



# The quandary of incorrect practice toward unused and expired pharmaceutical products in households

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## ABSTRACT

**Background:** The latest revolution in pharmaceutical industries has led to an enormous production of medications, and therefore massive prescriptions. Sadly, the innocence of the correct disposal methods correlates with the hazardous accumulation of unused and even expired medicines. This is a worldwide issue and needs to be monitored. The current study aims to assess patients and customers' knowledge, attitude, and awareness of the correct storage conditions of the prescribed medications, in addition to their disposal methods.

**Methods:** Online Google forms were randomly distributed among 450 participants. The achieved response rate was 97%. The questionnaire was titled "Regarding the Factors Influencing Consumers' Knowledge about Unused and Expired Medications".

**Results and conclusion:** The output of this study highlights the risk of mishandling expired and unused medications due to people's knowledge backwardness. The obtained data confirmed the effect of reference groups on patient behavior regarding storage conditions, the disposal of medicines, and the environmental and health hazards related to medications abuse. In essence, establishing a disposal program for unused and expired medicines under the supervision of trained pharmacists is necessary to increase social awareness, therefore alleviating misuse hazards.

## INTRODUCTION

With the growth of population and revolution in drug industries, there is a tremendous increase in the availability of prescribed medicines and also those available over the counter with no prescription required (Gidey *et al.*, 2020). The availability of medicines is accompanied by increasing the storage trends of unused medicines among populations. Sadly, poor storage

conditions often lead to loss of drug efficiency, increase toxicity risks, and accidental poisoning in children. Those with a suicidal tendency may also negatively affected by the availability of unused and expired medicines stored within reach. Moreover, environmental hazards would increase by the bad disposal of these chemical medicines (Gracia-Vásquez *et al.*, 2015). Detrimental consequences are not only limited to health, social, and ecological conditions, but also affect the economy; wasting pharmaceutical products entails a financial loss for both the governmental and private sectors (Alnahas *et al.*, 2020). The discarding protocols of expired medicines represent obstacles to many countries. The variable components of pharmaceutical formulas could hold toxicities after chemical modifications beyond the expiry date or result from bad storage conditions. If not disposed of under strict regulations, it could harm the ecosystem and the aquatic

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environment (Kozak *et al.*, 2016). Pharmacists have focused mainly on informing the patients about the correct dosing, contraindications, frequency of use, and watching possible side effects. On the other hand, they have placed less effort in explaining the best storage conditions of each item and the correct disposing protocol. Thus, populations have poor knowledge regarding the proper dealing with unused and expired drugs (Sharif *et al.*, 2010). Al-Samydai *et al.* (2019) defined consumer behavior according to different factors influencing the decisions made, including reason, time, place, and the way of responding. The importance behind understanding the behavior of people and expecting their decisions is to enable the healthcare systems to update their regulations and strategies in order to meet the expectations and to increase the satisfaction of the consumers (Aburjai *et al.*, 2019). This research project is designed to understand consumers' knowledge, and therefore behaviors regarding the best methods of disposing unused and expired medicines.

## MATERIALS AND METHODS

### Study design

The data was collected using the simple random sampling method. Google Forms was chosen and distributed among the participants' households to ensure variety, safety, and effectiveness (Kamal *et al.*, 2020). Young people from Amman, Jordan, were the target of the study, regardless of their gender. According to Sekaran's (2016) table, the minimum sample size should be 384 to be truly representative. Following this specification, our sample size was 436. The slight increase in number was to avoid dodging mistakes and to increase the results' accuracy. Random sampling through soft and hard copies of the Google Forms was used. Unreturned forms made up a ratio of around 5.7%, while 1.3% of the forms were not filled completely. The valid returned copies for statistical analysis totaled 436, which made up 93% of the total submitted forms. The questionnaire was divided into two main categories, demographic and variable measures, with 5 and 32 questions, subsequently. The design of the questions followed a Likert-type scale to obtain better understanding of the

participants' responses. The measuring scale was divided into 5 points where the highest degree matches the strongly agreement response (Yousif, 2019). The study was conducted from 15 June to 01 January 2021.

### Study model

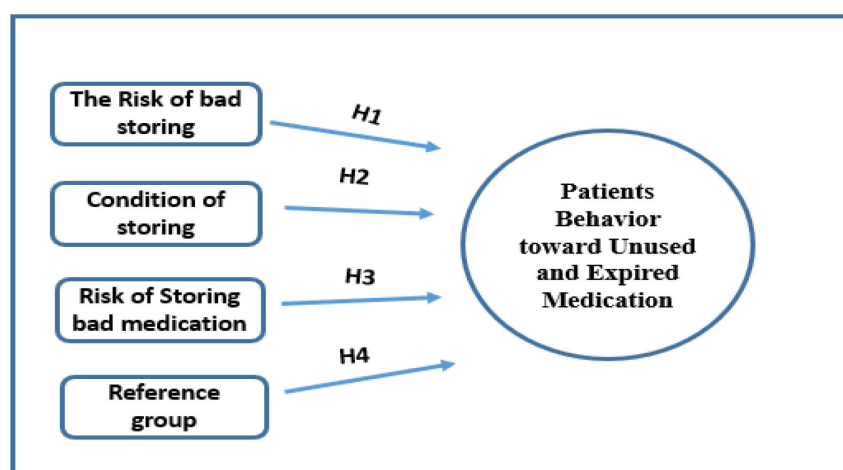
Figure 1 shows the study model containing the research problem, objectives, and hypothesis (Humam *et al.*, 2020). The hypothesis of this study is to investigate the impact of independent factors (the risk of bad storage conditions, storage conditions, risk of expired medication storage, and reference group) on the dependent factor (knowledge of consumers about unused and expired medications).

### Statistical analysis

The current study aims to evaluate people's awareness of the risk of bad storage conditions and the best disposal protocol of unused and expired medicines. Bivariate correlation analysis, linear regression, and one-way analysis of variances were carried out through SPSS software, version 22 (Humam *et al.*, 2020). The researcher could not calculate population size as there is no statistical data about the number of patients in Amman city.

## RESULTS AND DISCUSSION

The best way of dealing with medicines by the public to get the best out of it and avoiding risks correlated with it were our target in the current study. Storing medication at home and disposing expired medications are important topics that need to be discussed. In this study, we notice differences in the awareness levels between individuals regarding storing and disposing expired medications. The ages of respondents were divided into five different groups. Respondents whose age ranged between 15 and 25 years had the highest percentage (72.55%), while the lowest rate (2.3%) belonged to participants in age group if 55 and above. It was aimed to verify the hypothesis of this research study which states the risk of storing expired medication and reference group in consumers' knowledge and awareness about unused and expired medicines. The generated data were analyzed as



**Figure 1.** The study model showing the factors affecting patient behavior toward unused and expired medication. H1: there is an impact of bad storing on the patient behavior; H2: there is an impact of condition of storing on the patient behavior; H3: there is an impact of risk of storing bad medication on patient behavior; and H4: there is an impact of reference group on patient behavior.

described. According to social status, singles occupied the highest percentage, with 71.6% of the respondents. Most of the participants were highly educated. 71.1% of them held a bachelor's degree and 6.9% held postgraduate degrees (Table 1). After that, we analyzed the participants' financial status with the mean of their income, and low-income individuals of equal or less than 200 JD a month represented 48.2% of the total respondents. Individual awareness, the study-dependent variable, was significantly correlated with a set of independent variables include the risk of bad storage conditions, expired medications, and the disposal of unused and expired medicines. This significant variation was expressed as the  $F$ -value was less than 0.00 (less than 0.05). The calculated  $F$ -value was 187.225, which is higher than the  $F$ -value table (2.38). Accordingly, the hypothesis is accepted. A strong and positive relationship was found between the independent and dependent variables, as shown in Table 2. The values were higher than 0.5 ( $R = 0.812$ ,  $R^2 = 0.659$ ); these findings mean that the contribution and impact of independent variables were in a percentage of 65.9. The descriptive statistics for the dependent and independent variables are shown in Table 3. The correlation between the dependent and independent variables is shown in Table 4.

A correlation value of 0.001 indicates that the variables' reference group and awareness are highly correlated. Poor knowledge regarding the risk of bad storage was concluded with a correlation value of 0.009. The improper storage and discarding of

unused and expired medicines led to losses in the pharmaceutical industry and, unfortunately, to severe health and environmental issues (Kozak *et al.*, 2016). Minimizing environmental risks should be conducted by good management protocols such as recycling unused and expired drugs (Boxall, 2004).

Sadly, pharmaceutical waste was detected in soil and water, such as antibacterial; these could participate in the emergence of resistant strains of pathogenic bacteria overtime (Alnahas *et al.*, 2020; Boxall, 2004, Hajleh *et al.*, 2021). These results are a reflection of bad disposal behavior between consumers. The data we have generated confirm poor knowledge among the public regarding the sequences of the incorrect disposal of medicines. The public obtained their information from reference groups instead of specialized and expert individuals.

Researchers have investigated the reason behind storing excess medicines at home. They have found multiple reasons, including resolved medical conditions, changes in treatment regime, experiencing undesirable effects, forgetting to use the medicine, poor patient compliance, purchasing multiple packs of Over The Counter (OTC) medicines, and dispensing 90-day supplies (Gidey *et al.*, 2020). Creating specialist and strictly programmed protocols to manage and supervise the disposal of pharmaceutical products is essential to regulate and minimize health and environmental hazards. It is highly recommended that these programs be under the supervision of qualified pharmacists.

**Table 1.** Demographic distribution of the study sample.

	Type	Frequency	Percent
Age	15–25 year	316	72.55%
	26–334 year	36	8.3%
	34–44 year	36	8%
	45–54 year	39	8.9%
	55 and above	9	2.3%
Social status	Single	312	71.6%
	Married	112	25.7%
	Other	12	2.7%
Job	Employee Manager	74	17%
	No work Other	21	4.8%
		258	59.2%
Education	High school or less	83	19%
	Diploma Bachelor	31	7.1%
	Postgraduated	65	14.9%
		310	71.1%
Salary	200 JD or less monthly	30	6.9%
	201–500 JD monthly	210	48.2%
	501–800 JD monthly	112	25.7%
	801–1,000 monthly	50	11.5%
	More than 1,000 monthly	26	5.9%
		38	8.7%

**Table 2.** Multiple regression between dependent and independent variables.

Dependent variable	R	R <sup>2</sup>	F	Sig	Independent variable	$\beta$	t	Sig.
Knowledge of consumer about unused and medicines medications	0.812	0.659	208.848	<0.001	Risk of bad storing	-0.078	1.181	0.136
					Condition of storing	-0.095	1.645	0.783
					Risk of storing expired medication	0.222	3.970	<0.001
					Reference group	0.679	17.346	<0.001

R: Correlation coefficient, R<sup>2</sup>: Coefficient of determination, F: F-statistic, Sig.: Significance probability ( $p$ -value  $\leq 0.05$ : Statistically significant,  $p$ -value  $> 0.05$ : Not statistically significant),  $\beta$ : Unstandardized coefficients, t: Test statistic for  $t$ -test.

**Table 3.** Descriptive Statistics for dependent and independent variables.

	Minimum	Maximum	Mean	Std. deviation
First dimension: risk of bad storing	1.00	5.00	1.9689	0.54734
Second dimension: condition of storing	1.00	5.00	2.1117	0.62072
Third dimension: Risks of storing bad medications	1.00	4.80	2.4517	0.68535
Fourth dimension: reference group	1.00	5.00	2.8737	0.92922
Depended dimension: individual awareness	1.00	5.00	3.0351	1.11554
Valid N (listwise)	437			

**Table 4.** Correlation between dependent and independent variables.

	First dimension: risk of bad storing	Second dimension: condition of storing	Third dimension: risks of storing bad medications	Fourth dimension: reference group
Pearson's correlation	0.001	0.090	0.481**	0.804**
H5 Sig. (two-tailed)	0.987	0.062	0.000	0.000
N	437	437	437	437

\*\*Correlation is significant at the 0.01 level (two-tailed).

## CONCLUSION

The generated data confirmed that the perception of the correct way of disposing expired medicines varies according to age groups, financial status, and social and employment status. A large number of the population should be aware of the risk related to the use of expired drugs. Increasing social awareness would be achieved by setting educational programs and strict guidelines about proper disposing methods of unused and expired medicines. The pharmacists' role is not to be ignored as they are responsible for educating the patients while dispensing their drugs. Gathered efforts from the whole health sector and the social communities are highly recommended to minimize the health and economic loss due to misusing and disposing of medicines

## PROSPECTUS OF THE STUDY

Raising public awareness of the health hazards associated with using expired and incorrectly stored drugs is the responsibility of the health sector, in particular, pharmacists. This will be achieved by running educational programs, training courses, and any other suitable means to reach the target population.

## LIMITATIONS OF THE STUDY

The process of this study faced variable limitations that could affect the fairness of the generated results and bias the directions of the findings. The major hindrance was the capability to

generalize the outputs over a large number of the population because most respondents were residents in the capital city. Highly educated people were the largest proportion of the participants. Interpretation of the obtained data came up with 71.1% of the participants having bachelor's degrees and 6.9% of them with postgraduate degrees. This obstacle determines our hypothesis meant to target all the population sectors, regardless of their education levels. The questionnaire may need improvement, as the expectation that a 25-question survey is considered time-consuming and not encouraging to be filled fully by participants. In the survey, the absence of basic definitions, images, and examples was among the drawbacks of this study. The lack of these illustrative supplements could affect the understanding of the questions by respondents.

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## CONFLICT OF INTERESTS

The authors declare that they have no conflict of interest.

## AUTHORS' CONTRIBUTIONS

All authors made substantial contributions to conception and design, acquisition of data, or analysis and interpretation of data; took part in drafting the article or revising it critically for

important intellectual content; agreed to submit to the current journal; and agree to be accountable for all aspects of the work.

#### ETHICAL APPROVALS

Not applicable for this type of studies.

#### DATA AVAILABILITY

All data generated and analyzed are included within this research article.

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