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Evaluation of Current Households Management Practices of Solid Wastes from Pharmaceuticals in Soc Trang city, Vietnam

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ABSTRACT: Pharmaceutical wastes could pose serious health and environmental risk if inappropriately managed within the household. Hence, the objective of this paper was to evaluate the current households' management practices of solid wastes from pharmaceuticals in Soc Trang city, Vietnam using semi-structured questionnaires. The results showed that more than 300 different pharmaceutical brand names belonging to 14 groups of pharmaceutical drugs have been used in which digestive, pain relievers, antipyretics, steroid anti-inflammatory drugs, gout, bone and joint diseases, cardiovascular, parasitic, anti-inflammatory, antiviral, and antifungal drugs were the commons. Thirty-seven actively harmful ingredients to the environment and organisms were identified in the study area. The management of pharmaceutical wastes has not been well practiced since the unused medicines and its packaging were discarded with domestic solid wastes, burying, burning and flushing into the toilet. The interviewees reported that the reasons they discharged medicines are health improvement, experiencing side effects or failure in the treatment process. The interviewees did not have much knowledge of the impact of potentially harmful chemicals containing in the discarded medicines on health and ecosystems. This could lead to increasingly released and accumulating pharmaceutical wastes in environments. Appropriate collection and awareness raising for local people in the management of pharmaceutical wastes in the study area are essential.

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Vietnam is one of 17 countries ranked in the group with the highest pharmaceutical industry proliferation in the world, the demand for pharmaceutical products has been expanding as a result. In addition, the average medical expenditure of people raised significantly from 5.4 $ per person in 2000 to 38 $ per person in 2015, equivalent to the annual increase of 14%. It was expected that the mean pharmaceutical expense of each person will continue to increase at high level in the coming years. Thus, pharmaceuticals play a vital role in people's life (Jones *et al*., 2005). Besides the growing consumption of pharmaceuticals, the wastes that is generated also increased considerably. The main reason making pharmaceuticals enter the environment is the improper leftover medication's disposal of consumers (Jones *et al*., 2005). All of those drugs escape from the processes of sewage treatment, leading to accumulating in soil, entering river systems and groundwater, or even accessing

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into food and drinking water (Fent *et al*., 2006). In some countries where sewage is treated before releasing into the environment, nevertheless, pharmaceutical components are not likely to be removed because conventional sewage treatment facilities are not designed to treat pharmaceutical compounds due to their changeable physical and chemical properties (Jones *et al*., 2005; Fent *et al*., 2006). In fact, pharmaceuticals contain most of the active medicine ingredients, the rest are cassava and some harmless ingredients. When the active substances enter the water environment, they will be dissolved in the water, accumulated in the sediment or organisms (Yamashita *et al*., 2006). Being reliant to the concentration and exposure duration, acute or chronic toxicity of active pharmaceutical substances will be at various levels. There are some substances that need concentration and exposure duration sufficiently large, however, there are also some others that are toxic at very low concentration (Elizalde-Velázquez *et al*., 2016; Mariusz *et al*., 2019). In all the toxic pharmaceutical compounds, antibiotics considered are a major worry for the environment and organisms because their active pharmaceutical ingredients entering the organism will make the organisms resistant to drugs. Furthermore, with current climate change can make some species easy to develop explosively, which is difficult to control, thus posing potential threats to human and ecosystems. In addition, since the active antibiotic ingredients are structured like organism's hormones, they are likely to interfere with the organ's regulation processes in the body of organisms, especially the reproductive organs (Halling-Sørensen *et al*., 2000; Yamashita *et al*., 2006; Girardim *et al*., 2011; Elizalde-Velázquez *et al*., 2016). Currently, available information on the current status of pharmaceutical waste management at the households in Vietnam is still limited. Hence, the objective of this paper is to evaluate the current households management practices of solid wastes from pharmaceuticals Soc Trang city, Vietnam. The findings from this study could provide useful information for solutions on the management, use and disposal of medicine wastes in the study areas.

MATERIALS AND METHODS

The data for this study were collected by direct interviewing 150 households (30 households in each of the ward 1, 2, 3, 5 and 9) in Soc Trang city, Soc Trang province, Vietnam. Demographic information, kinds of diseases, places to buy medicines, understanding of medicine uses, understanding of antibiotics, reasons for pharmaceutical disposal, practices on medicinal waste management the important in the questionaires. The interviewing data were coded and imported into excel (Microsoft Excel, 2016) and the descriptive statistics were subsequently used in the data analysis. Simple charts and tables were utilized to illustrate the data. The chemical ingredients and potential impact information (on health and ecosystems) of active pharmaceutical ingredients in wastes were carefully searched from the available data of manufacturers, pharmaceutical management agencies and the published studies. The solutions of medicine waste management were proposed based on the currently effective regulations in Vietnam.

RESULTS AND DISCUSSION

Gender and profession of the respondents: The interview results showed that 94.7% of the interviewees were female, while only 5.3% were male. The interviewing results also showed that the respondents were mainly traders (49.3%), housewives (21.3%), workers (14.7%), state officials (12%) and livestock workers (2.7%). Most of the respondents were not interested answering the questions regarding the management and treatment of household's pharmaceutical wastes, but they only interested in aswering the questions relating to the uses of medicines for their health treatment purposes.

Common diseases in the study area: The diseases or symtoms that occurred frequently in human in the study area were presented in Table 1.

Table 1: Common diseases in the study area

No.	Types of disease/Symptoms	No. of respondents	Percent (%)
1	Headache	126	11.4
2	Dizziness	56	5.1
3	Flu	124	11.2
4	Fever	90	8.1
5	Blood pressure	69	6.2
6	Eyesore	23	2.1
7	Runny noses	92	8.2
8	Coughs	111	10.0
9	Earsore	8	0.7
10	Sore throat	103	9.3
11	Toothache	12	1.1
12	Heartburn/burp	15	1.4
13	Indigestion	77	7.0
14	Abdominal pain diarrhea	38	3.4
15	Bloating	15	1.4
16	Constipation	39	3.5
17	Aches and pains	89	8.0
18	Women's disease	19	1.7
	Total	**1106**	**100**

The results showed that there were many diseases that people often got, but the most common was headache with 126 people, accounting for 11.4%, following by colds, coughs, sore throats, runny noses accounted for 11.2%, 10%, 9.3% and 8.2%,

respectively. These were mostly common mild diseases, so people often tended to buy medicines from the local pharmacies or self-prescribe medicines that are then stocked at home for long time uses. The family often stored medicinal drugs at home and they paid very little attention to the expiration date leading to the risk of using expired medicines which could affect health. In addition, the unused and expired medicines could result in increasingly release into the environments.

Types of medicine uses: The interviewing results presented that the households used more than 300 different trade names of the medicines. In which, the group of drugs that accounted for the large numbers were digestive drugs accounting for 26.8%, followed by the group of pain relievers, antipyretics, steroid anti-inflammatory drugs, gout drugs and bone and joint diseases occupied by 21.3%. In addition, the number of drugs belonging to the group of cardiovascular and the group of parasitic, anti-inflammatory, antiviral and antifungal also accounted for 14.8% and 11.3%, respectively. Each drug usually contains only one main active ingredient, but there are also some types that contain up to 2-3 active ingredients, for examples, augmentin containing amoxicillin and clavulanic acid; pepsin containing guaiazulene and dimeticone; rezotum containing amoxicillin and sulbactam; albis containing ranitidine, bismuth and sucralfate; hasanbest containing metformin hydrochloride and glibenclamid. There were about 80 active ingredients that have been studied that would cause harmful risk to the environment and organisms. However, not all active ingredients would have adverse effects when entering the environment for examples alpha lipoic acid, pyridoxine hydrochloride and cholecalciferol. There were many active ingredients such as itraconazole, metronidazol, nystatin and neomycin that have not been intensively studied for environmental and health risk. Depending on the types of pharmaceutial drugs, there would be appropriate active ingredients to treat the diseases, however, these active ingredients could cause side effects that the symptoms manifest differently in individuals.

Understanding of the respondents of medicine use: When asked about where to buy pharmaceutical drugs, people in the wards answered that they chose to buy drugs at the local pharmacies with the rates of ward 1 accounting for 80%, ward 2 accounted for 80%, ward 3 accounted for 73.3%, ward 5 accounted for 50% and ward 9 accounted for 86.7%. The rest bought the medicines at the hospital pharmacies. People purchased medicines at the drugstores mainly for common drugs for the treatments of colds, headaches, fevers and coughs. In Soc Trang city, there are many qualified local pharmacies so it is easier for people to get medicines at the local pharmacies than at the hospital pharmacies. The results of the study showed that people in the wards who bought medicines at the hospital pharmacies were 38 people accounting for 25.3% while 112 people purchased medicine drugs at the local pharmacy accounting for 74.7%. As can be seen that the percentage of people buying medicine at the local pharmacy was higher than at the hospital pharmacy. Buying pharmaceutical drugs at hospital pharmacies using insurance, there was a high possiblity of disposing of medicines into the environments due to incomplete or ineffective use. People tended to buy medicines at the local pharmacy because it is convenient and it meets the consumers' requirement.

Table 2: Places for purchasing medicines of the respondents

Places to buy medicines	Ward 1	Ward 2	Ward 3	Ward 5	Ward 9
Hospital's pharmacies	6 (20%)	6 (20%)	8 (26.7%)	15 (50%)	4 (13.3%)
Local pharmacies	24 (80%)	24 (80%)	22 (73.3%)	15 (50%)	26 (86.7%)
Total	30 (100%)	30 (100%)	30 (100%)	30 (100%)	30 (100%)

Fig. 1 showed that the level of self-prescription of medicines. In ward 1, most people were rarely and very rarely self-prescribe medicines with the rate of 36.7% and 40% respectively. Some households regularly prescribed medicines for common ailments such as colds and headaches. The rest respondents in Ward 1 did not self-prescribe drugs and only bought medicines at the drugstores or at the hospital pharmacies. In ward 2, 43.3% of the respondents answered no self-prescription of medicines, 3.3% were often, 30% were rarely, and 23.3% were very rarely. In ward 3, the proportion of people who did not self-prescribe medicines accounted for the highest rate with 46.7%; the often level, rarely and very rarely had lower rates of 6.7%; 26.7%; 16.7%, respectively. In ward 5, the often level of self-prescription was the most answered with 56.7%, because there were few local pharmacies and hospitals pharmacies available leading to people stored medicines at home; the level of rarely and very rarely self-prescription drugs accounted for 23.3% and 13.3%, respectively; no self-prescription rate accounted for 6.7%. In ward 9, people did not prescribe medicines accounting for 43.3%, the rest were rarely or very rarely

self-prescribed medicines. The study results showed that the percentage of people who regularly prescribed drugs accounted for 16%, rarely prescribed drugs accounting for 29.3%; very rarely accounted for 24% and no self-prescription accounted for 30.7%. It is indicated that the proportion of people in the wards tended to prescribe medicines at home was relatively high, but most of them only prescribed the medicines for the common ailments such as colds, coughs and headaches.

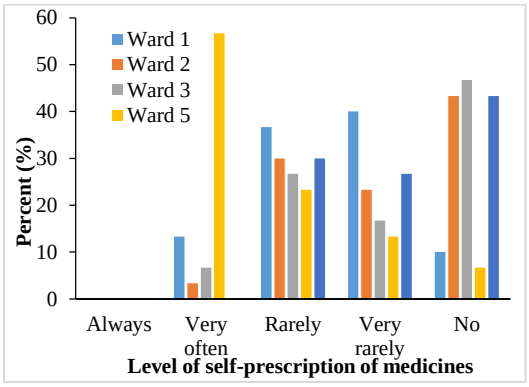

Fig. 1: Self-prescription of medicine of the interviewees

The results of the interviewing knowledge of antibiotics were shown in Fig. 2. Only 3.3% of people in ward 5 answered that they knew about antibiotics because they got information from the internet, newspapers, radio and they used a variety of antibiotics for the treatments of common diseases. The results showed that the level of knowledge about antibiotics of the local people in the study area was low. There were 0.7% of the people who know well, 3.3% know a lot, 39.3% know moderately, 40% know little and 16.7% do not know about antibiotics. People only knew a few common antibiotics that they often used such as ampicillin, amoxicillin and penicillin. Lacking knowledge of antibiotics could lead to more inappropriate disposal of antibiotics into environments.

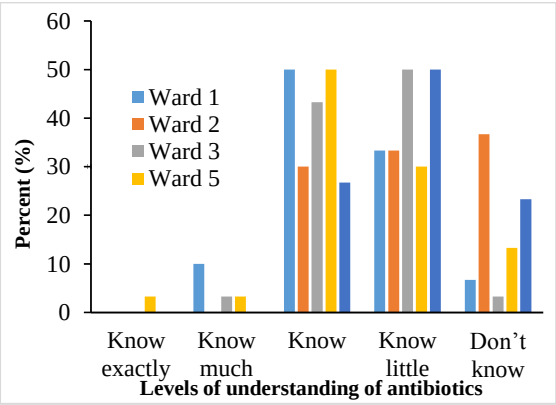

Fig. 2: Understanding of interviewees of antibiotics

The survey results in Fig. 3 presenting the level of antibiotic use of people in the wards. It was showed that most people in wards 1, 2, 3, 5, 9 rarely used antibiotics with a high rates of 66.7%, 60%, 50%, 56.7% and 60%, respectively. Some people in wards 1, 2, 3, 5 had regular use of antibiotics, but they all knew some harmful effects of antibiotics. People took antibiotics because they understood that antibiotics help cure diseases such as arthritis, joint pain and so on. Some people in ward 2 and ward 9 did not use antibiotics, accounting for 3.3% because people knew the harmful effects of using antibiotics such as its effect on immune system and antibiotic resistance. The results showed that the often level of antibiotic use accounted for 16%, rarely accounted for 58.7%, very rarely occupied by 24%, and no antibiotic use accounted for 1.3%. In general, the level of antibiotic use of the households in the wards was relatively low. The rate of not checking drug expiration date was the highest in ward 1, accounting for 43.4%. The rate in ward 2 accounted for 50%, in ward 3 accounted for 56.7%, in ward 5 accounted for 63.3% and in ward 9 accounted for 56.7%.

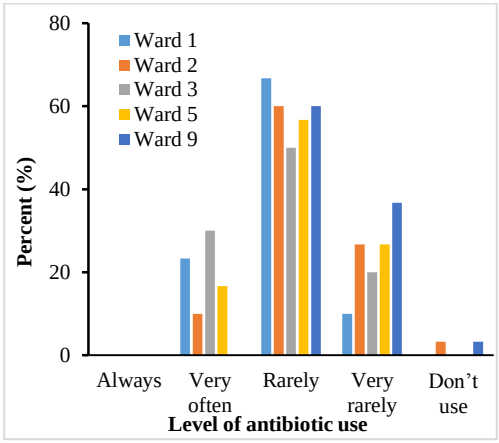

Fig. 3: Level of antibiotic uses of the households

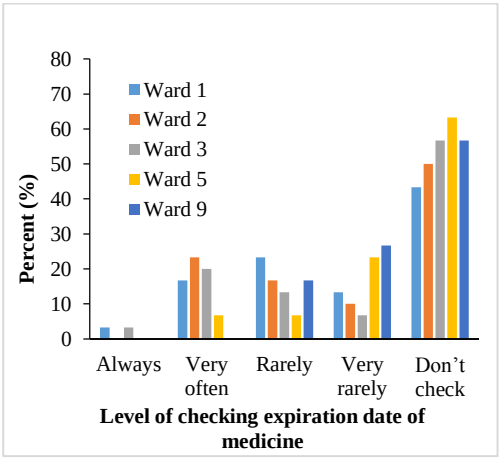

Fig. 4: Level of checking expiration date of medicines

The results in Table 3 showed that the proportion of people storing medicines at home was relatively high, with 50% in ward 1, 50% in ward 2, 40% in ward 3, 66.7% in ward 5 and 36.7% in ward 9. Almost everyone prepared some basic medicines to store in the family medicine cabinet for the purpose of treating some common ailments such as headache, cold and fever. The households stored hapacol or panadol for a cold, headache or fever. Besides, people also stored cough medicine (Eugica and Prospan), fever-reducing patches, blood pressure medicine (Nefedipine), digestive effervescent tablets (Dizzo) and some foods supportive products such as supplements for joint pain (Glucosamin, Calcium), supplements for brain (Ginkgo biloba), supplements for antibody (vitamins A, C and other multivitamins). The results showed that people did not store medicines at home accounted for 51.3%. When storing medicines at home, it is likely that people would not use up all the drugs, leading to their expired drugs and disposing of them into the environments.

Table 3: Storage of medicines at home of the respondents

Answer	Ward 1	Ward 2	Ward 3	Ward 5	Ward 9
Yes	15 (50%)	15 (50%)	12 (40%)	20 (66.7%)	11 (36.7%)
No	15 (50%)	15 (50%)	18 (60%)	10 (33.3%)	19 (63.3%)
Total	30 (100%)	30 (100%)	30 (100%)	30 (100%)	30 (100%)

The research results showed that the reasons for people in the wards threw away the medicines were because they felt that their health has not been improved, the medicine has expired, they feared side effects, they did not see expiration date label or their health already got recovery (Table 4). The number one reason for the medicine discharge was the expiration. This led to the rates of discharged in ward 1 was 56.7%, in ward 2 was 43.3%, in ward 3 was 66.7%, in ward 5 was 43.3% and in ward 9 was 30%. Ranked second was the reason of the health has been improved since this led to the stored medicine was no longer needed. Then, the surplus medicines were thrown away with the rates in ward 1 was 20%, in ward 2 was 26.7%, in ward 3 was 23.3%, in ward 5 was 30% and in ward 9 was also 30%. Other reasons for discharges of medicines could be found in Table 4.

Table 4: Reasons for discarding medicines of the respondents

	Ward				
Reasons	**Ward 1 (%)**	**Ward 2 (%)**	**Ward 3 (%)**	**Ward 5 (%)**	**Ward 9 (%)**
Health is not improved	3.3	0	3.3	3.3	6.7
Expired	56.7	43.3	66.7	43.3	30
Side effect	0	0	0	0	0
No expiration date	16.7	6.7	3.3	10	13.3
Health is improved	20	26.7	23.3	30	30
Other reasons	10	23.3	3.3	13.3	20
Total	**100**	**100**	**100**	**100**	**100**

Table 5: Ways of disposing expired medicines

	Ward				
Disposals	Ward 1 (%)	Ward 2 (%)	Ward 3 (%)	Ward 5 (%)	Ward 9 (%)
Discarded with domestic solid wastes (solid forms)	43.4	53.3	43.3	76.7	50
Reuse	0	0	3.3	6.7	0
Burying	6.7	0	6.7	0	6.7
Burning	0	6.7	3.3	0	0
Discarded into the restroom (liquid forms)	0	0	0	0	0
Discarded both with solid wastes and into the restroom	13.3	16.7	6.7	16.7	16.7
Others	36.7	23.3	36.7	0	26.6
Total	**100**	**100**	**100**	**100**	**100**

Methods of disposing of expired medicines: Table 5 showed that most of the people in the interviewed area disposed of unused medicines by putting them in the trash to be disposed of together with other household wastes (ward 1 accounted for 43.4%, ward 2 accounted for 53.3%, ward 3 accounted for 43.3%, ward 5 accounted for 76.7%, ward 9 accounted for 50%). A small number of people buried it in the soil because people thought that burying it in the ground could prevent others from using it and make it safer. Besides, some people used the methods such as placing unused medicines in the trash (solid form) and pouring it into the toilet (liquid form). Henschel *et al*. (1997) reported that 63% to 79% of people in other countries also disposed the expired medicines with household wastes. As can be seen that the practices of disposal of expired medicines are inappropriate and could lead to environmental consequences.

Treatment of medicine packaging: Ways of handling packaging's of drugs after use were presented in Table 6. Most people disposed of the wastes together with domestic solid waste in which ward 1 accounted for 53.3%, ward 2 accounted for 56.7%, ward 3 and ward 5 equally accounted for 60%, ward 9 accounted for 63.3%. People in wards 3, 5, and 9 also sold packaging's of drugs to the venders. People in wards 2, 3, and 5 burnt medicine packaging with domestic solid wastes. Meanwhile, some households in all wards disposed unused medicines with domestic solid wastes and recycled the plastics in it.

Table 6: Treatments of medicine packages after use

	Ward				
Treatments	Ward 1 (%)	Ward 2 (%)	Ward 3 (%)	Ward 5 (%)	Ward 9 (%)
Discarded with household wastes	53.3	56.7	60	60	63.3
Recycling plastics	0	0	20	13.3	23.3
Burning with household wastes	0	6.7	6.7	10	0
Discarded with household wastes and recycling plastics	46.7	36.6	13.3	16.7	13.3
Total	**100**	**100**	**100**	**100**	**100**

The level of understanding of the households regarding the effect of disposing medicinal drugs on environment was presented in Fig. 5. As can be seen that the proportion of people who know exactly and know much of the effect was only 6.6%, know little was 14.3% and do not know was 34.2%. In general, the level of people's understanding of the harmful effects of drug disposal on the environment was still low.

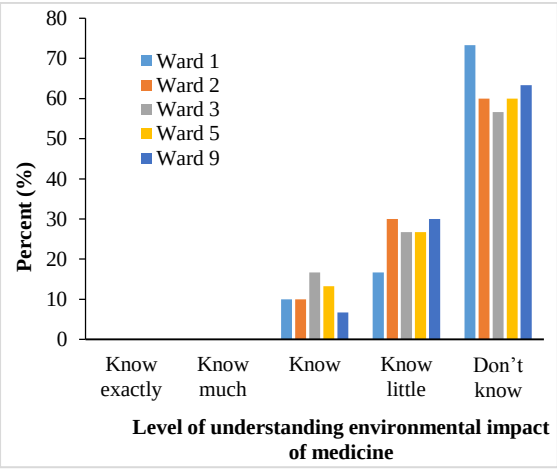

Fig. 5: Understanding of environmental impact of medicine after use

Table 7 showed that the responsibility for handling unused medicines and its packaging was the environmental management agency with the ratios in wards 1, 2, 3, 5, 9 were 53.3%, 46.7%, 23.3%, 50% and 36.6%, respectively. This was because people think that they did not have expertise as well as specialized equipment to treat pharmaceutical medicine wastes, therefore, the environmental management agency would ensure that pharmaceutical wastes to be treated safely. Some people believed that the responsibility for handling the medicine wastes and its packaging was the users. People also thought that this was the responsibility of both the users and the environmental management authority and both parties should work together to treat pharmaceutical waste in the most efficient way. Hospitals and manufacturers were also said to be responsible with a very low rates accounting for 3.3% and 6.7%, respectively.

Risk of pharmaceutical wastes to the environments: The survey results showed that the pharmaceuticals used by the people were diverse in types, including cardiovascular drugs accounting for 14.8%, drugs of analgesics, antipyretics, non-steroidal anti-inflammatory, gout and osteoarthritis accounted for 21.3%, digestive accounted for 26.8%, respiratory

accounted for 6.8%, the group of parasitic, anti-inflammatory, antiviral, antifungal accounted for 11.3%, minerals and vitamins accounted for 4.5%, antiallergic and hypersensitivity accounted for 2.9%, muscle relaxants accounted for 1.3%, psychotropic accounted for 7.4%, medicines for eye, ear, nose and throat treatments accounted for 0.6%, dermatological treatment accounted for 0.6%, hormone accounted for 0.6%, and rescue group accounted for 0.3%, solution to regulate water electrolytes and acid-base balance accounted for 0.6%. Through the survey, there were 37 active ingredients in the above groups containing potential hazards to environments. Among them, the group of drugs that was found to have the most harmful active ingredients was analgesics, antipyretics, steroids, anti-inflammatory drugs, gout and osteoarthritis, parasitic and anti-inflammatory, infectious, antiviral, antifungal and cardiovascular drugs. The results from this study suggested that people did not know well that the pharmaceutical wastes would cause harms to environments and organisms. The medicine users only cared about the efficient treatment for their health but not the harmful subtances containing in it. This could indicate that people's awareness of harmful impact of unused medicines was not high. Previous research results also showed that people have not paid much attention to the impact of medicinal drugs on the environment after using (Giao *et al*., 2020).

Table 7: Medicine waste treatment responsibility

	Ward				
In chargers	**Ward 1 (%)**	**Ward 2 (%)**	**Ward 3 (%)**	**Ward 5 (%)**	**Ward 9 (%)**
Users	20	40	46.7	33.3	43.4
Pharmacies	0	0	0	0	0
Hospitals	0	0	3.3	0	0
Producers	0	0	3.3	6.7	0
Environmental agency	53.3	46.7	23.3	50	36.6
Users and environmental agency	26.7	13.3	23.3	10	20
Total	**100**	**100**	**100**	**100**	**100**

Environmental contamination of pharmaceuticals contributes to the development of antibiotic resistance in the environment, causing mutations, and chemical reactions between compounds that can disrupt endocrine and reduce fertility. Concentrations of unused pharmaceutical compounds can be responsible for environmental effects such as sex and genital abnormalities in fish or even death (Štěpánová *et al*., 2013). The amount of antibiotics found is very low in the natural environment, usually nanograms per liter. But antibiotics and other pharmaceutical drugs can be toxic even at low concentrations (Ragugnetti *et al*., 2011; Saravanan *et al*., 2012; Bungau *et al*., 2016). They can accumulate and harm beneficial bacteria in nature - which play an important role in natural nutrient cycles, climate regulation, and the reduction of organic pollutants (Girardi *et al*., 2011). These natural bacteria play a vital role in maintaining soil and water quality. In fact, these bacteria are involved in biochemical cycling and degradation of organic pollutants thanks to their genetic diversity and metabolic capacity (Sebastine *et al*., 2003).

When antibiotics are present in the environment, they can alter the structure of the microbial community and have an indirect or direct effect on the microorganisms. The direct effect is to destroy beneficial bacterial species and disrupt their ecological function. Indirect effects include the development of antibiotic-resistant bacteria (Parolini *et al*., 2011). Antibiotic-resistant organisms entering aquatic environments can spread their genes to native bacteria, which are often beneficial bacteria that will harbor resistance genes (Baquero *et al*., 2008). The effects of antibiotics include changes in phylogenetic structure, expansion of resistance, and ecological dysfunction in ecosystems. Many studies have discovered changes in microbial community structure when antibiotics are present in soil and water environments (Ding and He, 2010). Antibiotics that exist in the aquatic environment will be degraded rapidly by biotic and abiotic factors, creating different intermediate products. These substances are potentially more toxic than their parent compound. These compounds present in water can be toxic to aquatic organisms from different levels and create ecological imbalance (Baquero *et al*., 2008; Elizalde-Velázquez *et al*., 2016).

According to Mariusz *et al*. (2019) antibiotics affect soil microorganisms by altering their enzymatic activity and ability to metabolize carbon sources. Studies using nucleic acid analysis methods

demonstrate that antibiotics alter the biodiversity of the soil microbial community. In addition to the problem of environmental pollution due to toxic active ingredients existing in pharmaceuticals, the problem of disposing of pharmaceutical packaging/cases has also become a concern related to current plastic waste pollution (Sebastine and Wakeman, 2003). Most medicines are packaged in plastic pill bottles, glass bottles or blister packs. But the blister pack is a waste when discharged, which affects the environment, because the blister is covered by a PVC or aluminum film (Sebastine and Wakeman, 2003; Baquero *et al*., 2008). Rigid PVC film is a kind of hard film used for medical packaging, packaging for school supplies such as blister packs, paper covers, and product protection covers. This type of film has extremely high durability and protection, mainly against impact and damage to the product, protecting the product from the impact of the external environment. Therefore, when the blister pack is discharged outside, if not properly handled, the amount of PVC plastic will accumulate in the soil affecting the surrounding environment (Sebastine and Wakeman, 2003; Baquero *et al*., 2008).

Conclusions: The results showed that 300 different trade names of medicines belonging to 14 groups of pharmaceutical drugs have been found in the study areas. The majority of the interviewed households stored the medicines at home for the common diseases. The interviewees did not have much knowledge of the chemicals containing in the medicines. The households simply know the remedies of the medicine uses. The interviewees discarded medicines when the health is improved, medicine expired, having side effects and remedial failure. The unused medicines together with its packaging becomes wastes. The wastes then discarded with domestic solid wastes, burying, burning and flushing into the toilet. These practices are considered inappropriate and potentially harm ecosystems and human health. The local environmental managers should help the households in understanding and appropriately managing the medicinal wastes. Waste separation at source and collection system should be established for pharmaceutical wastes since these wastes are hazardous.

Declaration of Conflict of Interest: The authors declare that there is no any conflict of interest.

Data Availability Statement: Authors declare the availability of research data from corresponding author or any of the other authors upon request.

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