

Practices and attitudes concerning expiration date, unused, and expired medication disposal

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ABSTRACT

Background: According to the product type, the date of expiration is set after manufacturing or after dispensing of the medication or after opening of the medication's container. **Objective:** The objective of the study was to assess practices and attitudes concerning unused, disposal, and expiration date of medications among Saudi population in the Northern Border Region of Saudi Arabia. **Materials and Methods:** A cross-sectional study conducted during a period of 9 months from April 2019 to January 2020 on a random sample, all data were analyzed by means of descriptive analysis. **Results:** The total number of people answered the questionnaire during the study period were 529, nearly all the participants (99%) keep medication in their homes at the study time. Only half of the participants (53%) were aware that expiry date on the bottle differs after bottle opening. About 24% of participants do not check the expiry date while purchasing medications. The main cause mentioned for not checking the expiry dates while purchasing medicines were that pharmacist already checked (71%), about half of study participants (56%) check the expiry date of stored medicines at the time of usage. About 34% and 41% of participants reported that if they buy eye/ear drops and ointment/cream respectively, they will keep it in bedroom. About 74% of study participants throw away expired medicine in household garbage as it is. **Conclusion:** It is obvious that Saudi people have a sufficient level of awareness of the expiry date of medication; however, their practices are poor. In light of the study findings, there is a great need to improve public awareness toward the storage and disposal of drugs and its bad consequences.

KEY WORDS: Practices; Attitudes; Expiry Date, Unused Medication; Expired Medication; Disposal


INTRODUCTION

Expiry date of drug means “The date placed on the container of a drug product designating the time during which a batch of a product is expected to remain within the approved shelf life specification if stored under defined conditions and after which it may not be used.”^[1]

According to the product type, the date of expiration is set after manufacturing or after dispensing of the medication or

after opening of the medication's container.^[2] However, it is not a fixed concept that all drugs deteriorate at the same rate or interval of time^[3] whereas, medicines belong to the different synthetic or formulated categories mark the shelf life position.^[4] According to the World Health Organization (WHO), every pharmaceutical product should have a defined package pamphlet which gives all the essential information regarding the indications of medicines, adverse effects, interactions, and the date of expiration.^[5] Since 1979, the Food and Drug Administration (FDA), obligated mentioning expiration dates on every pharmaceutical product for pharmaceutical manufacturers.^[6]

The terms “shelf-life” “expiry date” or “best before” are not only applied to pharmaceutical products but also are applied to products such as beverages, food items, chemicals, and cosmetics.^[7] In most of the cases of pharmaceutical products,

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the expiry date reflects the product quality as after the expiration, contamination is observed by increased levels of microbial index or moisture contents can also influence the non-utilization of such medicines.^[8]

Adverse effects of expired drugs are loss of efficacy, safety, potency, and formation of harmful products.^[9] Expired medication may not adequately treat minor conditions (e.g., minor headache, cold) or serious conditions (e.g., diabetes or heart disease) because of reduced efficacy.^[10] As a consequence, inadequate relief from sickness could eventually lead to longer sick days, increased absences from work/school, and lost productivity at work/school.^[10]

Drug therapy is considered the most commonly used modality for prophylaxis and treatment of diseases.^[11] Pharmacists and other health-care professionals most often counsel patients about the proper medication use, including route of administration, duration of therapy, and conditions need to be referred to physician during their use for medication. However, sufficient information about storage, disposal, and the decision of either continue on or dispose a drug after a while left there are lacking.^[12,13] Inappropriate medications' storage and handling of medications eventually lead to losing their potency and efficacy.^[14-16]

There many previous studies which tried to assess awareness, attitude, and practices of people regarding expired medications. A previous Indian study's results showed that about 72% of study subjects do not check expiry date when purchasing or taking the medications.^[17] Another study also provided evidence regarding 17% people's careless regarding checking of expiry date.^[18] On the other hand, a previous Nigerian study, the results revealed that majority of participants (93.3%) were well aware regarding expired drugs.^[19] Ahmed *et al.* conducted a study in Karachi revealed that 20% of participants were unaware of the hazardous effect of expired medicines whereas Singh in his study indicated that the majority (84%) of people usually checked dates before using medicines.^[20,21]

Expired medications are also a source of unintentional poisoning and abuse, so there should be an adequate system for their disposal.^[22] Keeping the medications after their expiration dates may cause them to start absorbing moisture-enhancing microbial contamination.^[9] No significant deaths recorded in any study due to the use of expired medications. However, most of the international articles published directly or indirectly reveal their adverse effects. For instance, there is evidence that Fanconi syndrome was caused by expired tetracycline in 1963 in the U.S.^[23,24] Vaccines, insulin, biological products, and oral nitroglycerin could also be subject to quick degradation once the expiration date is reached.^[23,25]

According to the WHO, more than half of all medication is inappropriately prescribed or prescribed and sold, which

causes unnecessary storage and creates an environmental threat.^[26] According to the WHO, 50% of patients fail to take medicine correctly.^[27] Unnecessary medications and non-adherence to medications can also cause the storage of left-over medicines at home. Therefore, it is usual that patients keep unused medications, which will be in certain time expired medications and its risks have gained attention across the world.^[28]

The patients dispose of the medications which remain after most treatments in different ways such as throwing in garbage bins and flushing in toilets. This inappropriate disposal of medicines poses a danger to the community and the environment.^[11] The disposal of medicinal products must be carried out in such a way which protects public health and does not result in any risk to the environment.^[29]

Disposal of expired or unused medications in an improper way represents an environmental risk. For example, in the USA, many drugs such as ethinylestradiol, verapamil, antibiotics, and acetaminophen are found in waterways.^[30] The presence of the active principle of oral contraceptives such as the ethinylestradiol in the waterways impairs sexual development and development of sex characteristics of fish.^[31] In addition, the presence of antibiotics in water may lead to antibiotic resistance^[32] and on the long term, may cause genetic defects in humans and marine life.^[33] In October 2008, the byproducts of a mass vaccination campaign of a large number of people against polio in Afghanistan were discarded in the local municipal waste, causing infectious injury to people who search waste dump sites for reusable items. Other medical wastes, including pharmaceuticals, have been found disposed in the open land-fills near hospitals in urban areas.^[34]

This study aims to assess practices and attitudes concerning unused, disposal and expiration date of medications among Saudi population in the Northern Border Region of Saudi Arabia, assess knowledge of participants about proper drug storage and its relation with the expiry of medications, assess knowledge, and practices of participants about the expiration date of medication after opening of the drug container. And to determine the most common routes for disposal of unused or expired drugs among participants.

MATERIALS AND METHODS

Study Design, Duration

This was a cross-sectional study conducted during a period of 3 months from November 2019 to January 2020 in Northern Border Region of Saudi Arabia.

Study Population

This study was a random sample of 529 Saudi males and females.

The Inclusion Criteria

The following criteria were included in the study:

- Adult male and female Saudi people of different age ranges and education
- Age ≥ 18 years
- Neither be health-care professionals nor students from any medical/health-related field living in the northern border region
- Agree to fill the questionnaire.

The Exclusion Criteria

The following criteria were excluded from the study:

- Males and females below the age of 18 years
- People who refused to give consent
- Work in health sector.

Data Collection and Data Collection Instrument

After permission from the ethics committee, the data were collected using an online questionnaire specially designed for the research purpose.

The questionnaire sent to a random sample of the people living in different areas of Northern Border Region – Saudi Arabia.

The questionnaire was divided into six main sections:

- Sociodemographic characteristics of the study population
- General and specific knowledge of study subjects about the expiry date
- Practices of respondents regarding expiry date checking
- Participants' behavior concerning the handling of drug products
- Practices of respondents regarding medications storage
- Study subjects' practices and attitudes concerning unused and expired medication disposal.

The questionnaire was tested for its readability and understanding to the public before distribution. All participants were asked to answer all questions. All incomplete questionnaires were omitted from the study.

Statistical Analysis

All data were analyzed by means of descriptive analysis using MS EXCEL. The frequency and percentage calculated for all the participant's sociodemographic and answers for the questionnaire with representation for the answers by tables.

RESULTS

Sociodemographic Characteristics of Study Population

The total number of people answered the questionnaire during the study period was 529 (details of study group sociodemographic characteristics represented in Table 1).

Table 1: Sociodemographic characteristics of the study population ($n=529$)

Variable	Categories	Frequency	Percentage
Sex	Male	82	16
	Female	447	84
Age (years)	18–25	166	31
	26–35	103	19
	36–45	197	37
	46–55	60	11
	56–65	3	2
Social status	Married	362	68
	Not married	167	32
Education	Illiterate	5	1
	Not complete university education	90	17
	University education	412	78
Residence	Postgraduate study	22	4
	Arar	412	78
	Hail	18	3
	Hafralbaten	12	2
	Rafha	8	1.5
	Turif	3	1
Other	72	14	

Reported Classes and Dosage Forms of the Stored Medications

Nearly all the participants (99%) keep medication in their homes at the study time (details of reported classes and dosage forms of the stored medications represented in Table 2). Analgesic, antipyretic, and nonsteroidal anti-inflammatory drug (NSAID) represented (91%) of the stored drugs, followed by antibiotics, antacid, and cough and cold preparations, respectively (67%, 37%, and 36%). Tablet indicated by the majority of study subjects as the main dosage form stored in their homes followed by syrup and capsules, respectively (64% and 51%).

General Knowledge of Study Subjects about Expiry Date

Large percentage (88%) of participants was aware that medicines manufactured can be used only for a limited period of time, after which they should not be used (details of general knowledge of study subjects about expiry date represented in Table 3).

Specific Knowledge of Study Subjects about Expiry Date

About 86% of the study subjects were aware that some types of medications are sensitive to light or heat or humidity, slightly lower than half indicated that not any type of medication can be stored in the refrigerator. However, one-third (31%) believed that any medication type can be stored in the refrigerator. Only half of the participants (53%) were

Table 2: Reported classes and dosage forms of the stored medications (*n*=529)

Questions	Categories	Frequency	Percentage
Do you keep any medication in your home at the present time?	Yes	522	99
	No	7	1
Type of medications you keep at your home	Antibiotics	355	67
	Analgesic, antipyretic, NSAID	480	91
	Antacid	197	37
	Topical preparations (eye/ear drops, dermatological)	163	31
	Cough and cold preparations	193	36
	Antidiarrheal, laxative	64	12
	Chronic disease medications	148	28
The kept medicine is in the form of:	Tablet	369	70
	Capsule	272	51
	Syrup	393	64
	Drops	153	29
	Inhalations	40	8
	Injections	23	4
	Suppositories	158	30

Table 3: General knowledge of study subjects about expiry date (*n*=529)

Questions	Categories	Frequency	Percentage
Medicines manufactured can be used only for a limited period of time after which they should not be used	Yes	456	88
	No	21	4
	Do not know	43	8
The specific time period till when a medicine can be used is mentioned on the packs of the medicines as “expiry dates”	Yes	484	91
	No	19	4
	Do not know	26	5
You expect that the damaged part of the expired drug represents	100%	166	31
	90%	51	10
	70%	40	8
	50%	45	9
	30%	30	6
	10%	21	4
	Do not know	176	32
The expired medicines can adversely affect the body	Yes	443	84
	No	29	5
	Do not know	57	11
You may use the expired medicine when you need it	Yes	36	7
	No	393	93

aware that the expiry date on the bottle differs after bottle opening. More than three quarters of study participants (78%) believe that cough syrup after opening should be stored in refrigerator and 22% either do not know or believed that cough syrup should not be stored in refrigerator after opening. Nearly three quarters of study participants (70%)

were aware that antibiotics suspensions after opening and dissolution should be stored in refrigerator, about (70%) of participants know that antibiotics suspensions after opening and dissolution should be used within 1–2 weeks [Table 4].

Practices of Respondents Regarding Expiry Date Checking

About 24% of participants do not check the expiry date while purchasing medications, 34% not interested in reading internal pamphlet or label of the drug before storage to know storage conditions. The causes mentioned for not checking the expiry dates while purchasing medicines were that pharmacists already checked (71%), laziness (13%), do not consider it necessary and lack of time (7%). About half of study participants (56%) check the expiry date of stored medicines at the time of usage, 8% check it monthly, 5% check it every 3 months, and 7% do not check it at all [Table 5].

Participants’ Behavior Concerning Handling of Drug Products

About one-fifth (20%) of study participants may add water and shake drug before use when notice drug deposition at the bottom of the bottle. About 88% of the participants reported that they will discard the drug if forget it for a whole day in the car during summer. In addition, 87% of participants indicated that they will not continue to use the drug if its color changed [Table 6].

Practices of Respondents Regarding Medications Storage

About 47% of participants reported that if they buy tablets, they will keep it according to the pharmacists’ recommendations,

Table 4: Specific knowledge of study subjects about expiry date (*n*=529)

Questions	Categories	Frequency	Percentage
Some types of medications are sensitive to light or heat or humidity	Yes	453	86
	No	13	2
	Do not know	63	12
Any type of medication can be stored in the refrigerator	Yes	165	31
	No	238	45
	Do not know	126	24
Expiry date on the bottle differs after bottle opening	Yes	281	53
	No	123	23
	Do not know	125	24
Cough syrup after opening should be stored in refrigerator	Yes	411	78
	No	52	10
	Do not know	66	12
Antibiotics suspensions after opening and dissolution should be stored in refrigerator	Yes	370	70
	No	88	17
	Do not know	71	13
Antibiotics suspensions after opening and dissolution should be used within 1–2 weeks	Yes	378	71
	No	64	12
	Do not know	87	17
Eye drops/ointments should be used within 28 days after opening	Yes	314	59
	No	59	11
	Do not know	156	30
Syrup should be used within 6 months of bottle opening	Yes	191	36
	No	140	26
	Do not know	198	37
Tablets or capsules in one container should be used within 1 year of bottle opening	Yes	171	32
	No	123	23
	Do not know	235	44
Separately packaged tablets and capsules can be used until the expiry date mentioned on the package	Yes	406	77
	No	28	5
	Do not know	95	18
Externally applied creams or ointment contained in tube should be used within 3 months of opening	Yes	259	49
	No	73	14
	Do not know	197	37
Externally applied creams or ointment in the form of pack with top cover should be used within 1 month of opening	Yes	253	48
	No	83	16
	Do not know	193	36

24% reported that they will keep it in the bedroom. About 35% of participants reported that if they buy syrups, they will keep it according to the pharmacists' recommendations, 47% reported that they will keep it in refrigerator [Table 7].

Table 5: Practices of respondents regarding expiry date checking

Questions	Categories	Frequency	Percentage
Do you check the expiry date while purchasing medications?	Yes	403	76
	No	126	24
Are you interested in reading internal pamphlet or label of the drug before storage to know storage conditions?	Yes	408	77
	No	178	34
Causes for not checking the expiry dates while purchasing medicines (<i>n</i> =432)	Laziness	56	13
	Lack of time	31	7
	Do not consider it necessary	39	9
	Pharmacist already checked	306	71
Period after which you checked the expiry date of stored medicines	At the time of usage	295	56
	Every 6 months	2	1
	Every 3 months	26	5
	Monthly	45	8
	Yearly	5	1
	Do not do so	37	7

Table 6: Participants' behavior concerning handling of drug products

Questions	Categories	Frequency	Percentage
If you notice drug deposition at the bottom of the bottle, you may add water and shake it before use	Yes	105	20
	No	334	63
	Do not know	90	17
If you forget a drug for a whole day in the car during summer, you should discard it	Yes	456	88
	No	23	4
	Do not know	41	8
If the color or form of medicine has changed, you can continue use it	Yes	28	5
	No	461	87
	Do not know	40	8

Study Subjects' Practices and Attitudes Concerning Unused and Expired Medication Disposal

About 74% of study participants throw away expired medicine in household garbage as it is, 13% throw it away in household garbage after crushing, 4% flush expired medications in toilet or sink, and also 4% return it to medical store/pharmacy [Table 8].

Incidence of Adverse Events Related to Expired Medications

About 17% of the study subjects reported that they have seen/experienced bad incidence associated with the intake of expired drugs [Table 9].

Table 7: Practices of respondents regarding medications storage

Questions	Categories	Frequency	Percentage
If you buy tablet or capsule from the pharmacy, you will keep it in	Bedroom	127	24
	Living room	13	2
	Kitchen	32	6
	Bathroom	2	1
	Refrigerator	104	20
According to pharmacists' recommendations		251	47
	Bedroom	57	11
	Living room	9	2
	Kitchen	23	4
	Bathroom	2	1
Refrigerator		250	47
	According to pharmacists' recommendations	188	35
	Bedroom	174	34
	Living room	13	2
	Kitchen	15	3
Bathroom		4	1
	Refrigerator	143	27
	According to pharmacists' recommendations	180	34
	Bedroom	217	41
	Living room	16	3
Kitchen		15	3
	Bathroom	4	1
	Refrigerator	97	18
	According to pharmacists' recommendations	180	34
	Bedroom	29	6
Living room		0	0
	Kitchen	9	2
	Bathroom	2	1
	Refrigerator	425	80
	According to pharmacists' recommendations	63	12

Table 8: Study subjects' practices and attitudes concerning unused and expired medication disposal

Questions	Categories	Frequency	Percentage
What do you do with expired medicines?	Throw away in household garbage as it is	393	74
	Throw away in household garbage after crushing	70	13
	Flush expired medications in toilet or sink	21	4
	Burial under the soil	7	1
	Return it to medical store/ pharmacy	23	4
	Nothing	15	3

Table 9: Incidence of adverse events related to expired medications

Questions	Categories	Frequency	Percentage
Have you or any of your relatives seen/ experienced any bad incidence associated with intake of expired drugs	Yes	87	17
	No	438	83

The findings of the present study are valuable for the community and health-care sector as it reveals the degree of public knowledge and awareness of Saudi people regarding expiry data of medication and their practices of medications storage. Nearly all study participants (99%) had stored medicine in their home during study time. This result is in accordance with the study conducted in Sudan from March 2002 to May 2002 indicated that 97.7% of participants had at least one drug product stored at home^[36] and also similar to other studies; 94% in the Iraqi study and 100% in a Qatari study. However, northern Uganda showed less percent (35%).^[11,13,35,36]

The availability of in-home stored medications is the direct leading factor to inappropriate drug using behavior such as continued use of stored drugs upon need, self-medication, and drug exchange among families and poor adherence and compliance^[37] owing to the fact of the ease of access to stored drugs when needed.^[37] Analgesic, antipyretic, NSAID represented the top of stored medications (91%), followed by antibiotics, antacid, and cough and cold preparations, respectively (67%, 37%, and 36%) which is similar to other studies where the most common drugs stored at home were antibiotics, analgesics, antispasmodics, cough drugs, antipyretic drugs, and insulin.^[11,12,33,36] In a previous study done in Basra, Iraq in April 2010, of 300 participants, the majority (94%) stored drugs at home. Antibiotics hit the top of the stored drug list with a percent of (26%).^[13] The most common uses indicated were for treatment of influenza, upper respiratory tract infections, diarrhea, and tonsillitis.^[13]

Although, as a simple analgesic, paracetamol is one of the safest drugs to use, accidental poisoning with paracetamol has also been highlighted by a number of authors.^[38-40] Therefore, it is

DISCUSSION

The present study conducted to assess the knowledge and practices about the expiration date of medications among Saudi population in the Northern Border Region of Saudi Arabia. Similar to other studies, it is not surprising to find that majority of respondents were female (84%) given that their responses were often filled in and received at the office hours of their partners.^[11,13,35,36]

matter of importance to use, store, and dispose medicine safely, especially when the patient is practicing self-medication. Due to improper use, store and dispose, drug composition affected and hence adverse effects on health care may arise. Among the possible adverse consequences of self-medication to individual patients are those that include misdiagnosis and missed diagnosis, misuse of drugs^[41,42] increased risk of adverse reactions and drug interactions, particularly in children, the elderly, pregnant women, and those with pre-existing diseases.^[13]

It is seen from the literature that tablets degrade if not kept in a suitable temperature. Hence, the storage place and container should be appropriate. Storage of medicines in homes under damp and humid conditions, as well as exposure to light or high temperature, can cause medicines to degrade more quickly than expected. About 24% of participants reported that they will keep tablets in bedroom, 34% of participants reported to keep eye or ear drops in bedroom, and 41% of participants reported to keep ointment or cream in bedroom, as was reported in the results of the previous study in Basrah, Iraq.^[13] Furthermore, some of the current study participants rated kitchen and bathroom as places to keep medicines, although majority (86%) reported that some types of medications are sensitive to light or heat or humidity.

The current study revealed encouraging results regarding awareness and practices regarding expiry of medicines. According to our study results, 86% of participants always checked the expiry date of drugs, this proportion being comparatively higher than determined by Jain *et al.* in northern India, where only 28% respondents practically checked any expiry dates.^[17] This remarkable difference shows the better attitudes and practices of our population as comparatively. The causes mentioned for not checking the expiry dates while purchasing medicines were that pharmacists already checked, laziness, do not consider it necessary, and lack of time. Studies conducted in Nigeria and Karachi favored the results of the current study as their large proportions of respondents were also aware of the expiry dates along with their potential adverse effects, proportions being 93.3% and 80%, respectively.^[19,20]

Wide-range of drugs is not toxic when expired but indeed loses their effectiveness over time. The expiration date is the final date that the manufacturer guarantees the full potency and safety of a medication.^[43] Slightly higher than one-third (32%) of participants have not any knowledge about the percentage of the damaged part of the expired drug and one-third (31%) expect that the damaged part of the expired drug represents (100%). Large proportion (84%) of the study subjects believe that expired medicines can adversely affect the body. A small number of study subjects represent (7%) indicated that they may use expired medicine when need it.

This study also highlighted other issues which are needed to be addressed such as disposal of drugs and self-medication. According to our results, 74% of study participants throw away expired medicine in household garbage as it is, 13% throw it away in household garbage after crushing, 4% flush expired

medications in toilet or sink, and also 4% return it to medical store/pharmacy. This is remarkably different than the findings of a study conducted in the United States of America where 54% respondents disposed of medications in the garbage, 35.4% flushed medications down the toilet or sink, 7.2% did not dispose of medications, and 2% related they used all medications before expiration and 1.4% returned medications to a pharmacy.^[44]

It was recommended in the FDA guidelines for drug disposal that unused/expired medicines should not be flushed in toilet or drain. Before throwing the unused/expired medicines in the dustbin, it was suggested to mix the solid medications with the substance like coffee grounds and put into a disposable container and the liquid medications with salt and turmeric.^[45]

CONCLUSION

It is obvious that Saudi people have a sufficient level of awareness of the expiry date of medication; however, their practices are poor. In light of the study findings, there is a great need to improve public awareness toward the storage and disposal of drugs and its bad consequences.

Hence, a proper awareness program is the need of the hour to tackle the issues arising from improper drug storage and disposal.

Pharmacists as drug experts must to educate/counsel medicine users.

Plan effective public education programs for promotion about rational use and expiry date of drugs to improve their attitudes and practices regarding safe disposal of expired medicines of medicines in the community are necessary.

Increase the sensitization of the public about the benefits of the appropriate use of medicines.

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