

**ENVIRONMENTAL IMPACT OF EXPIRED DRUG DISPOSAL**

Turki Hussain Dakhil Allugmani¹, Abdul Rahman Marouf Alzahrani², Abid. A. Altayari³, Mansour Ahmed Mohammed Alzahrani⁴, Ali Hudlan Ibrahim Alaryani⁵, Thamer Minahi Turki Algethami⁶, Nasser Mansour Aljohani⁷, Salem Kraidem Momsen Alharbi⁸, Mohammed Saad Algethami⁹, Ghazi Mohammed Ibraheam Ahmed¹⁰, Ali Saleh Hassan Alghamdi¹¹, Mosbeh Aowad Abdullah Almalki¹², Nasser Hammoud Alrashdi¹³, Mohammed Jamaan Mousa Alzahrani¹⁴, Areej Taher Ben Sadek¹⁵, Abdullah Mohmmmed Jarallah¹⁶, Fawaz Ahmed Jarallah Alzahrani¹⁷, Mohammed Ali Ahmed Meshari¹⁸, Ali Jaber Ahmed Hazzazi, Yahya Jaber Ahmed Hazzazi¹⁹

Summary:

The aim of the current study was: What types of expired drugs have environmental impacts? What are the environmental impacts of disposing of expired medications? What are some safe ways to dispose of expired medications? The questionnaire was prepared electronically through the Google Drive program and then distributed through a mobile social networking program (WhatsApp). All participants could answer the questionnaire via email. 600 questionnaires were distributed to all mobile groups and 550 questionnaires were emailed to the researchers. (The target group is residents aged 30-65 in the holy city of Mecca).

Keywords: risk, wasting, unused medicine, patient, society

¹⁻⁸Ministry of health-Health cluster in Makkah-Saudi Arabia

⁹⁻¹⁰Ministry of health-Health cluster in Taif-Saudi Arabia

¹¹⁻¹³ Ministry of health-Health cluster in Jeddah-Saudi Arabia

¹⁴Ministry of health-Health cluster in Al-Baha-Saudi Arabia

¹⁵Ministry of health-General Medical Committee-Saudi Arabia

¹⁶Ministry of health-Health cluster in Jazan-Saudi Arabia

¹⁷Ministry of health-Health cluster in Al-Baha-Saudi Arabia

¹⁸⁻¹⁹Ministry of health-Health cluster in Jazan-Saudi Arabia

***Corresponding Author:** Turki. H. D. Allugmani

*Ministry of health-Health cluster in Makkah-Saudi Arabia

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1. Introduction:

The use of pharmaceuticals continues to increase worldwide (1). However, studies show that many of these products end up unused or expire (2,3,4). Medication wastage can result from poor patient medication compliance, overprescription by physicians, improvement in condition, or change in treatment regimen (5), (6). Improper storage and disposal of unused medications may have adverse consequences. Improper storage of medicines can lead to misuse and accidental poisoning, posing serious health risks (7). Pharmaceutical waste poses significant risks to the environment and can lead to health problems due to subsequent public exposure. There is evidence that accumulation of antibiotics in water systems worsens antibiotic resistance and impairs microbial virulence (8). Ethinyl estradiol, an active ingredient in common oral contraceptives, has been shown to cause endocrine disruption in cockroach populations (9). Trace organic contaminants from pharmaceuticals have also been found in conventional drinking water treatment plants (10). As a result of this disease, concerns were raised about the impact of drugs on the environment, encouraging the establishment of a new science called ecopharmacology. This refers to the science and activities related to the detection, assessment, understanding, and prevention of harmful effects of pharmaceuticals on the environment (11). Consumers need to know how to properly dispose of medicines. However, environmentally harmful pharmaceutical disposal practices are common in several regions of the world. Studies conducted in the United States found that more than 50% of patients flush medications down the toilet (12) and less than 1% return unused medications to the pharmacy (13). Other surveys conducted in China, India, Bangladesh, and Ghana have also found that the most common method of disposing of unused medications is to throw them into the trash and then end up in landfills (14, 15, 16, 17). No research has been conducted on poor drug disposal practices in Indonesia. This information is necessary to develop effective measures to raise public awareness of the hazards caused by drug disposal and its improper handling. This study

examined Indonesian consumers' handling of unused and expired medicines. Take topical medications in the shower. (18) However, most are caused by improper handling of unused and expired medications. (19) Unknown number of developing countries

Recently, the consumption of pharmaceutical waste (and its volume) in the consumption of pharmaceutical products has increased significantly. (20,21) This has led to global concerns related to pharmaceutical waste generation, which in turn requires further development of knowledge and awareness of how to safely dispose of waste to the public. (22,23) Among these global concerns are inappropriate self-medication, accidental consumption by children, accumulation of agents in streams as environmental contaminants, the risk of antimicrobial resistance, and accidental poisoning of wildlife (23) For example, Diclofenac, a nonsteroidal anti-inflammatory drug, has been classified as a dangerous drug. Vultures that ingested beef treated with the drug became active, causing kidney failure. 11 Expired tetracyclines have also been shown to cause damage to renal tubules (24)) Therefore, damaged or expired drugs should be placed directly. After removal from pharmacy inventory or return to the patient, place it in a special waste container for disposal. If pharmaceutical waste cannot be disposed of immediately, it should be separated from other pharmaceuticals, labeled as "destroyed pharmaceuticals" and stored in a designated isolation area under the control of authorized personnel until timely disposal. Such pharmaceutical waste should not accumulate in pharmacies. (25) Drugs enter the environment through three main routes: they are excreted by humans and animals in unchanged or metabolized form, mainly through urine; they are transported into the environment directly or through sewage treatment plants. Unused pharmaceuticals enter the environment through domestic wastewater or treated municipal waste. Manufacturing facilities that produce active ingredients may inadvertently release drugs into the environment. Thanks to improvements in measurement methods, it is now possible to detect drugs at concentrations that might have been present but unmeasurable decades ago.

Many pharmaceutical preparations are excreted or washed away (after consumption): studies have shown that 30% to 70% of oral substances are excreted, with higher rates for topical ointments or gels (26)(27). Some pharmaceuticals are reduced to varying degrees in wastewater treatment plants, while others leave the plant in active chemical form. Active residues of pharmaceuticals have been detected in surface waters and can persist in the environment for long periods of time. Large quantities of antibiotics and other pharmaceuticals are found at the outlet of wastewater treatment plants in underwater basins where hospital wastewater discharges dominate or in watersheds where pharmaceutical industry discharges occur. Soybeans absorb persistent pharmaceutical environmental pollutants from treated sewage sludge used as fertilizer, and antibiotics have also been found in the plant leaves (28). The ways in which active pharmaceutical ingredients enter drinking water vary. Drinking water supplies come primarily from drinking water reservoirs, groundwater and natural filtration along river banks. When treated wastewater is discharged into watersheds that supply drinking water, pharmaceuticals that were not removed during the drinking water treatment process can be detected. For example, 37% of the drinking water in the Netherlands comes from surface water, mainly through natural filtration along the banks of the Rhine and Meuse rivers. In this case, special attention should be paid to the handling of drug residues (29).

2. Material and Methods:

3-The research began in (the holy city of Mecca, Saudi Arabia), began writing research reports and recording questionnaires in June 2021, and ended data collection in September 2021. The researchers used a descriptive analysis method, which is a quantitative analysis method or a qualitative description of a social phenomenon (the environmental impact of the disposal of expired medicines). This type of research is characterized by being analytical, rational, objective and realistic as it involves individuals and society, studying variables and their impact on individual, social and consumer health, the spread of diseases,

etc. Relationships with demographic variables such as age, gender, nationality, and marital status. State, Occupation (30) and use the Excel 2010 Office Suite Histogram to sort the results using the following frequency table: Percentage (31). Questionnaires are an excellent and useful tool for collecting large amounts of data. However, due to distancing regulations at the time, the researchers were unable to interview participants in the online survey in person to prevent contamination between participants and researchers and vice versa (not that COVID-19 participation would completely disappear from society). He only answered the questionnaire electronically because it consisted of nine questions, all of which were closed-ended. Online methods have also been used to generate valid samples in similar studies in Saudi Arabia and elsewhere (32).

3. Results:

The proportion of consent to participate among the target population of the research questionnaire is expected to be 100%, and the age group proportions are as follows: 25 to 34 years old: 47.8%, and the proportion is between 35 and 34 years old. 34.8% for those aged 44, 15.2% for those aged 45-54, and 2.2% for those aged 55-60. In terms of gender and participant ratio, the male proportion was 78.3% and the female proportion was 21.7%. In terms of nationality, the proportion of non-Saudis is 19.6% and the proportion of Saudis is 80.4%. Their occupations are: students 0%, civil servants 60.9%, private sector employees 30.4%, housewives 4.3%, entrepreneurs 4.4%, and freelancers 0%. The educational level in order is: 0% cannot read or write, 0% is primary school, 2% is junior high school, 0% is junior high school, 19.6% has diploma, 63% is university, 6.7% is master, and 8.7% is doctorate. Based on responses to the study questionnaire, the answers are as follows: Question 1: Is it dangerous to dispose of medications through the toilet or sink? Is it considered an environmental and health disaster? 93.5% yes, 6.5% no. Second question: Is it possible for laboratory wastewater containing pharmaceutical chemicals to mix with rivers and seawater, affecting river and marine environments and

various organisms? 95.7% yes, 4.3% no. Question 3: Does unsafe disposal of medicines increase the spread of antibiotic resistance? 84.4% agreed and 15.6% opposed. The fourth problem: too many drugs that are not fully absorbed or absorbed by the body and can enter the body

The environment after passing through the sewage treatment plant? Yes, 86.7%; No, 13.3%. Question 5: Globally, what proportion of household drugs become medical waste, up to 50%? 84.8% agreed and 15.2% opposed. Question 6: If pharmaceutical waste is not properly disposed of, will it have an impact on the environment if it seeps into groundwater? 89.6% agreed and 10.6% opposed. Question 7: Can pharmaceutical waste be divided into four categories?

- 1- Combustible waste
- 2- Pharmaceutical waste containing acidic or alkaline substances
- 3- Pharmaceutical waste that interacts negatively with other chemicals
- 4- Toxic pharmaceutical waste such as mercury? 95.7% yes, 4.3% no. Question 8: Will the misuse of antibiotics cause animal mutations and promote bacterial resistance to antibiotics? 89.1% agreed and 10.9% opposed. Question 9: Can a mechanism be established to redistribute unused medicines that are about to expire to improve the balance between supply and demand and avoid waste? 91.3% yes, 8.7% no. (figure 1).

Figure 1: Opinions and attitudes of the target population (Mecca City residents) on the environmental impact of expired drug disposal.

4. Discussion:

We found in this study that expired pharmaceuticals have an impact on the environment, particularly if they are not disposed of in a safe, appropriate and correct way, posing a significant threat to the environment and the environment if they end up in groundwater and rivers. So that person.

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6. References:

- 1- S. Sonowal, C. Desai, J.D. Kapadia, M.K. Desai, A survey of knowledge, attitude, and practice of consumers at a tertiary care hospital regarding the disposal of unused medicines, *J. Basic Clin. Pharm.* 8 (2016) 4–7.
- 2- World Health Organization, *Challenges in Expanding Access to Essential Medicines*, 2004.
<http://apps.who.int/medicinedocs/en/d/Js5571e/2.html>. Accessed 16.04.28.
- 3- T. Atinafu, A. Takele, A. Kassie, A. Yehualaw, G. Tesfaw, T. Desseno, et al., Unused medications disposal practice: the case of Patients visiting university of Gondar specialized teaching Hospital, Gondar, Ethiopia, *Int. J. Pharma Sci. Res.* 5 (2014) 995–1005.
- 4- Y. Ayele, M. Mamu, Assessment of knowledge, attitude, and practice towards disposal of unused and expired pharmaceuticals among community in Harar city, Eastern Ethiopia, *J Pharm Policy Pract* 11 (2018) 27.
- 5- C.G. Daughton, T.A. Ternes, Pharmaceuticals and personal care products in the environment: agents of subtle change? *Environ. Health Perspect.* 107 (1999) 907.
- 6- J.P. Bound, N. Voulvoulis, Household disposal of pharmaceuticals as a pathway for aquatic contamination in the United Kingdom, *Environ. Health Perspect.* 113 (2005) 1705–1711.
- 7- T.M. Beirens, E.F. van Beeck, R. Dekker, J. Brug, H. Raat, Unsafe storage of poisons in homes with toddlers, *Accid. Anal. Prev.* 38 (2006) 772–776.
- 8- P.K. Thai, L.X. Ky, V.N. Binh, P.H. Nhung, P.T. Han, N.Q. Hieu, et al., Occurrence of antibiotic residues and antibiotic-resistant bacteria in effluents of pharmaceutical manufacturers and other sources around Hanoi, Vietnam, *Sci. Total Environ.* 645 (2018) 393–400.
- 9- S. Jobling, R. Williams, A. Johnson, A. Taylor, M. Gross-Sorokin, M. Nolan, et

al., Predicted exposures to steroid estrogens in UK rivers correlate with widespread W.N. Insani et al. *Heliyon* 6 (2020) e04551 4 sexual disruption in wild fish populations, *Environ. Health Perspect.* 114 (2006) 32–39.