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DEPARTMENT OF PHARMACY
Graduation Project

**Evaluation of Pharmacist Knowledge towards Expire Date and Disposal
Methods of expired Pharmaceutical Products in Karbala city**

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Abstract

Background: Expired medications pose environmental and public health risks.

Pharmacists play a crucial role in safe disposal practices. This study evaluated the knowledge, attitudes, and practices of pharmacists in Karbala city, Iraq, regarding expired medication disposal.

Methods: A cross-sectional study utilized face-to-face questionnaires administered to 200 pharmacists in Karbala between December 2024 and March 2025. Data included demographics, knowledge, attitudes, and disposal practices. Statistical analysis involved frequencies, percentages, and Cronbach's alpha for reliability.

Results: Participants were predominantly young, early-career pharmacists, with 77% having 1-5 years of experience. Most (99%) recognized the impact of storage conditions on medication stability, but 39% incorrectly believed medications remain effective past expiration. Tablets were the most commonly expired dosage form (47%). Disposal practices varied, with 40% using household trash and 20% flushing medications. A significant portion (39%) reported expired medications on pharmacy shelves. While 94% refrained from dispensing expired drugs, 6% admitted to doing so. 62% checked expiration dates monthly, but 46.3% sometimes overlooked this due to time constraints. 45% recognized environmental and health risks from improper disposal, but awareness of specific risks like antibiotic resistance was low.

Conclusion: This study highlights knowledge gaps and inconsistent disposal practices among Karbala pharmacists. Educational interventions and drug take-back

programs are needed to improve safe disposal practices and mitigate environmental and health risks.

Keywords: Expired medications, medication disposal, Karbala, drug stability, pharmaceutical waste.

1. Introduction

The U.S. Food and Drug Administration (FDA) mandates that all medications display expiration dates, which signify the last date the manufacturer can ensure full effectiveness and safety. However, expired medications often build up in households due to various reasons such as patient deaths, health improvements, medication changes, poor adherence, or concerns over side effects. Improper disposal of expired drugs presents serious environmental and public health issues. These medications can contribute to antibiotic resistance, become accessible for illegal use, and increase the likelihood of accidental poisonings involving children and pets. Additionally, expired drugs may contaminate water sources, potentially affecting the drinking water supply [1].

Many developed countries are addressing these issues by implementing drug take-back programs to promote safe disposal. One suggested approach includes placing tamper-resistant collection boxes in pharmacies where consumers can return expired medications to trained pharmacists [2]. If such programs are unavailable, the White House Office of National Drug Control Policy (ONDCP) advises discarding medications in household trash as an alternative. For this method, it's important to first remove personal information from the labels, mix medications with an undesirable substance (such as coffee grounds), place them in a sealed container (like a zipper bag), and then dispose of the package in the trash [3]. The American Pharmacists Association adds a recommendation to crush or dissolve unwanted

medications before mixing them, which discourages potential misuse by scavengers. However, the FDA advises against crushing medications, recommending instead to simply mix them with an undesirable substance before sealing and disposing (FDA, 2011) [3].

The methods of expired drug disposal differ widely worldwide. In Kenya and Nigeria, people commonly throw away expired drugs or flush them down the toilet [4]. In Ghana and Kabul, uncertainty leads people to store expired medications at home or share them with friends and family [5]. On the other hand, countries like the UK, USA, and parts of the Middle East offer drug take-back programs for safe disposal [4]. Australia [6] and Canada have government-supported initiatives, such as the "National Return and Disposal of Unwanted Medicines" Program, to encourage safe community disposal of expired drugs. New Zealand's DUMP campaign promotes returning expired medications to pharmacies, while Sweden has maintained a pharmacy return system since 1971 [6]. Yet, many countries still lack official disposal protocols or guidelines, leaving consumers uncertain about proper disposal methods.

There is a significant amount of drug wastage as medications often go unused before expiration. Given the high costs of medications, this issue is especially pressing in parts of Asia and Africa, where affordability is a common challenge [7]. The debate centers on whether medications could remain effective and usable even beyond their expiration dates. Most data on drug expiration dates come from FDA study conducted for the military, which faced challenges in managing large, costly drug stockpiles that would need replacing every few years [8]. The study revealed that 90% of over 100 drugs, both prescription and over the counter, remained effective up to 15 years past their expiration dates [9].

An expiration date indicates the last day a manufacturer guarantees a medication's full potency and safety [10]. Most prescription, over the counter (OTC), and dietary supplements have expiration dates on their labels. Proper storage can help maintain a medication's potency; however, high-heat or humid environments, such as bathrooms or cars, can degrade medications more quickly. For optimal stability, medications should be stored in cool, dry areas away from light, with tightly closed containers, and out of reach of children and pets [11].

A 2015 commentary in Mayo Clinic Proceedings suggested manufacturers could initially set a tentative expiration date and update it following long-term testing. Alternatively, an independent organization could test drug stability, similar to the FDA's extension program. However, the FDA officially advises discarding expired drugs, though some argue that this practice is wasteful and primarily benefits pharmaceutical companies financially [12].

While expiration dates were mandated by law in 1979 to assure drug potency and safety, medical authorities have found that many medications retain a significant degree of potency years after expiration, although effectiveness may decline [13]. Exceptions include drugs like nitroglycerin, insulin, and liquid antibiotics, which may lose potency more rapidly. Medications stored properly, especially solid forms like tablets and capsules, are often still effective well beyond their expiration dates [11]. However, certain medications, such as antibiotics in solutions, may lose efficacy, posing health risks if used to treat infections and potentially contributing to antibiotic resistance. Studies from the FDA's Shelf-Life Extension Program (SLEP) show that many drugs stored under ideal conditions remain effective for years past their expiration dates [14].

According to SLEP data, 88% of the drug lots tested remained stable for an average of over five years past their expiration dates, although drugs with a narrow therapeutic index and biologics like monoclonal antibodies require careful attention to their expiration dates to avoid efficacy or safety issues [15].

Stability testing by the FDA ensures a medication's expiration date accurately reflects its safety, potency, and quality when stored as directed. Stability is influenced by environmental factors, with extreme temperatures, humidity, and light accelerating chemical degradation [16]. Common degradation processes include hydrolysis, oxidation, and isomerization, which can alter the drug's properties, sometimes reducing effectiveness or increasing toxicity. For instance, aspirin breaks down into acetic acid and salicylic acid, which can irritate the stomach, while tetracycline can degrade into nephrotoxic compounds [17].

Biological drugs, such as those derived from proteins or cellular components, have shorter shelf lives due to their complex structures, making them particularly sensitive to environmental conditions [18]. Following storage instructions closely, handling with care to avoid contamination, and disposing of expired biological medications promptly are critical for ensuring their safe and effective use [18].

This study aims to evaluate pharmacists' knowledge, attitudes, and practices in Karbla Governorate concerning the proper handling, storage, and disposal of expired medications. It seeks to pinpoint gaps in their knowledge and practices and to propose strategies for enhancing pharmacist awareness and behavior, ultimately supporting improved public health and environmental protection.

2. Methods

A cross-sectional study using a face-to-face questionnaire assessed Iraqi pharmacists' knowledge, attitudes, and practices regarding expired medication disposal. Data, collected through direct interviews between November 2024 and February 2025, included demographic information and responses to multiple-choice, Likert scale, and dichotomous questions. The questionnaire was administered to 200 pharmacists in Karbala city working in different health institutions with different levels of experience.

Statistical analysis focused on frequencies and percentages to describe pharmacists' knowledge, attitudes, and practices. Knowledge scores were calculated by summing correct answers.

Participant confidentiality was ensured, with no personal information recorded. The study's aims were explained, and participation was voluntary. The questionnaire was validated by experts and pilot-tested for clarity, with necessary modifications made.

3. Results

3.1. Demographic Characteristics of Participants

The demographic profile of the 200 pharmacist participants revealed a diverse group: 45% were aged 23-28 years, another 45% were 30-35 years, and 10% were 36-45 years old. Graduation universities varied, with Karbala University being the most common (25%), followed by Alzahrawi University (21%), and other universities representing smaller percentages. A significant majority (77%) of participants had 1-5 years of experience, while 19% had 5-10 years, and only 4% had over 10 years. The gender distribution was nearly even, with 52% male and 48% female.

Characteristic	Frequency
Age	
23-28 years old	45 %
30-35 years old	45 %
36-45 years old	10 %
Graduation University	
Karbala	25 %
Alzahrawi	21 %
Babylon	19%
Baghdad	10%
Al kufa	9%
Al kafeel	7%
Al safua	3%
Al Farahidi	3%
Al turath	2%
Oman	1%
Years of Experience	
1-5 years	77 %
5-10 years	19 %
More than 10 years	4%
Gender	52 %
	48 %

Table 1: Demographic Characteristics of Participants

3.2. Pharmacists' Knowledge and Practices Regarding Expired Medications

As shown in Table 2, most pharmacists (39%) believed that medications lose potency within the month of their expiration date, though 6% incorrectly thought medications remained effective even a month past expiration. Nearly all pharmacists (99%) understood that storage conditions significantly affect medication stability, and most believed that solid dosage forms, especially tablets, retain efficacy longer than liquid or semisolid forms. Tablets were the most frequently expired dosage form found in pharmacies (47%), followed by topical medications (25%), syrups (21%), and capsules (7%). Additionally, 39% of pharmacies reported having expired medications on their shelves. The drug classes most found expired were antibiotics (18%), topical medications (31%), vitamins (16%), antidiabetics(5%) only and antihypertensives (30%).

Questions	Response	Percentage (%)
What is your known about the effect of expired drugs?	Harmful	44%
	Very harmful	17%
	No effect	%30
	I don't know	9%
Did you know when does the drug lose its activity?	Month before the expiry date	2%
	The same month as the expiration date	39%
	Month after the expiry date	53%
	I don't know	6 %
If the medicine has become expired, is it still active?	Yes	77%
	No	23 %

Do storage conditions (heat, moisture, light) affect the validity inefficacy of medicine?	Yes No	99% 1%
What are the most dosage form retaining a portion of effectiveness after expiration?	Solid dosage form Liquid dosage form Semisolid dosage form	69% 17% 14%
What is the most expired dosage form in your pharmacy?	Tablet Capsules Topical Syrups	47% 7% 25% 21%
Are there expired medicines in the pharmacy?	Yes No	39% 61%
The number of expired medicines in the pharmacy during this week?	3 4 5 No one	27% 10% 5% 58%
What are the classes of expire drugs in your pharmacy?	Antibiotics Antidiabetic Vitamin Topical drug Antihypertensive	18% 5% 16% 31% 30%

Table 2: Pharmacists' Perceptions of Expired Drug Effects

3.3. Pharmacists' Practices Regarding Expired Medications

Table 3 presents pharmacists' practices regarding expired medications. Most pharmacists (62%) check medication expiration dates monthly, though a significant portion (46.3%) they forget to do that regularly. Nevertheless, the majority (80%) consistently inform patients about expiration dates before dispensing medications. For disposal practices, the most common approach is discarding expired medications in household trash (40%), while 20% flush them down the toilet or sink, raising environmental concerns. When purchasing stock, 52% of pharmacists buy medications nearing expiration at a discounted rate. Although nearly all pharmacists (94%) refrain from dispensing expired medications, a small percentage (6%) have done so. Most pharmacists (69%) routinely verify expiration dates before dispensing, and 75% are aware of programs that allow for the return of expired medications to pharmaceutical companies for safe disposal or recycling.

Questions	Response	Percentage(%)
How often do you check the expired medicines in the pharmacy?	Every month	62%
	Every two months	22%
	I don't check	16%
Why don't you check the expiry date of medicines?	I don't have time	36.6%
	I Forget to do that	46.3%
	I don't know	17.1%
Do you buy medicines that are soon to expire at a lower price?	Yes	52 %
	No	48 %
Is the patient informed about the expiration of the medication before taking it	Yes	80 %
	No	20 %

If you have an expired medicine, do you dispense it to the patient?	Yes	6%
	No	94%
What do you do with the expired medicines?	Throw away in household garbage	40 %
	Flush expired medications in toilet/sink	20 %
	Return to the pharmacy	15 %
	I don't know what to do with the expired drugs	15 %
	Others (land fill, burn ,keep at home)	10 %
Do you Verify expiry date before a administering Medications?	Always	%69
	Often	17%
	Sometimes	9%
	Rare	0%
	Never	0%
If you do not pay attention to the expiration date taken by the patient, is it possible to address this issue	Yes	60 %
	No	40 %
Have you ever taken an expired medicine, and what happened to you?	It effected my health	2%
	I benefited from it	20 %
	Nothing happened to me	33%
	I never did that	45%
Are there some medications protected by the company to return the medications after they reach the expiry date? or replacement with new medicines?	Yes	75 %
	No	25 %

Table 3: Pharmacists' Practices Regarding Expired Medications

3.4. Pharmacists' Knowledge and Attitudes Towards Expired Medication Disposal

Table 4 indicates that most pharmacists (70%) read medication disposal instructions, but there's no agreement on the best disposal methods. While some pharmacists return expired medications to pharmacies, others throw them in household trash or flush them. Nearly half (45%) acknowledge the environmental and health hazards of improper disposal, but many are unaware of specific risks like antibiotic resistance from flushing medications. Pharmacists generally support clearer guidance on safe disposal and see healthcare professionals as essential in educating patients on proper practices. The study underscores the need for increased awareness and education on safe disposal practices, suggesting that drug take-back programs and clearer disposal instructions could help mitigate environmental and health risks.

Questions	Response	Percentage(%)
Do you ever read medicines disposal instructions	Yes	70 %
	No	30 %
How do you dispose of expired medicines?	Return it to the drugstore	16%
	Return it to the company	32%
	Throw in the trash	28 %
	Leave it at the pharmacy	7%
	Throw it in the sink	17%
Does improper disposal of expired medicines affect the environment and health?	Yes	45%
	No	25%
	I don't know	30%
	Yes	20 %

Do drugs enter the water sewage system if withdrawn in the toilet/sink?	No I don't know	50 % 30 %
Does improper disposal of antibiotics lead to drug resistance?	Yes No I don't know	20 % 50 % 30 %
What is the “drug-take-back system”, used in some countries, responsible for?	Drug “disposal” in some countries Drug “sharing or donation” in some countries I don't know what it is responsible fo	30% 30 % 40 %
Ways of disposal of expired medicines should be taught.	Strongly Disagree Disagree Neutral Agree Strongly Agree	5 % 5 % 20 % 35% 35 %
Doctors and healthcare professionals provide advice on the safe disposal of expired medicines	Strongly Disagree Disagree Neutral Agree	10 % 10% 20 % 60%
How should we dispose a drug, including toxic and nontoxic ones, in household trash?	As It is. Crashed Before Discarding	40 % 60 %

What type of drugs can be flushed in the toilet?	Any type of drugs	35%
	None	35 %
	Only drugs that are listed on the flush list, which is written in the label or in the patient information leaflet of the medicine known to cause harm include death by accidental exposure	15%
	I don't know	15%
There is lack of adequate information on the safe disposal of expired household medicines!	Strongly Disagree	20 %
	Disagree	20 %
	Neutral	10 %
	Agree	25 %
	Strongly Agree	25 %
How could hazardous effects of expired medicines be minimized or controlled?	Provide proper guidance to the consumer	15 %
	Prescribe the adequate quantities and durations that ensure	10 %
	Patient compliance reduce the number of prescribed medicines by doctor	13 %
	Donate or share the unused drug to friends or relatives before It gets expired!	15 %
	Keep the expired drugs in a safe place	20 %
	Dispose them in the toilet	7 %
	Burn them	20 %
	Pharmacy	35 %
	Hospital	35 %

Where is the best location for placing a secure container to collect the expired drugs?	Supermarket	20 %
	I Don't Need This Program	10 %

Table4: Pharmacists' Knowledge and Practices Regarding Expired Medication Disposal

4. Discussion

The proper collection and disposal of unused and expired medications through effective systems and collection programs is essential for ensuring public safety and protecting the environment. The demographic profile of the 200 pharmacist participants, primarily from Karbala city, revealed a predominantly young and early-career workforce. Specifically, 77% of participants had 1-5 years of experience, with 19% having 5-10 years, and only 4% possessing over 10 years. The age distribution further supports this trend, with 45% of participants aged 23-28 years and another 45% aged 30-35 years, indicating a concentration within younger age brackets. The majority of participants graduated from local Iraqi universities, with Karbala University being the most common, reflecting regional educational patterns. The gender distribution was nearly balanced, with 52% male and 48% female participants, ensuring a representative sample. These factors give insight into how generational and educational backgrounds might shape pharmacists' knowledge and practices concerning expired medication disposal [19].

Our findings highlight mixed awareness among pharmacists about medication potency and stability, with 39% understanding that medications lose potency within the expiration month. However, 6% mistakenly believe some medications remain effective after expiration by one month. Nearly all participants (99%) acknowledged the importance of storage conditions in preserving medication stability, with

awareness that solid forms like tablets retain potency longer than liquids and semisolids. Tablets, along with antibiotics, topical treatments, and antihypertensives, were the most expired. These results point to the need for targeted education on proper handling and monitoring of frequently expired medications [19].

In terms of expiration date management, most pharmacists (62%) regularly check dates monthly, though 46.3% sometimes overlook this due to time constraints. A majority (80%) actively inform patients of expiration dates, reflecting a commitment to safety. However, disposal practices raise concerns: 40% of pharmacists discard expired medications in household trash, and 20% use environmentally harmful methods, such as flushing them. While nearly all (94%) refrain from dispensing expired drugs, a small percentage (6%) still do, posing potential health risks. This emphasizes the need for consistent protocols to address the environmental impact of improper disposal and uphold patient safety.

Comparing our findings with other studies highlights similar and differing patterns. In Bangladesh, 87% of pharmacists reported limited knowledge of the effects of expired medications and were unaware of drug take-back systems [20]. Meanwhile, a study in Adigrat showed 50.14% of pharmacists were well-informed about the harms of improper disposal, attributed to local awareness campaigns and training initiatives [2]. In Afghanistan, 78% of respondents disposed of expired medications in trash, with 12% flushing them in sinks [21]. These studies emphasize the need for educational programs and structured disposal systems across different regions to reduce environmental and health risks associated with expired medications [5].

Conclusion.

In summary, this study underscores the importance of pharmacists' knowledge, attitudes, and practices concerning expired medications. The results highlight the ongoing need for education and training to enhance pharmacists' comprehension of medication expiration, storage impacts, and safe disposal practices. While many

pharmacists are aware of the risks tied to expired medications, knowledge and practice gaps remain. The study stresses the value of establishing effective drug take-back programs and providing clear disposal guidelines. Addressing these issues can help reduce environmental and health risks associated with expired medications, support sustainable healthcare practices, and safeguard community well-being.

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