p < 0.05$, the difference is statistically significant

Comparison of Attitude Score Between Groups

ANOVA

Attitude score

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	11.376	1	11.376	1.219	.270
Within Groups	2836.444	304	9.330		
Total	2847.820	305			

Result:

There was no statistically significant difference in attitude scores between the groups ($F(1,304) = 1.219$, $p = 0.270$).

DISCUSSION

Regarding knowledge, a majority of the respondents were aware that improper medication disposal may cause adverse effects on health. People had adequate knowledge that improper disposal of medicine could affect the environment through news, awareness campaigns, and educational institutions. In fact, over half of the respondents were unfamiliar with the term "eco-pharmacovigilance" and it shows the necessity of specific education programs.

The findings of the attitude-based survey were positive. The majority of the respondents believed that both the government and medical professionals were responsible for promoting awareness on how to properly dispose of unused medications. The majority of respondents believed that disposal labelling on medication packaging affects the disposal behaviour, indicating that behaviour can be positively impacted by strong guidelines. Also, many participants showed interest in taking part in eco-pharmacovigilance training or activities.

The practice section identified several kinds of risky behaviours. Many respondents reported that they either stored unused medications for later use or discarded them at home, and many did not finish the full course of prescribed medications. Only a small proportion of people visited pharmacies to return expired medications. Practices like burning medications or flushing them down, toilets or sinks are common. Although over half of the respondents reported that they check the expiry dates before buying medications.

CONCLUSION

As per the study, majority of the participants were aware that improper medication disposal can have a negative effect on both the environment and human health. The primary sources of awareness were educational institutions, media outlets, and awareness campaigns. However, a considerable proportion of respondents were unaware of the concept of eco-pharmacovigilance, and many had not received proper instructions regarding safe medicine disposal, indicating insufficient formal education on the subject.

Assessment of attitude showed that the majority of the participants had a positive attitude towards eco-pharmacovigilance. Most of the respondents believed that both government and healthcare professionals have the responsibility in creating public awareness about safe drug disposal. Support for government regulations and willingness to participate in eco-pharmacovigilance training programs were also observed among a large proportion of participants.

On the other hand, improper pharmaceutical usage and disposal practices were identified by the practice assessment. Stopping of prescribed medicines, keeping leftover medications, and dumping of medications in household rubbish were common behaviours. Only a small proportion of users returned unused or expired medications to pharmacies/collection point.

In conclusion, although community pharmacy patrons show adequate knowledge and a satisfactory attitude, safe drug disposal practices were inadequate. This highlights that there is a need for strengthened public education, pharmacist-led counselling, clear disposal instructions, and implementation of medicine take-back programs to promote eco-pharmacovigilance and protect environmental and public health.

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