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Research Article

Level of Knowledge and Practices of Medications Waste Disposal among Community Pharmacies' Staff in Salahaddin Governorate of Iraq

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Abstract

Background: Improper disposal of pharmaceutical waste products poses environmental and public health risks. ***Objective***: To assess the level of knowledge and practices of disposal of unused or expired pharmaceutical medications among the staff of community pharmacies. ***Methods***: A community-based cross-sectional descriptive study was conducted in different cities of Salahaddin Governorate, Iraq, during November 2023 to May 2024. Primary inclusion criteria included any person who worked in a community pharmacy for at least 1 year. Data was collected with a pretested structured questionnaire and analyzed using descriptive statistical methods. ***Results***: A total of 309 subjects completed the questionnaire; of them, 46.6%, 44.7%, and 8.7% were pharmacists, pharmacist assistants, and pharmacy students, respectively. Their mean age was 29.1 years with a duration of experience of 5.1 years. The majority (96.1%) discarded various pharmaceutical dosage form products in a general rubbish bin. Disposing of various anti-infective agents and controlled substances directly in the general rubbish bin was reported by 89.4% and 61.42%, respectively. Alternatively, the return-back method of various antineoplastic agents was the common method of disposal reported by 71.8% of the participants. The duration of experience had a significant effect on the method of disposal of controlled substances, while the age of participants had a significant effect on the disposal method of various antineoplastics. ***Conclusions***: Community pharmacies' staff had a relatively poor level of knowledge and practice regarding drug waste disposal methods. More efforts are needed to educate them about the proper disposal of medications.

Keywords: Community pharmacies, Knowledge, Medications waste disposal, Practices.

تحديد مستوى المعرفة والممارسات المتعلقة بالتخلص من مخلفات الأدوية بين العاملين في صيدليات المجتمع في محافظة صلاح الدين في العراق

الخلاصة

الخلفية: يشكل التخلص غير السليم من النفايات الصيدلانية مخاطر بيئية وصحية عامة. **الهدف**: تحديد مستوى المعرفة والممارسات المتعلقة بالتخلص من الأدوية غير المستخدمة أو منتهية الصلاحية بين العاملين في صيدليات المجتمع. **الطرائق**: تم إجراء هذه دراسة الوصفية المقطعية المجتمعية في عدة مدن بمحافظة صلاح الدين في العراق في الفترة من 17 نوفمبر 2023 إلى 24 مايو 2024. وشملت هذه الدراسة بصورة رئيسية أي شخص يعمل في صيدلية مجتمعية لمدة لا تقل عن سنة واحدة. تم جمع البيانات باستخدام استبيان منظم تم اختباره مسبقًا وتم تحليلها باستخدام الأساليب الإحصائية الوصفية. **النتائج**: تم أكمال معلومات الاستبيان كافة من قبل 309 شخصًا، منهم (46.6%، 44.7 و8.7%) صيادلة ومساعدي صيادلة وطلاب كلية صيدلة على التوالي. بلغ متوسط أعمارهم (4.86±29.1) سنة ومدة الخبرة (3.9±5.1) سنة. قام غالبية المشاركين (96.1%) بالتخلص من الادوية الصيدلانية بمختلف اشكالها في سلة المهملات العامة. بلغت نسبة المشاركين الذين قاموا بالتخلص من الادوية المضادة للعدوى والمواد الخاضعة للرقابة بمختلف اشكالها الصيدلانية مباشرة في صناديق القمامة العامة بنسبة (89.4٪) و (61.42٪) على التوالي. في حين كانت طريقة الاسترجاع للادوية المضادة للأورام بمختلف اشكالها الطريقة الأكثر شيوعًا للتخلص منها كما أفاد (71.8٪) من المشاركين. كان لمدة الخبرة تأثيرا معنويا على الطريقة المتبعة للتخلص من المواد الخاضعة للرقابة، في حين كان لعمر المشاركين تأثيرا معنويا على طريقة التخلص من مضادات الأورام. **الاستنتاجات**: يمتلك العاملين في صيدليات المجتمع مستوى ضعيفا نسبيا من المعرفة والممارسات المتعلقة بطرق التخلص من نفايات الأدوية. وينصح ببذل المزيد من الجهود لتثقيفهم حول التخلص السليم من نفايات الأدوية.

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INTRODUCTION

Medication waste is defined as any pharmaceutical product that is designated for disposal, which includes discontinued or unused medication, expired prescriptions, or medication that is unable to be returned to the manufacturer or supplier [1,2]. The global increase in the use of pharmaceutical products has led to many becoming unused or expired. Unnecessary prescribing of pharmaceutical medications by the physicians, patients' poor adherence to this medication, altering the therapy regimen, or resolution of the medical condition can contribute to medication waste production [3]. Disposal regulations ensure that active ingredients must be destroyed or deactivated and that all accompanying constituents are appropriately disposed of since pharmaceutical components are considered a clear risk to humans and animals as well as to the environment [4]. Evidence reported that

antibiotics that were accumulated in the aquatic system can exacerbate antibiotic resistance and affect the virulence of microorganisms [5]. Additionally, trace concentrations of organic contaminants that resulted from pharmaceutical waste products were also detected in ordinary drinking water treatment facilities. Various non-steroidal anti-inflammatory drugs, antibiotics, beta-blockers, carbamazepine, efavirenz, and zidovudine residues were among the frequently detected pharmaceutical residues that were detected in wastewaters and water bodies of South Africa [6]. It has been reported that an environmentally improper disposal practice of medications is prevalent in many parts of the world. A study that was conducted in the United States found that more than 50% of the enrolled patients flushed their medications down the toilet and less than 1% returned any unused prescription to the pharmacy [7]. Other studies in China, India, Bangladesh, and Ghana also reported that the most common method of disposing of unused medicines was disposing of them in the ordinary trash bin, which eventually ended up in landfills [8-11]. Limited studies had been conducted about the disposal practices of pharmaceutical waste products in Iraq among health care providers [12,13]. Such information is necessary for developing successful strategies to enhance public awareness of medication disposal and risks connected with its improper practices. Therefore, this study was aimed at assessing the level of knowledge and practice of disposal methods of unused or expired pharmaceutical medicines among the staffs of the community pharmacies in the Salahaddin governorate of Iraq.

METHODS

Study design and participants

This cross-sectional descriptive study was carried out in Samarra, Tikrit, Balad, and Sharqat cities of Salahaddin Governorate in Iraq from 17 November 2023 to 24 May 2024. The primary inclusion criteria involved any pharmacist, pharmacist assistant, or pharmacy student who worked in a community pharmacy for at least 1 year, was over 20 years old, and was readily accessible and eager to participate, while those who had any kind of communication issue or were unwilling to engage in this study were left out. Approximately 820 community pharmacies were registered in the Syndicate of Iraqi Pharmacists in the Salahaddin Governorate of Iraq at the time of the study. Based on this and using a confidence interval of 95%, a standard deviation of 0.5, and a margin of error of 5%, the minimum sample size required was 262 community pharmacies. This was calculated with the aid of Raosoft® online Sample Size Calculator.

Data collection

A face-to-face interview with a structured questionnaire was developed with each participant who consented to participate. No validated questionnaires were available in this context. Accordingly, and based on available literature, a standardized questionnaire was conducted by the researchers. This questionnaire consisted of three sections. The first section included questions on the participant's descriptive characteristics (gender, age, position, duration of experience in a community pharmacy, and educational level). The second section included questions that assessed participants' knowledge of drug disposal information (disposal instructions, courses, or lectures regarding the proper disposal and which of the medicines can be pharmaceutical wastes). The third section asked specifically about the practice of disposal patterns of various dosage forms, namely solid, semi-solid, aerosol canister, and liquid dosage forms; in addition to the disposal practice of anti-infectives (antibiotics, antifungals, and antivirals), controlled substances (opioids, depressants, hallucinogens, and anabolic steroids), and antineoplastics (anti-cancer medications or chemotherapy). The questionnaire was pretested (pilot testing) during November 2023 to assess the clarity and validity of the questionnaire involving 45 randomly selected participants. Also, the questionnaire was exposed to a face validation by a panel of experts consisting of three PhD-holding faculty members of clinical pharmacy sciences. This resulted in the omission, addition, or modification of questions to ensure participant understanding.

Ethical approval

The Ethical Committee at Tikrit University's College of Pharmacy approved this study. No incentives were offered. The participation was optional and anonymous. Each participant was given an explanation about the purpose of the study in detail, and confidentiality was ensured. The interviews conducted with one participant lasted approximately 8-13 minutes.

Statistical analysis

The data were organized, reviewed, analyzed, and tabulated by using SPSS version 23.0 (IBM Corp., Armonk, New York, USA). Continuous variables are expressed by using their mean ± standard deviation (SD), while discrete variables were presented using their number and percentages. The chi-square test was used for comparisons of discrete variables of the study groups, and the value of $p < 0.05$ was statistically significant.

RESULTS

Three hundred and fifty-seven subjects were selected to participate. Some of them refused to participate directly, while the others did not match the inclusion criteria. Therefore, only 309 subjects completed the questionnaire successfully. Of them, 243 (78.6%) were males and 66 (21.4%) were females. The mean age for these participants was 29.1±4.86 years, and the majority (88.3%) of them were less than 35 years old. Regarding the pharmacy position of the

participants, approximately half of them were pharmacists (46.6%), while the remaining participants were either pharmacist assistants (44.7%) or pharmacy students (8.7%). The mean ± SD of their duration of experience in community pharmacies was 5.1 ± 3.9 years. Most of the participants (91.3%) gained bachelor and diploma degrees, while the remaining (9.7%) did not gain a higher education degree at the time of conducting this study (Table 1).

Table 1: General information of the participants (n = 309)

Parameter		n(%)
Gender	Male	243(78.6)
	Female	66(21.4)
Age (year)	< 30	183(59.3)
	30-40	120(38.8)
	> 40	6(1.9)
Position at the community pharmacy	Pharmacist	144(46.6)
	Pharmacist assistance	138(44.7)
	Pharmacy student	27(8.7)
Duration of experience (year)	< 5	168(54.4)
	5-10	111(35.9)
	> 10	30(9.7)
Academic degree	Bachelor	147(47.5)
	Diploma	135(43.7)
	Not yet	27(8.8)

When asking the participants whether they read or heard about medication disposal instructions, 120 (38.8%) participants answered yes, while the remaining 189 (61.2%) did not read or hear about these instructions. Also, when the participants were asked whether they received during their study any course or lecture regarding the proper disposal of an expired or unused medicine, eighty-one (26.2%) participants answered with yes, while the remaining 228 (73.8%) did not receive during their study any course or lecture regarding the proper disposal of an expired medicine. When the participants were asked about the knowledge of which medicines can be considered to be pharmaceutical wastes, approximately 96.1% of the participants replied that an expired drug can be considered to be a waste medicine, 25.2% of the participants replied that a leftover medicine can be considered to be a waste medicine, and 84.5% of the participants replied that a damaged medicine that cannot be used can be considered to be a waste medicine. Finally, 48.5% of the participants replied that a medication once opened and beyond its recommended use date can be a waste of medicine. Most of the participants in this study reported disposing of various dosage forms by throwing them in the general trash bin (91.1%, 89.3%, 79.6%, and 42.7% for solid, semi-solid, aerosol canister, and liquid dosage forms, respectively). 56.3% of participants in this study reported flushing various liquid medications straight down the sink as the alternative method of disposal, while 44.6% of participants attempted to return these products to wholesalers or distributors as a method of disposal. On the other hand, some of the participants dispose of their waste medications by burning them in an open container (8.7%). 86.4% of the participants reported that the most popular method of disposal for various anti-infective agents was to simply throw them in the trash, and 13.6% of the participants reported that they returned the agents. The most typical method of disposal for various controlled substances was to simply throw them in the trash, as reported by 61.2% of participants. 38.8% of participants reported using the return method for these agents. 71.8% of the participants reported that the return method of disposing of various antineoplastic agents was the most popular, and 28.2% of the participants reported that they directly disposed of these agents in the general trash bin. As illustrated in Table 2, various participants' characteristic features (gender, age, and duration of experience in the pharmacy) reported in this study had insignificant effects ($p > 0.05$) on the method of disposal of various medication waste products.

Table 2: Effect of participants' characteristics on the methods of medication wastes disposal

Participants characteristics		General Rubbish Bin (n=297)	Flush in the Sink (n=174)	Return back (n=138)	Container Burner (n=27)	*p*-value*
Gender	Male	234	132	111	18	0.385
	Female	63	42	27	9	
Age (year)	< 30	174	105	93	21	0.102
	> 40	123	69	45	6	
Duration of experience (year)	< 5	156	75	72	12	0.203
	> 5	141	99	66	15	

*Chi-square test.

As illustrated in Table 3, various participants' characteristic features reported in this study had insignificant effects ($p > 0.05$) on the method of disposal practice of various anti-invective medications. As illustrated in Table 4, participants' characteristic features (gender and age) reported in this study had insignificant effects ($p > 0.05$) on the method of disposal practice of various controlled substances except for the duration of experience, which had a significant effect ($p < 0.05$).

Table 3: Effect of participants' characteristics on the methods of disposal practice of various anti-infective agents

Participants characteristics		General Rubbish Bin (n=267)	Return back (n=42)	*p*-value*
Gender	Male	204	27	0.092
	Female	63	15	
Age (year)	< 30	144	21	0.634
	> 40	123	21	
Duration of experience (year)	< 5	135	18	0.353
	> 5	132	24	

* Chi-square test.

Table 4: Effect of participants' characteristics on methods of disposal practice of various controlled substances

Participants characteristics		General Rubbish Bin (n=189)	Return back (n=120)	*p*-value*
Gender	Male	156	93	0.275
	Female	33	27	
Age (year)	< 30	114	78	0.408
	> 40	75	42	
Duration of experience (year)	< 5	105	93	<0.0001
	> 5	84	27	

* Chi-square test.

As illustrated in Table 5, participants' characteristic features (gender and duration of experience) reported in this study had insignificant effects ($p > 0.05$) on the method of disposal practice of various antineoplastics except for the age of participants, which had a significant effect ($p < 0.05$).

Table 5: Effect of participants' characteristics on the methods of disposal practice of various antineoplastics

Participants characteristics		General Rubbish Bin (n=87)	Return back (n=222)	*p*-value*
Gender	Male	60	150	0.812
	Female	27	72	
Age (year)	< 30	42	162	<0.0001
	> 40	45	60	
Duration of experience (year)	< 5	48	120	0.859
	> 5	39	102	

* Chi-square test.

DISCUSSION

This cross-sectional study investigated the disposal knowledge and practice of pharmaceutical waste products among community pharmacies' staff. A limited understanding of several aspects of the pharmaceutical disposal methods among the participants was observed. With the growing production and consumption of pharmaceutical products, accumulation and improper disposal of expired and unused medications can lead to various public health and environmental problems. This can be minimized by implementing medicine disposal policy and guidelines and improving awareness of the public on appropriate medicine disposal methods and practices [14]. Regarding the question, have you ever read or heard about medicine disposal instructions? The answers were yes (38.8%) while 61.2% were no. In line with this, when the participants were asked, did you receive any course or lecture during your study regarding the proper disposal of an expired medicine? The answer was 26.2% yes and 73.8% no. The majority of those who answered yes earned their bachelor's degree in pharmacy outside Iraq. This gives an explanation that the Iraqi pharmacy educational programs lack adequate information regarding this topic. A survey conducted in Saudi Arabia among undergraduate or postgraduate pharmacy students indicated that more than half (60%) of the participants had never received any information during their studies or training on how to store or dispose of medications. Moreover, 89% of them reported previously disposing of unused medications primarily in household trash bins [15]. Nairat *et al*. reported that out of 400 pharmacists who participated in their study, 348 indicated that they did not receive courses on safe disposal methods of unwanted medications. Additionally, pharmacists frequently advised patients to dispose of unused or expired medications—particularly antibiotics, hormonal medications, inhalers, and solid and semisolid medications—in the garbage [16]. Tabash *et al*., in their study, evaluated the influence of an educational program on the knowledge, attitude, and practice of healthcare staff regarding the management of pharmaceutical waste products. The survey was carried out among various healthcare staff before, after, and six months following the educational program implementation. As a result of this program, a significant improvement in the knowledge, attitude, and practice of healthcare staff regarding the management of pharmaceutical waste products was reported, and the level of knowledge and practice increased from 50 to 75% [17]. Regarding the question: which of these is medical waste? The highest percentage (96.1%) went to expired medications, then damaged medications (84.5%), opened medications (48.5%), and leftover medications (25.2%). These results can be compared with a study conducted in Ethiopia that showed similar results, as expired medicine represented 47.9%, damaged medicines 43%, opened medicines 45.8%, and leftover medicines 39.1% [14]. The results showed that 96.1% of the disposal of various dosage forms (including solid, semi-solid, aerosol, and liquid dosage forms) was by general rubbish bin.

However, disposal of pharmaceutical waste products via the general rubbish bin would not always be proper for all dosage forms [12]. Similar to these findings, a study conducted in India showed that more than (90%) of solid and semi-solid pharmaceutical products were disposed of in the general garbage, around (18%) of liquid medications were rinsed in the sink, and only (5%) were flushed down toilets [18]. Also, most pharmacists in Kuwait disposed of their pharmaceutical wastes by throwing them in the trash (73%) or pouring them down the toilet or sink (9% and 32%, respectively) [19]. An analysis of literature showed that the main method of disposing of unwanted drugs was by throwing them into the trash bin. Indeed, in many countries, especially in Asia and Africa, throwing medications into the trash or pouring them down the sink or toilet is the only way to dispose of them [20]. A lack of education or inadequate education in this field, a lack of an appropriate system or program for the return of unused drugs, and a lack of punishment (no responsibility) could be the reason for this improper practice [20]. On the other hand, the results showed that 44.6% of pharmaceutical waste products were returned back to wholesalers/distributors. The results were inconsistent with those of a study in Saudi Arabia that found the primary disposal method for all dosage forms was to return them to the distributors (>75%) [21]. In addition, Kharaba *et al*. reported that authorized contractors collected more than a third of various expired pharmaceutical dosage forms [22]. Other studies reported a higher level of various pharmaceutical products that were returned to the pharmacies or healthcare facilities [23,24]. The low level of unused and expired medicine returning practice reported in this study might be related to a lack of an established medication take-back program. Anti-infective medications were mainly disposed of, as reported by this study, via the general rubbish bin (89.4%), while a small percentage of these agents (13.6%) were returned to wholesalers/distributors. Depending on WHO guidelines, anti-infective agents should not be discarded in their original untreated form. Because of their unstable nature, they are best incinerated, and if that is not possible, encapsulated or intertied. While liquid anti-infective agents can be diluted in water, left for 2 weeks, and then disposed of in the sewer [25]. The presence of expired pharmaceutical products in the sewage can enhance antibiotic resistance to various microorganism strains present in the sewage. These resistant microorganisms can be mutated to deadly and resistant pathogens from harmless microbes [26]. Cytotoxic agents, non-biodegradable anti-infective drugs, and disinfectants can destroy bacteria necessary for the treatment of sewage [27]. Recently, antibiotic resistance has been linked to the administration of trace quantities of antibiotics in the surrounding waters due to the poor disposal practice of unused and expired medications [28]. Regarding the controlled substances, the largest percentage of the participants stated that they get rid of them through the general rubbish bin (61.42%), and the remaining participants (38.8%) stated that they get rid of them by returning them back to distributors/wholesalers. The WHO guidelines on disposal stated that these agents should either be rendered unusable by encapsulation or inertization and then dispersed among the municipal solid waste in a landfill or incinerated [29]. In addition to that, this study showed that 28.2% of participants disposed of antineoplastic agents via general rubbish bins while 71.8% of them disposed of these agents by returning them back to distributors/wholesalers. Most of the participants in this study agreed that returning these medications is the best way of disposal because they are dangerous drugs that may harm humans and the environment if they are disposed of in water or soil. Antineoplastics should be segregated from other pharmaceutical products and kept separately in clearly marked containers with rigid walls. They should preferably be carefully packaged and returned to the supplier for disposal. They must be destroyed in a two-chamber incinerator that runs at a high temperature of at least 1200°C in the secondary chamber and is fitted with gas cleaning equipment [28]. Kadhim and Kadhim reported that most participating pharmacists in their study had fair to excellent knowledge and practice regarding safe handling of cytotoxic medications [30].

Study limitations

This study was subjected to some limitations, including the restriction to community pharmacies in Salahaddin Governorate; therefore, the results may not reflect disposal practices in other regions of Iraq. Also, the self-reported nature of the questionnaire data may not offer an accurate assessment of staff practices compared to the observation methods.

Conclusion

Most participating community pharmacies' staff had relatively poor knowledge and practice regarding disposal methods of various pharmaceutical waste products that raised serious concerns. Formal training (educational courses and workshops) is needed to educate them about the proper disposal methods of medication and the risk of their improper disposal and how to perform it appropriately.

Conflict of interests

No conflict of interest was declared by the authors.

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Data sharing statement

Supplementary data can be shared with the corresponding author upon reasonable request.

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