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A STUDY ON ANALYSIS OF ECOPHARMACOVIGILANCE AWARENESS AND PRACTICE ACROSS HEALTHCARE PROFESSIONALS AND GENERAL POPULATION

K. Kanista[1]*, S. Syed Rabiya[3], K. Radhika[2], S. Punitha[4], S. Dhilipkumar[1]

[1]Department of Pharmacy Practice, Mother Terasa College of Pharmacy, Pudukottai.
[2]Department of Pharmaceutical Analysis, Mother Terasa College of Pharmacy, Pudukottai.
[3]Department of Pharmaceutical Biotechnology, Mother Terasa College of Pharmacy, Pudukottai.
[4]Department of Pharmaceutics, Mother Terasa College of Pharmacy, Pudukottai.

***Corresponding Author: K. Kanista**

Department of Pharmacy Practice, Mother Terasa College of Pharmacy, Pudukottai.

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ABSTRACT

The rapid growth of the global population, increasing disease burden, and advances in pharmaceutical development have significantly increased medicine production and consumption, resulting in widespread environmental contamination by pharmaceutical residues. These compounds, often termed pseudo-persistent pollutants, enter the environment through improper disposal, healthcare waste, manufacturing effluents, and veterinary use, posing risks to ecosystems and human health. Ecopharmacovigilance (EPV) has emerged as a strategy to monitor, assess, and prevent adverse environmental effects of pharmaceuticals. This observational study aimed to evaluate awareness and practices related to EPV among healthcare professionals and the general population in Tiruchirappalli. A total of 200 participants were included, comprising 50 pharmacists, 50 nurses, 50 doctors, and 50 members of the general public. Data were collected using a structured questionnaire assessing demographics, disposal practices, and awareness of environmental impacts. Descriptive statistics were applied for analysis. Most participants were aged 18–30 years, with a nearly equal gender distribution. Healthcare professionals demonstrated high awareness regarding safe disposal, environmental harm, checking expiry dates, and following disposal instructions. In contrast, baseline awareness among the general public was lower but improved substantially after counselling, particularly regarding unsafe disposal in household trash, returning medicines to pharmacies, and consulting pharmacists for guidance. Across all groups, the majority recognized that improper disposal harms the environment and that expired medicines should not be used. The study highlights significant gaps in disposal practices, especially among the general population, and underscores the positive impact of counselling. Strengthening EPV awareness through education, pharmacist involvement, and structured disposal programs is essential to minimize environmental contamination and protect public health.

KEYWORDS: Ecopharmacovigilance, Pharmaceutical waste, Drug disposal practices, Environmental contamination, Healthcare professionals and Public awareness.

INTRODUCTION

Rapid population growth, rising disease prevalence, and continuous advances in pharmaceutical development have led to a marked increase in the production and consumption of medicines worldwide. Consequently, pharmaceutical compounds are now widely detected in the environment.[1-3] Diverse classes of drugs including antibiotics, hormones, analgesics, anti-inflammatory agents, antihypertensives, and antidepressants have been identified in soil, sediments, surface and groundwater, drinking water, and even biota. Owing to their constant use, continuous environmental release, and incomplete removal during treatment processes, pharmaceuticals are considered pseudo-persistent pollutants. Pharmaceutical residues enter the environment through multiple routes, such as manufacturing effluents, improper disposal of unused or expired medicines, hospital and pharmacy waste, veterinary applications, and agricultural practices. Improper disposal contributes to environmental contamination and poses potential risks to human and ecological health. Although often present at low concentrations, the chronic and cumulative release of

these substances can disrupt ecosystems, promote antibiotic resistance, and adversely affect wildlife and humans. Notable examples include the decline of vulture populations linked to veterinary diclofenac use and endocrine disruption in aquatic species caused by hormonal residues.[4-5] Although pharmaceuticals represent a significant class of emerging environmental pollutants, they are largely excluded from existing regulatory frameworks for environmental detection, reporting, and control. Moreover, conventional sewage and wastewater treatment systems are inadequate for effectively removing many pharmaceutical residues. Historically, the environmental consequences of drug contamination have received limited scientific attention, despite the continuous growth in pharmaceutical use in both human and veterinary medicine. Projections indicate that global consumption of veterinary antibiotics alone may exceed 100,000 tons by 2030.[6-8] Earlier studies reporting pharmaceutical contamination of water bodies were predominantly from high-income countries. However, a large multinational investigation spanning 1,052 rivers across 104 countries demonstrated that the highest levels of contamination occur in low- and middle-income regions, particularly in South America, South Asia, and sub-Saharan Africa. Despite the increasing relevance of safe medicine disposal, awareness among both healthcare professionals and the general public remains inadequate.[9-10] To address these concerns, ecopharmacovigilance (EPV) has been introduced and is defined as the science and set of activities dedicated to detecting, evaluating, understanding, and preventing the adverse environmental effects of pharmaceuticals. The primary objective of EPV is to control and reduce sources of pharmaceutical exposure.[11-13] It encompasses the monitoring and regulation of drug residues while considering factors such as environmental degradation, wastewater management, and drinking water treatment efficiency. EPV promotes responsible manufacturing practices, rational medicine use, and the safe disposal of unused or expired drugs. EPV strategies prioritize pharmaceuticals known to pose significant environmental risks, particularly in high-exposure and heavily polluted settings. Proposed measures include the development of environmentally friendly medicines, improved control of industrial emissions, structured medication return programs, and appropriate prescribing and use practices. Although a universally standardized implementation framework for EPV is still lacking, practical applications are already in place.[14-16] In the European Union, for example, an environmental risk assessment is mandatory prior to marketing authorization for all human medicinal products, as mandated by the European Medicines Agency. Furthermore, regions such as the United States, the European Union, and Canada have taken leading roles in EPV-related legislation, while pharmaceutical companies, including AstraZeneca, have adopted environmental risk management plans to strengthen monitoring and mitigation of environmental impacts.[17]

AIM

The aim of this study is to evaluate the awareness and practice about ecopharmacovigilance across healthcare professionals and general population.

OBJECTIVE

- To detecting pharmaceutical in the environment and assessing their potential impact on ecosystems
- To evaluating the environmental risks associated with pharmaceuticals and implementing measures to mitigate them.
- To investigate the disposal practices of consumers with respect to their unused and expired medicines
- To educating stakeholders, including healthcare professionals, regulators, and the public, about the environmental risks associated with pharmaceuticals and promoting responsible disposal practices
- To safeguarding ecosystems to indirectly protect human health by preventing environmental contamination from pharmaceuticals.

METHODOLOGY

Study Design

Observational study.

Site of Study

The study was conducted in Tiruchirappalli among healthcare professionals and the general population.

Study Population

A total of 200 participants were included in the study, comprising 50 pharmacists, 50 nurses, 50 doctors, and 50 individuals from the general population.

Data Collection

Data were collected separately from healthcare professionals and the general population using a structured data collection format. The form included demographic details such as name, age, sex, address, email ID, and mobile number, along with information related to practices and awareness regarding the disposal of unused and expired medicines and their potential environmental impact.

Statistical analysis: Simple statistical analysis like mean, median and mode was conducted.

RESULT AND DISCUSSION

Table 1 shows that the majority of participants were aged 18–30 years (42.5%), followed by those aged 31–45 years (36%) and 45–60 years (20%). Only a small proportion were below 18 years (0.5%) or above 60 years (1%), indicating that the study population predominantly comprised young and middle-aged adults. Table 2 demonstrates a nearly equal gender distribution, with 103 females (51.5%) and 97 males (48.5%) among the 200 participants, reflecting a balanced representation of both genders. Table 3 indicates that the professional distribution was uniform, with 50 participants (25%) each from the general public, doctors, pharmacists, and

nurses, ensuring equal representation of all professional groups in the study.

Table 1: Age based distribution.

Age (in yrs)	Number of participants	Percentage of participants
Below 18 years old	1	**0.5%**
18-30 years old	85	**42.5%**
31-45 years old	72	**36%**
45-60 years old	40	**20%**
Below 60 years old	2	**1%**
Total	**200**	**100%**

Table 2: Gender based distribution.

Gender	Number of participants	Percentage of participants
Male	97	**48.5%**
Female	103	**51.5%**
Total	**200**	**100%**

Table 3: Profession based distribution.

Profession	Number of participants	Percentage of participants
General people	50	**25%**
Doctor	50	**25%**
Pharmacist	50	**25%**
Nurse	50	**25%**
Total	**200**	**100%**

Regarding unused or expired medication storage at home, doctors (100%), pharmacists (98%), and nurses (94%) demonstrated a high level of correct responses, reflecting strong professional awareness. In contrast, the general public showed a much lower correct response rate (38%), indicating poor knowledge in this area. Overall, the average correct response rate was 82.5%, highlighting a significant knowledge gap between healthcare professionals and the general population. Knowledge of safe medication disposal was excellent among doctors and pharmacists (100% and 98%) and remained high among nurses (88%). In contrast, awareness among the general public was notably low (18%). Overall, the mean correct response rate was 76%, highlighting strong professional understanding but a clear need for improved public education on safe disposal practices. Regular checking of medication expiration dates was highly practiced across all groups, with doctors (100%), pharmacists (98%), nurses (96%), and the general public (94%) demonstrating high correct responses. Overall, the average correct response rate was 97%, indicating excellent awareness regarding expiration date monitoring.

Awareness of specific disposal instructions on medicine labels was highest among doctors (100%) and pharmacists (98%), followed by nurses (84%). In contrast, the general public showed lower awareness (66%). Overall, the average correct response rate was 87%, indicating good knowledge among healthcare professionals but comparatively limited understanding among the general population. Knowledge and practice of returning unused medications to pharmacies were generally low across all groups. Pharmacists (60%) and doctors (54%) showed moderate awareness, while nurses (18%) and the general public (0%) demonstrated very poor knowledge. Overall, the average correct response rate was only 33%, highlighting a significant gap and the need to strengthen awareness and take-back programs for unused medications. Most participants across all groups reported correctly separating expired medications from active ones. Pharmacists and doctors (98% each) showed the highest compliance, followed by the general public (90%) and nurses (82%). Overall, the average correct response rate was 92%, indicating good practice in medication organization among both healthcare professionals and the public.

Awareness of the importance of local guidelines for medicine disposal was universal among pharmacists, doctors, and nurses (100% each). In contrast, only 52% of the general public recognized their importance. Overall, the average correct response rate was 88%, indicating strong professional awareness but moderate understanding among the general population. Proper storage of unused or expired medications at home was well understood across all groups. Doctors (98%), pharmacists (96%), and nurses (94%) showed high correct responses, while the general public also demonstrated good awareness (84%). Overall, the average correct response rate was 93%, indicating strong knowledge regarding safe medication storage practices. Consulting a pharmacist for medication disposal was most commonly recognized by doctors (92%), followed by pharmacists (62%) and nurses (54%). Awareness among the general public was very low (6%). Overall,

the average correct response rate was 53.5%, indicating moderate awareness among healthcare professionals but a substantial gap in public knowledge regarding pharmacist consultation for safe disposal. Most healthcare professionals correctly recognized that expired medicines are unsafe regardless of their appearance, with high awareness among doctors and nurses (96% each) and pharmacists (90%). The general public showed lower awareness (70%). Overall, the average correct response rate was 88%, indicating good understanding, though gaps remain among the public.

Awareness regarding recycling empty prescription bottles varied across groups. Doctors showed the highest correct response rate (94%), followed by pharmacists (74%) and nurses (56%). The general public demonstrated low awareness (16%). Overall, the average correct response rate was 60%, indicating moderate knowledge with a clear need for improved public education on recycling practices. All healthcare professionals (pharmacists, doctors, and nurses) correctly identified that donating unused medications to friends or family is unsafe (100%). In contrast, only 52% of the general public answered correctly. Overall, the average correct response rate was 88%, showing strong professional awareness but moderate understanding among the public. All healthcare professionals (pharmacists, doctors, and nurses) correctly recognized that keeping expired vitamins and supplements is unsafe (100%). Among the general public, 72% answered correctly. Overall, the average correct response rate was 93%, indicating strong professional knowledge and relatively good public awareness.

All healthcare professionals (pharmacists, doctors, and nurses) correctly identified that giving expired medications to pets is unsafe (100%). Among the general public, 92% answered correctly. Overall, the average correct response rate was 98%, indicating excellent awareness across all groups regarding the risks of administering expired medicines to animals. Awareness about the risks of burying medications for disposal varied among participants. Doctors showed the highest correct response rate (92%), followed by pharmacists (66%), general public (42%), and nurses (36%). Overall, the average correct response rate was 59%, indicating moderate understanding and highlighting the need for better education on environmentally safe disposal methods. Knowledge regarding disposal of medications in their original packaging was generally low. Pharmacists showed moderate correct responses (54%), while doctors (12%), nurses (26%), and the general public (8%) demonstrated poor awareness. Overall, the average correct response rate was only 25%, highlighting a significant gap in understanding safe disposal practices related to original packaging.

Awareness of proper drug disposal methods was highest among doctors (92%) and pharmacists (88%), moderate among nurses (56%), and absent in the general public (0%). Overall, the average correct response rate was 59%, indicating good knowledge among healthcare professionals but a significant lack of awareness in the general population. Knowledge of drug take-back programs was limited across all groups. Pharmacists had the highest correct response rate (58%), followed by doctors (42%), nurses (16%), and the general public (2%). Overall, the average correct response rate was 29.5%, highlighting a substantial knowledge gap regarding take-back programs and the need for increased awareness initiatives. Awareness of using black bags for pharmaceutical waste disposal was very high among doctors (100%), pharmacists (96%), and nurses (94%). The general public showed moderate awareness (52%). Overall, the average correct response rate was 85.5%, indicating strong knowledge among healthcare professionals and moderate understanding among the public. All healthcare professionals (pharmacists, doctors, and nurses) unanimously recognized the necessity of proper drug disposal (100%). Among the general public, 88% were aware. Overall, the average correct response rate was 97%, reflecting widespread understanding of the importance of safe medication disposal.

Figure 1 demonstrates that doctors and pharmacists had higher correct response rates regarding medication disposal compared to the general public, indicating better awareness among healthcare professionals and highlighting knowledge gaps in the general population. Figure 2 shows a consistent improvement in knowledge after the intervention across all domains, especially concerning local disposal guidelines and environmental hazards, confirming the effectiveness of the intervention. Figure 3 reflects an overall increase in correct responses across key aspects of medication disposal, reinforcing the positive impact of educational intervention on participant awareness.

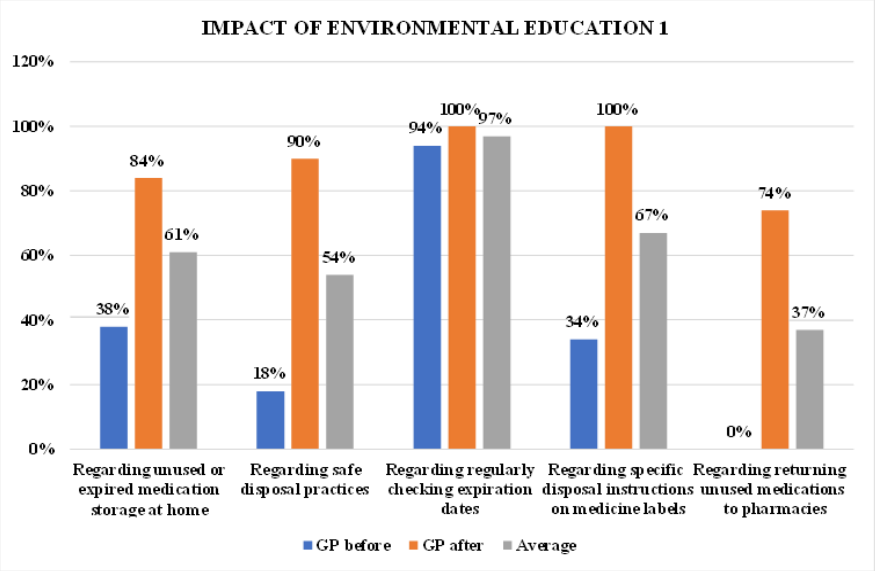

FIGURE 1: IMPACT OF ENVIRONMENTAL EDUCATION 1.

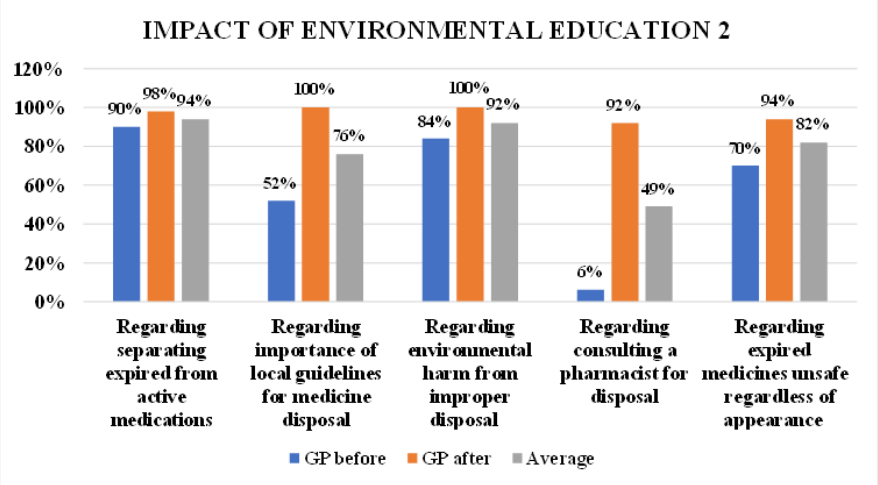

FIGURE 2: IMPACT OF ENVIRONMENTAL EDUCATION 2.

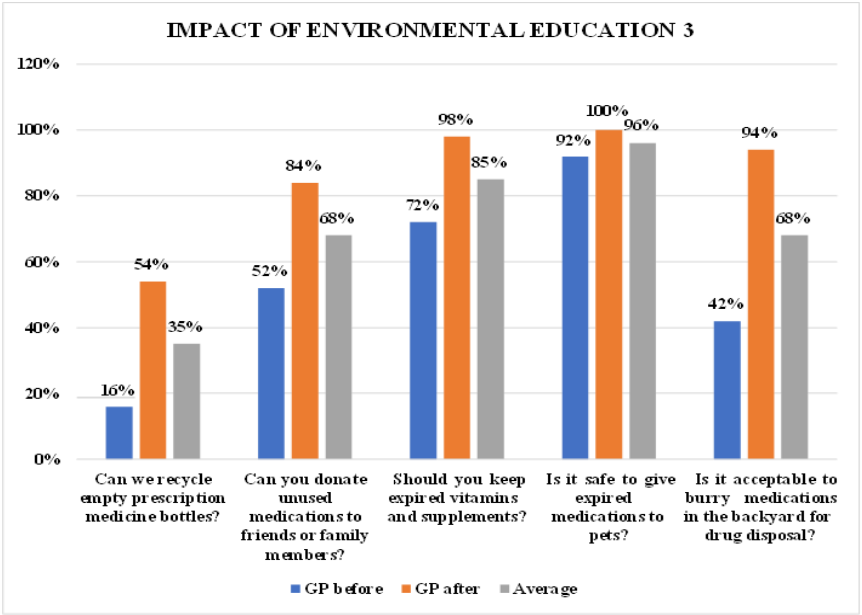

FIGURE 3: IMPACT OF ENVIRONMENTAL EDUCATION 3.

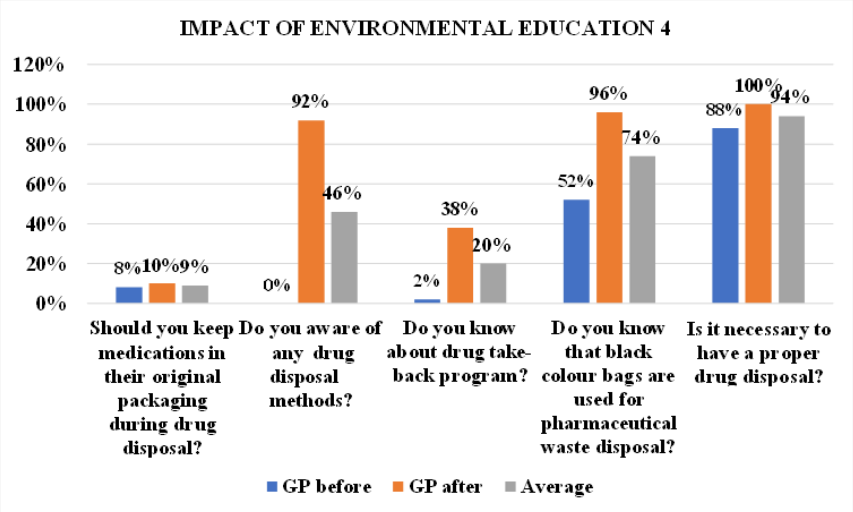

FIGURE 4: IMPACT OF ENVIRONMENTAL EDUCATION 4.

CONCLUSION

This study demonstrates good baseline awareness among healthcare professionals regarding safe disposal and environmental risks of unused and expired medicines, while gaps were evident in the general public. Educational counselling significantly improved public knowledge and practices, particularly in avoiding household disposal, returning medicines to pharmacies, and recognizing environmental harm. Overall, the findings highlight the critical role of targeted counselling and pharmacist-led education in promoting responsible medicine disposal and ecopharmacovigilance.

REFERENCES

1. Yu X, Sui Q, Lyu S, et al. Municipal solid waste landfills: An underestimated source of pharmaceutical and personal care products in the water environment. Environ. Sci. Technol. 2020; 54(16): 9757-9768. doi: 10.1021/acs.est.0c00565
2. Naidu R, Arias Espana VA, Liu Y, Jit J. Emerging contaminants in the environment: Risk-based analysis for better management. Chemosphere. 2016; 154: 350-357. doi: 10.1016/j.chemosphere.2016.03.068
3. Wang J, He B, Yan D, Hu X. Implementing ecopharmacovigilance (EPV) from a pharmacy perspective: A focus on non-steroidal anti-inflammatory drugs. Sci, Total Environ., 2017; 603-604: 772-784. doi: 10.1016/j.scitotenv.2017.02.209
4. Wang J, He B, Hu X. Human-use antibacterial residues in the natural environment of China: Implication for ecopharmacovigilance. Environ. Monit. Assess., 2015; 187(6): 331. doi: 10.1007/s10661-015-4514-6
5. Voigt M, Savelsberg C, Jaeger M. Identification of pharmaceuticals in the aquatic environment using HPLCESI-Q-TOF-MS and elimination of erythromycin through photo-induced degradation. J. Vis. Exp., 2018; 138: 57434. doi: 10.3791/57434
6. Kim HY, Lee IS, Oh JE. Human and veterinary pharmaceuticals in the marine environment including fish farms in Korea. Sci. Total Environ., 2017; 579: 940-949. doi: 10.1016/j.scitotenv.2016.10.039
7. Daughton CG. Pharmaceuticals and the environment (PiE): Evolution and impact of the published literature revealed by bibliometric analysis. Sci. Total Environ., 2016; 562: 391-426. doi: 10.1016/j.scitotenv.2016.03.109
8. He BS, Wang J, Liu J, Hu XM. Eco-pharmacovigilance of non-steroidal anti-inflammatory drugs: Necessity and opportunities. Chemosphere. 2017; 181: 178-189. doi: 10.1016/j.chemosphere.2017.04.084
9. Blair BD. Potential upstream strategies for the mitigation of pharmaceuticals in the aquatic environment: A brief review. Curr. Environ. Health Rep., 2016; 3(2): 153-160. doi: 10.1007/s40572-016-0088-x
10. Rodríguez-Navas C, Björklund E, Bak SA, et al. Pollution pathways of pharmaceutical residues in the aquatic environment on the Island of Mallorca, Spain. Arch. Environ. Contam. Toxicol., 2013; 65(1): 56-66. doi: 10.1007/s00244-013-9880-x.
11. Holm G, Snape JR, Murray-Smith R, Talbot J, Taylor D, Sörme P. Implementing ecopharmacovigilance in practice: Challenges and potential opportunities. Drug Saf., 2013; 36(7): 533-546. doi: 10.1007/s40264-013-0049-3
12. Wang J, Zhao SQ, Zhang MY, He BS. Targeted ecopharmacovigilance for ketoprofen in the environment: Need, strategy and challenge. Chemosphere. 2018; 194: 450-462. doi: 10.1016/j.chemosphere.2017.12.020.
13. Silva LJ, Lino CM, Meisel LM, Pena A. Selective serotonin re-uptake inhibitors (SSRIs) in the aquatic environment: An ecopharmacovigilance approach. Sci Total Environ. 2012; 437: 185-195. doi: 10.1016/j.scitotenv.2012.08.021.

14. Li S, Guo J, He B, Zhu Y, Wang J. Environmental knowledge, behaviors, and attitudes regarding caffeine consumption among Chinese university students from the perspective of ecopharmacovigilance. Environ Sci Pollut Res Int. 2021; 28(5): 5347-5358. doi: 10.1007/s11356-020-10878-x.
15. Wang J, Li S, Zhu Y, Guo J, Liu J, He B. Targeted ecopharmacovigilance as an optimized management strategy for adverse effects of pharmaceuticals in the environment. Environ. Toxicol. Pharmacol., 2021; 82: 103565. doi: 10.1016/j.etap.2020.103565.
16. European Medicines Agency. Guideline on the Environmental Risk Assessment of Medicinal Products for Human Use; EMA/ CHMP/SWP/4447/00 Rev. 1. European Medicines Agency; 2019. Available from: https://www.ema.europa.eu/en/ documents/scientific-guideline/guideline-environmentalrisk-assessment-medicinal-products-human-userevision-1_en.pdf.
17. Wang J, Hu X. Ecopharmacovigilance: Current state, challenges, and opportunities in China. Indian J. Pharmacol., 2014; 46(1): 13-17. doi: 10.4103/0253-7613.125158.