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Research article

Patients' knowledge, attitude, and practices toward unused medications in Qatar: A cross-sectional survey

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ABSTRACT

Background: Global evidence has linked unused medications and their inappropriate disposal to adverse health, economic, environmental, and ethical impacts. However, such evidence is scarce in Qatar. This study explored patients' knowledge and attitude toward unused medications and their practices toward medication supply and disposal (KAP) in Qatar.

Materials and methods

Study design: A cross-sectional survey using a pretested questionnaire was performed between February 2020 and October 2020. Descriptive statistics, Man Whitney U, and Kruskal–Wallis Rank-Sum tests were applied. The Chi square test assessed the association between socio-demographic characteristics and KAP scores. Characteristics that were found significantly associated with KAP (i.e., p-values <0.05) were further included as predictor variables in the multiple linear regression model.

Results: All items pertaining to patients' knowledge were found to be good (mean score > 3), except for "awareness of unwanted medication return policy" (mean score < 3), i.e., the lowest level of patient agreement (31 %) (median (M) $= 3$, Interquartile Range (IQR) $= 3$). Their attitude was generally good (mean score > 3). Conversely, their practice toward medication supply was poor (mean score < 3). Possible future use was the most reported reason (79 %) for keeping medications at home, and home trash was the most widely disposing place of unused ones (76 %). Knowledge was significantly higher among non-laborers and other occupations than among patients with no work ($p < 0.001$) and ($p = 0.005$), respectively. The attitude was significantly lower among patients with healthcare providers (HCPs) in their household than among those without ($p = 0.001$). Practices were also significantly lower among those aged 40–49 years and

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those with HCPs in their household than those aged 18–29 years ($p = 0.012$) and those without HCPs, ($p < 0.001$), respectively.
Conclusions: Overall, patients' knowledge and attitude toward unused medications seem good, while their practices toward medication supply and disposal are bad. To mitigate the health, economic, and environmental impacts of unused medications, interventions including rationalizing drug supply, use, disposal, prescribing, manufacturing, and promotion are recommended.

1. Introduction

Medications are crucial for improving many medical conditions and wellbeing [1]. When they remain unused, their presence at home or inappropriate disposal can have various harmful effects [2]. It is globally estimated that more than 50 % of medications are prescribed, dispensed, or sold inappropriately, and that almost 50 % of patients fail to use them as instructed [3]. The percentage of unused home medications varies between 15 % and 98 % worldwide [4–6]. Various reasons can lead to the presence of unused medications such as: nonadherence due to their side effects, changes in treatment, and the resolution of medical conditions, etc., [7]. However, nonadherence remains one of the main reasons for unused medications and subsequent wastage [8]. More importantly, in addition to medication wastage, nonadherence can lead to deterioration of health, loss of manpower, and further hospitalization [9]. Only 50–60 % of patients taking medications for chronic illnesses have been found to adhere to their medication regimens [10]. The WHO stated that adherence to medications for chronic diseases is as low as 50 % [11]. The reasons for nonadherence have been rigorously discussed within the WHO five-dimensional theoretical framework of nonadherence: socioeconomic-related factors, therapy-related factors, condition-related factors, and healthcare system-related factors [11]. However, patient-related factors were found to be the most important among these factors [12].

Eventually, these unused medications may end up at home garbage as the main destination, as shown by several studies worldwide, or at sewers, pharmacies, and other places as secondary destinations [13]. The health impact of unused medications can arise from inappropriate use, storage, and disposal [14]. Inappropriate disposal of unused or expired medications is widespread and results in significant environmental contamination and public health risks [15]. Inappropriate disposal occurred due to lack of awareness about how to treat expired medications [16]. In another study, male respondents, especially older adults, showed less interest in and care for the appropriate disposal of unused medications [17]. In a study conducted in Saudi Arabia, most respondents confirmed receiving no information regarding the appropriate disposal of unused medications [18]. Tong et al. (2011) reported that knowing about the environmental risks caused by inappropriate disposal of unused medications increases the likelihood that individuals would take these commodities to collection boxes [19]. Responses from previous studies suggested that raising awareness of the public and HCPs toward the use and disposal of medications, would minimize harm [18,20].

In Qatar, a study revealed that almost 60 % of parents keep unused medications at home [21]. Another study of patients with diabetes in Qatar revealed that low adherence due to forgetfulness and subsequently uncontrolled glucose levels lead to many complications, such as diabetic nephropathy, neuropathy, and retinopathy [22]. Nonadherence was also identified to be as high as 84 % in another 293 patients with chronic diseases [23]. Data obtained from 49 households in Qatar showed that most respondents were found to throw unused medications in the trash (65 %). A small proportion of the respondents (15 %) did not take the prescribed dose, and medication sharing was evident. The study recommended raising public awareness of the issues regarding unused medications and their proper storage and disposal to avoid environmental impacts [24]. Furthermore, antibiotic medications were stockpiled and shared among families and friends to treat viral infections (an incorrect perception) in a Qatar-based study [25]. To our knowledge, no research in Qatar has intensively studied patients' knowledge and attitude toward unused medications, nor their practices toward medication supply and disposal, from all over Qatar. This study sought to assess these gaps and to determine the effect of patients' socio-demographic characteristics on these variables. Understanding this triad may lead to suggestions and interventions that may, for instance, improve adherence to medications and, consequently, health conditions, prevent health risks to households and the environment; and reduce expenditures.

2. Materials and Methods

2.1. Study design

This study is a descriptive, cross-sectional survey using a pretested questionnaire.

2.2. Inclusion criteria

All adult patients who were found waiting to pick up their medications from the selected pharmacies at the time of data collection were considered for this study.

2.3. Exclusion criteria

Vulnerable populations, including children, prisoners, or mentally disabled persons were excluded from the study.

2.4. Sample size

The sample size was based on a proportion equation [26,27] as the population was large and neither precisely known, nor variability in proportion was known. Therefore, we assumed p = 0.5 (maximum variability). Furthermore, a 95 % confidence level and ±5 % precision were desired. Fig. 1 shows the formula used to calculate the sample size.

$n_0 = (1.96)^2\ (0.5)\ (0.5)\ /\ (0.05)^2$

$n_0 = 385$

Applying Daniel's prevalence formula [28], yielded a similar sample size.

The same sample size (n = 385) was estimated when the Raosoft sample size calculator 2004 (http://www.raosoft.com/samplesize.html) was used in similar studies [29,30], considering that the total population of Qatar was 2,930,528 in 2021 [31], with a confidence level of 95 %, a margin of error of 5 %, and a response distribution of 50 %. Similar to the calculation strategy employed by a study exploring unused medications among the public in Malta [32], the estimated sample size in this study was 385 to give 95 % confidence intervals with a 5 % margin of error. Thus, a similar sample size was obtained when Daniel's formula, the Cochran formula, and the Roasoft online calculator were applied. To account for non-completion rates, an additional 30 % was theoretically considered to make the estimated sample size approximately 500, which was divided equally among the three-study settings (i.e., 167 participants from each of HMC, PHCC, and private pharmacies).

2.5. Sampling technique

To ensure that the sampling process is practical and that the sample is representative of all outpatients in Qatar, this study using a computer software [33], first stratified 12 outpatient pharmacies from public tertiary hospitals (i.e., HMC), public primary healthcare centers (i.e., PHCC), and the private healthcare sector. Second, researchers systematically and randomly selected an equal share of 14 patients from these 36 premises to reach the required sample size of approximately 500 patients. Equal shares of patients were selected from each facility as their numbers were not constant during the COVID-19 outbreak.

2.6. Study instrument

The researchers developed, translated, and validated a bilingual (English/Arabic) KAP questionnaire that suits the study objective and context [34]. It is composed of 4 different sections: section A - Patients' sociodemographic characteristics; section B – Patients' knowledge toward unused medications and their disposal; section C – Patients' attitude toward medication wastage; and section D – Patients' practices toward medication supply and disposal. The answers to the questions in the knowledge and attitude sections were grouped on a Likert-type scale ranging from (strongly disagree), to (unsure), to (strongly agree) (Tables 2 and 3). Similarly, answers to questions in the practice section were grouped as (Never or Rarely), (Sometimes), and (Always or Often) (Table 4), except for some other answers in multiple-choice-answer forms.

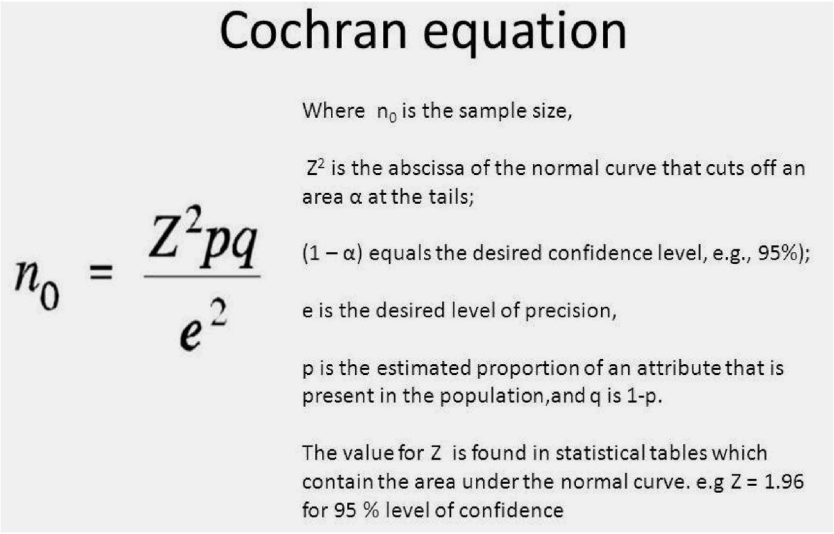

Fig. 1. Formula for calculation of sample size.

2.6.1. Content validity

Content validity was determined for the comprehensiveness and representativeness of the content of the instrument. A four-point CVI based on the judgement of nine experts was evaluated in the form of the S-CVI/Average and S-CVI/UA indices. The values of the S–CVI/Average and S-CVI/UA were 0.88 and 0.84, respectively. Thus, the questionnaire was considered for further analysis.

2.6.2. Factor analysis

The variance explained by the multivariate model was 85.0 % for the knowledge domain, 94.8 % for the attitude domain, and 89.8 % for the practice domain.

2.6.3. Reliability

The Cronbach's alpha coefficients of the new scales were 0.68 for knowledge, 0.82 for attitude, and 0.84 for practice. A Cronbach's alpha near or above 0.7 confirms the reliability of the items under these constructs. The questionnaire was revised based on the information gathered from the experts for content, grammar, and spellings before collecting the data.

2.7. Data collection procedure

Patient sampling was based on the selection of every 10th consecutive token number received, while patients waited to pick up their medications from the selected pharmacies. In addition to being random, this range of 10th patient is to allow enough time to collect data before the next 10th patient is called in. The data were collected between February 2020 and October 2020. The data collection procedure is detailed in Fig. 2 below.

2.8. Statistical analysis

Statistical analysis was performed with IBM SPSS® (Statistical Package for Social Sciences) version 27 (IBM Corporation, Armonk, NY). Descriptive statistics (mean, standard deviation, frequency, percentage, median, IQR) were applied to summarize the data. The Likert scale data were converted to trinomial data by combining all "Strongly agree" and "Agree" responses, on the one hand, as "Agree", "Unsure" response as it is, and all "Strongly disagree" and "Disagree" responses, on the other hand, as "Disagree".

As the data were not normally distributed, non-parametric tests (the Man Whitney *U* test and Kruskal–Wallis Rank-Sum Test) were applied. The Chi square test was applied to assess the associations between socio-demographic characteristics and knowledge, attitude, and practices scores. Textual responses generated through the open question were analyzed using a content analysis approach. Socio-

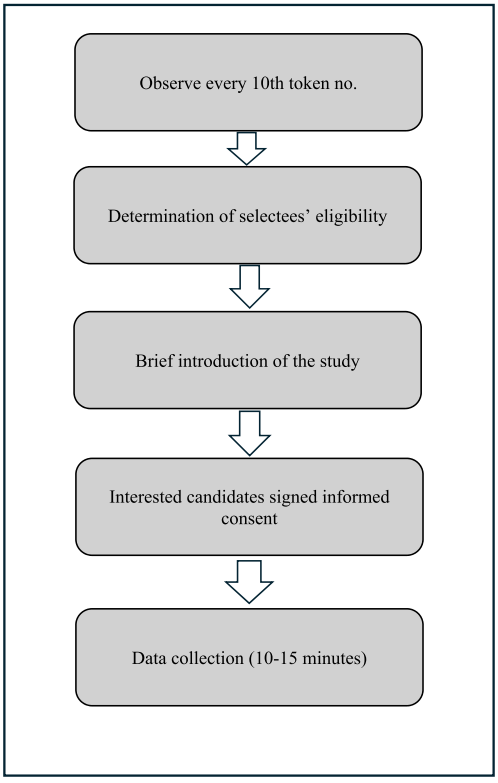

Fig. 2. Data collection procedure.

demographic variables that were found to be significantly associated with KAP (i.e., p-values <0.05) in univariate analysis using the Kruskal-Wallis test (Table 2), were further included as predictor variables in the multiple linear regression model. Three different regression KAP models were fit:

Model 1 knowledge: $Y_1 = \beta_0 + \beta_1 Age_1 + \beta_2 Age_2 + \beta_3 Age_3 + \beta_4 Age_4 + \beta_5 Occupation_1 + \beta_6 Occupation_2 + \beta_7 Occupation_3 + \varepsilon$

Model 2 attitude: $Y_2 = \beta_0 + \beta_1 Occupation_1 + \beta_2 Occupation_2 + \beta_3 Occupation_3 + \beta_2 HCP + \varepsilon$

Model 3 practices: $Y_3 = \beta_0 + \beta_1 Age_1 + \beta_2 Age_2 + \beta_3 Age_3 + \beta_4 Age_4 + \beta_5 Occupation_1 + \beta_6 Occupation_2 + \beta_7 Occupation_3 + \beta_8 Education_1 + \beta_9 Education_2 + \beta_{10} Income_1 + \beta_{11} Income_2 + \beta_{12} HCP + \beta_{13} Nationality_1 + \beta_{14} Nationality_2 + \beta_{15} Nationality_3 + \beta_{16} Nationality_4 + \beta_{17} Nationality_5 + \beta_{18} Nationality_6 + \varepsilon$

3. Results

3.1. Respondents characteristics

Due to the constraints caused by the COVID-19 outbreak, 410 out of 500 patients participated; thus, the response rate was 82 %. Most respondents (38 %, n = 156) were aged between 30 and 39 years. Approximately 52 % (n = 215) of the respondents were male. The respondents' nationalities varied, and included Indians (27 %, n = 110), Nepalis (15 %, n = 60), Egyptians (12 %, n = 48), Filipinos (11 %, n = 47), Pakistanis (10 %, n = 42), Qataris (5 %, n = 20), and others (20 %, n = 83). The majority of respondents (70 %, n = 285) had no HCPs in their households (Table 1).

Table 1
Respondents' socio-demographic characteristics (n = 410).

Respondents' socio-demographic characteristics	Frequency	Percent
Age of respondents		
18–29 years	64	16 %
30–39 years	156	38 %
40–49 years	134	33 %
50–59 years	35	9 %
60 years and above	21	5 %
Gender		
Male	215	52 %
Female	195	48 %
Nationality		
Indian	110	27 %
Nepali	60	15 %
Egyptian	48	12 %
Filipino	47	11 %
Pakistani	42	10 %
Qatari	20	5 %
Others	83	20 %
Average monthly income (QAR)		
No income	46	11 %
Below QR 1000	26	6 %
QR 1000–9999	207	50 %
QR 10,000–19,999	97	24 %
QR 20,000–29,999	29	7 %
QR 30,000 and above	5	1 %
Respondents' socio-demographic characteristics	Frequency	Percent
Highest educational level		
No formal education	8	2 %
Primary	2	0 %
Secondary	70	17 %
University	292	71 %
Postgraduate	38	9 %
Occupation		
Employee: non-laborer	235	57 %
Laborer	93	23 %
Retired	27	7 %
No work	24	6 %
Other	31	8 %
HCP in household		
Yes	124	30 %
No	285	70 %

Table 2
Patients' knowledge toward unused medications and their disposal in Qatar (n = 410).

No	Survey Item				Mean	Median	Standard Deviation	IQR
		Disagree	Unsure	Agree				
B1	An unused medication or leftover drug is the medicine which remains after the patient has quit using it for some reason/s and may include: expired/unexpired, spilt, contaminated, and the no longer required.	28 (7 %)	57 (14 %)	325 (79 %)	3.97	4	0.92	1
B2	I am aware of the subject of "unused medications at home".	34 (8 %)	89 (22 %)	287 (70 %)	3.85	4	0.92	1
B3	I do not care about unused medications at home.	122 (30 %)	135 (33 %)	153 (37 %)	3.08	3	1.26	2
B4	I am aware of the health impact of unused medications at home.	36 (9 %)	41 (10 %)	333 (81 %)	3.97	4	0.88	1
B5	I am aware of the economic impact of medication wastage in Qatar.	34 (8 %)	65 (16 %)	311 (76 %)	3.88	4	0.90	0
B6	I am aware of the environmental impact of inappropriate medication disposal.	31 (8 %)	67 (16 %)	312 (76 %)	3.92	4	0.92	1
B7	I am aware that the same medication could have different brand names.	43 (10 %)	98 (24 %)	269 (66 %)	3.87	4	1.05	2
B8	I am aware of how to properly store my medications.	95 (23 %)	59 (14 %)	256 (62 %)	3.53	4	1.28	1
B9	I am aware of how to properly get rid of unused medications.	59 (14 %)	103 (25 %)	248 (60 %)	3.75	4	1.19	2
B10	I am aware of "unwanted medication return policy" in Qatar.	196 (48 %)	89 (22 %)	125 (30 %)	2.65	3	1.36	3

3.2. Patients' knowledge toward unused medications and their disposal in Qatar

Table 2 indicated good knowledge toward different aspects of unused medications except for "unwanted medication return policy", which had a mean score < 3, i.e., the lowest level of respondents agreement (31 %) (M = 3, IQR = 3).

3.3. Patients' attitude toward medication wastage in Qatar

The respondents' attitude toward medication wastage was good, with a mean score > 3 for all items, e.g., item C6 in the attitude domain (I think older adults gather more medications than younger individuals in the household), and item C8 (I think pharmacists can educate me about the subject of medication wastage and its various impacts) had the highest level of agreement (70 % and 72 %, respectively) among respondents, with a median score of 4 (IQR = 2), while item C1 (I think I contribute to increasing medication wastage in Qatar) had a mean score < 3, i.e., the lowest level of agreement (median = 2, IQR = 1; Table 3).

Table 3
Patients' attitude toward medication wastage in Qatar (n = 410).

No.	Survey Items				Mean	Median	Standard Deviation	IQR
		Disagree	Unsure	Agree				
C1	I think I contribute to the increasing medication wastage in Qatar.	215 (52 %)	110 (27 %)	85 (21 %)	2.59	2	1.12	1
C2	I think other people contribute to the increasing medication wastage in Qatar.	55 (13 %)	158 (39 %)	197 (48 %)	3.43	3	0.96	1
C3	I think pharmacists contribute to the increasing medication wastage in Qatar	80 (20 %)	134 (33 %)	196 (48 %)	3.41	3	1.13	1
C4	I think doctors contribute to the increasing medication wastage in Qatar	70 (17 %)	83 (20 %)	257 (63 %)	3.66	4	1.15	2
C5	I think it is wise to keep unused medications at home.	132 (32 %)	66 (16 %)	212 (52 %)	3.27	4	1.15	2
C6	I think older adults gather more medications than younger individuals in the household.	56 (14 %)	70 (17 %)	284 (69 %)	3.84	4	1.06	2
C7	I think the free/co-pay medication policy contributes to medication wastage in Qatar.	56 (14 %)	104 (25 %)	250 (61 %)	3.70	4	1.06	2
C8	I think pharmacists can educate me about the subject of medication wastage and its various impacts.	60 (15 %)	57 (14 %)	293 (71 %)	3.78	4	1.12	2
C9	I think doctors can educate me about the subject of medication wastage and its various impacts.	58 (14 %)	63 (15 %)	289 (70 %)	3.84	4	1.08	2
C10	I think doctors could do more to reduce medication wastage in Qatar.	48 (12 %)	92 (22 %)	270 (66 %)	3.70	4	0.94	1

Table 4
Patients' practice toward medication supply in Qatar (n = 410).

No.	Survey Items				Mean	Median	Standard Deviation	IQR
		Never or rarely	Sometimes	Often or Always				
D1	I check whether I have medications or not before I get supply.	152 (37 %)	86 (21 %)	172 (42 %)	2.20	2	1.45	3
D2	I get my medications whether I have or run out of them.	171 (42 %)	109 (27 %)	130 (32 %)	1.74	2	1.15	2
D3	I get more medications than I need.	170 (41 %)	108 (26 %)	132 (32 %)	1.75	2	1.19	2
D4	I get medications from other people.	141 (34 %)	175 (43 %)	94 (23 %)	1.85	2	1.07	1
D5	I get different medications for the same medical condition as I follow the advice of different people.	282 (69 %)	79 (19 %)	49 (12 %)	1.19	1	1.13	2
D6	I get medications based on what I read in books, magazines, internet, and other media.	200 (49 %)	141 (34 %)	69 (17 %)	1.53	2	1.05	1
D7	When I visit a doctor or a pharmacist, I put them under pressure to supply me with medications.	211 (51 %)	128 (31 %)	71 (17 %)	1.54	1	1.06	1

3.4. Patients' practices toward medication supply and disposal in Qatar

The respondents' practice toward medication supply was poor (mean score < 3). Table 4 showed that respondents who never (15 %, n = 62), rarely (22 %, n = 90), or sometimes (21 %, n = 86) agreed with 'I check whether I have medications or not before I get supply' with a median score (M = 2, IQR = 3). On the other hand, item D5 showed that only 5 % (n = 22) of respondents often, (7 %, n = 27) always get different medications for the same medical condition because they followed the advice of different people (median = 1, IQR = 2).

Regarding respondents' reasons for keeping more medications at home, possible future use was the most reported reason (79 %), followed by fear of medication shortage (40 %), belief in medications (23 %), and giving them to another person (20 %) (Fig. 3).

Regarding disposal practices toward expired medications, respondents reported disposing of them in the trash (76 %), throwing them toilet/sink (35 %), taking them back to a designated collection point (22 %), or giving them to a pharmacy (11 %) (Fig. 4).

In contrast, for nonexpired medications, respondents reported keeping medications for possible future use (79 %), giving them to a pharmacy to give them to somebody else (30 %), or throwing them in the trash (28 %) (Fig. 5).

The results from the Kruskal Wallis test indicated that knowledge about unused medications at home was significantly associated with age (p = 0.019) and occupation (p = 0.007). Moreover, attitude toward unused medications and wastage was significantly associated with occupation (p = 0.014), and the presence of HCPs in the household (p < 0.001). Practices related to medication supply were significantly associated with almost all socio-demographic variables, except gender and income. Reasons for keeping more medications were significantly associated with occupation (p = 0.001) and presence of HCPs in the household (p = 0.001). Sources of information about unused medications were significantly associated with all socio-demographic variables except for level of education and the presence of HCPs in the household. In contrast, only nationality (p < 0.001) and the presence of HCPs in the household (p = 0.002) were significantly associated with reasons that prevent/limit the use of medications. Practices toward expired medications were significantly associated with occupation (p = 0.019) and the presence of HCPs in the household (p = 0.001). However, practices toward nonexpired medications were found to be significantly associated with only gender (p < 0.001) and occupation (p = 0.002) (Table 5).

While all other variables were held constant in the model, the estimated regression coefficients for occupation revealed that the respondents' knowledge about unused medications was significantly higher among non-laborers (Standard error, SE = 1.408 (0.397))

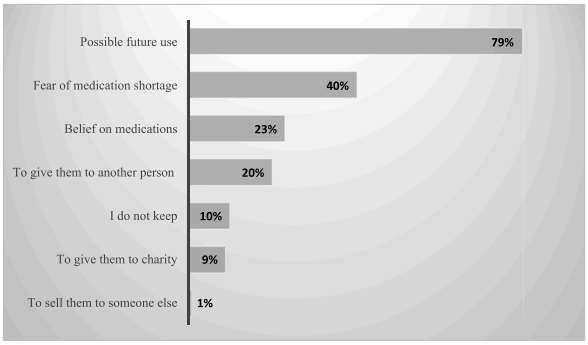

Fig. 3. Patients' reasons for keeping more medications at home (n = 410).

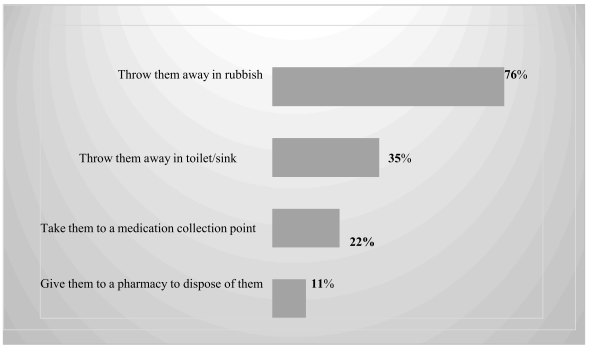

Fig. 4. Patients' practices toward expired medications in Qatar (n = 410).

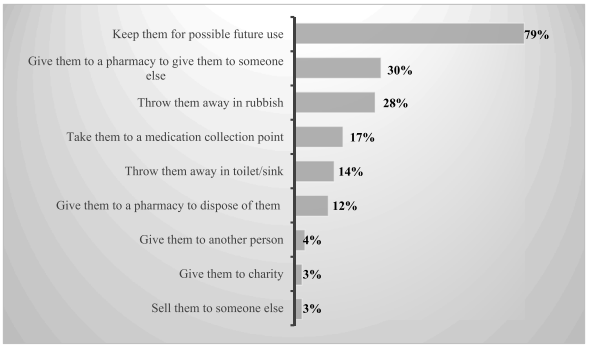

Fig. 5. Patients' practices toward non-expired medications in Qatar (n = 410).

Table 5
Inferential analysis of the effect of respondents' socio-demographic characteristics on KAP variables.

Respondents' socio-demographic characteristics	Knowledge toward unused medications	Attitude toward unused medications	Practices toward medication supply	Reasons for keeping more medications	Sources of information	Reasons preventing the use of medications	Practices toward expired medications	Practices toward non-expired medications
Age group	0.019[a]	0.123	0.009[a]	0.188	0.007[a]	0.132	0.123	0.109
Gender	0.627	0.109	0.052	0.271	0.009[a]	0.052	0.285	<0.001[a]
Nationality	0.667	0.074	<0.001[a]	0.570	<0.001[a]	<0.001[a]	0.449	0.065
Income	0.860	0.496	0.285	0.333	0.006[a]	0.373	0.114	0.577
Education	0.132	0.271	0.001[a]	0.988	0.078	0.760	0.309	0.287
Occupation	0.007[a]	0.014[a]	<0.001[a]	0.001[a]	<0.001[a]	0.752	0.019[a]	0.002[a]
HCPs in the household	0.188	<0.001[a]	<0.001[a]	0.001[a]	0.780	0.002[a]	0.001[a]	0.684

[a] Significant at 5 % level.

and other occupations (SE = 1.287 (0.457)) than among those with no work ($p < 0.001$) and ($p = 0.005$), respectively. Their Attitude toward unused medications was significantly higher among non-laborers (SE = 0.880 (0.425)) than those with no work ($p = 0.039$). The attitude was also significantly lower among respondents with HCPs in their household (SE = −0.77 (0.231)) than among those without HCPs ($p = 0.001$). The practices related to medication supply and disposal were significantly lower among those aged 40–49 years (SE = −0.786 (0.312)) and those with HCPs in their household (SE = −0.848 (0.237)) than among those aged 18–29 years ($p = 0.012$) and those without HCPs ($p < 0.001$), respectively. Furthermore, practices were significantly higher among Indian (SE = 1.727 (0.502)), Filipino (SE = 2.418 (0.581)), and Nepali (SE = 2.046 (0.559)) nationalities than among Qatari nationality ($p < 0.001$) (Table 6).

Table 6
Estimated regression coefficients for the KAP models.

Respondents' socio-demographic Variable	Model 1 knowledge		Model 2 attitude		Model 3 practices	
	Estimate (SE)	p-value	Estimate (SE)	p-value	Estimate (SE)	p-value
Intercept	5.315 (0.431)	<0.001*	5.286 (0.416)	<0.001*	4.328 (0.72)	<0.001*
Age Group (ref. category: 18–29 years old)						
30–39 years	0.173 (0.274)	0.529			−0.233 (0.297)	0.434
40–49 years	−0.335 (0.28)	0.231			−0.786 (0.312)	0.012*
50–59 years	−0.585 (0.398)	0.142			0.028 (0.442)	0.949
60+ year	0.772 (0.488)	0.114			−0.345 (0.535)	0.519
Nationality (ref. category: Qatari)						
Indian					1.727 (0.502)	0.001*
Filipino					2.418 (0.581)	<0.001*
Nepali					2.046 (0.559)	<0.001*
Pakistani					0.929 (0.576)	0.107
Egyptian					1.057 (0.551)	0.056
Others					0.885 (0.503)	0.079
Education (ref. category: secondary)						
University					0.315 (0.316)	0.319
Postgraduate					0.114 (0.464)	0.805
Income (ref. category: no income)						
< QR1,000					−0.599 (0.454)	0.187
QR1,000+					0.031 (0.453)	0.946
Occupation (ref. category: no work)						
Laborers	0.611 (0.424)	0.150	0.147 (0.456)	0.747	0.253 (0.520)	0.627
Non-laborers	1.408 (0.397)	<0.001*	0.880 (0.425)	0.039*	0.848 (0.481)	0.079
Other	1.287 (0.457)	0.005*	0.611 (0.486)	0.210	0.619 (0.504)	0.220
HCP in household (ref. category: No)						
Yes			−0.77 (0.231)	0.001*	−0.848 (0.237)	<0.001*

4. Discussion

The aim of this study is to assess patients' knowledge and attitude toward unused medications, and their practices toward medication supply and disposal in Qatar. It is also to determine the effect of patients' socio-demographic characteristics on these variables. In many regions of the world, people are aware of and have a good attitude toward the disposal of unused medications; however, they often behave differently [35]. The respondents in the current study had good knowledge about various aspects of unused medications, as most of them agreed with most of the awareness statements. For instance, most of them agreed that unused medications can have adverse health, economic, and environmental impacts, which is similar to findings derived from another study [36]. More than 60 % (n = 256) of the respondents in the current study were aware of proper medication storage, unlike those in Uganda [37]. Improper storage may result in the irrational use of medications [38], or medications being degraded [39].

Patient undistingushing between medications' brand and generic names, non-adherence, therapeutic duplication, multiple prescribers, and different medication storage locations were associated with weak or poor health outcomes [40]. Fortunately, most (66 %, n = 269) respondents in the current study were aware that a medication may have different brand names, which would minimize the accumulation of similar medications that may lead to duplication of the dose and/or wasting of resources.

Although, they were aware of the adverse impacts of unused medications, most respondents in this study did not care about the availability of unused medications at home and were unaware of the unwanted medication return policy. Their unawareness of this policy might be due to overlooking from the HCPs. This is consistent with another study that found no associations between awareness and interest in wasting [32]. A similar study indicated that 51.8 % (n = 199) of the respondents were unaware of medication waste, and 60.7 % (n = 233) did not hear about medications' proper disposal instructions. Respondents not hearing about unwanted medications take-back programs was confirmed by another Qatar-based study; however, almost 60 % of these respondents stated that they would utilize such programs if available [21]. Conversely, a similar study indicated that inappropriate disposal occurred due to lack of awareness about how to treat expired medications [16]. In a study conducted in Saudi Arabia, most respondents confirmed receiving no information regarding the appropriate disposal of unused medications [18]. A previous study concluded that raising awareness of the appropriate methods of disposal of unused medications paid off [41]. In Sweden, 85 % of the public knew that returning unwanted medications to pharmacies was the appropriate disposal method, but only 43 % actually practiced it [5]. Half of the respondents returned these medications worrying about their environmental impact [5]. Kotchen et al. [42] reported that people who knew the harm medications could do to the environment, were expected to properly dispose of their unused medications [42]. A lack of awareness of the safe disposal of unused medications lead to accumulation behavior, which adversely affects household safety [43]. The possibility of returning these medications to distributors from pharmacists [44] would encourage pharmacists to receive these commodities from people. Responses from the current and previous studies [18,20] suggest raising awareness of the public and HCPs toward the use and disposal of medications, to minimize harm. Hence, informing the public about the availability and importance of medication take-back programs is considered crucial in reaching appropriate disposal.

In the current study, only 21 %, (n = 85) of respondents blamed themselves for wasting medications, while others accused older adults, pharmacists, doctors, and the free/co-pay medication policy. Patients may skip doses or take fewer medications to minimize the

burden of high medication costs [45], and thus, waste may rise. The so-called stockpile syndrome is well known and could be the apparent attitude seen when medications are cleared from homes [46]. Another study revealed that adherence to medications was associated with co-payment, forgetfulness, the Medication Regimen Complexity Index (MRCI), and knowledge about medications [47].

Most respondents in the current study believed that pharmacists and doctors can educate people about how to avoid medication waste and its impacts. Similarly, the respondents of another study opined that public awareness of the safe disposal of unused medications can be raised through education by HCPs, different media, and written advice on medication packages [48]. Additionally, respondents in another study believed that low medication costs, follow-up, access to pharmacies, pharmacist counseling, and pill-boxes may improve medication use [49].

Similar to previous findings [32,36], almost half of the respondents in this study (47.8 %, n = 196) had unused medications in their homes at the time of completing the questionnaire. Another study in Qatar revealed that almost 60 % of parents declared that they keep unused medications at home [21]. In the present study, having unused medications in the patient's home was significantly associated with age group ($\chi^2 = 16.846$, $p = 0.032$), nationality ($\chi^2 = 39.133$, $p < 0.001$), household income ($\chi^2 = 25.262$, $p < 0.001$), and occupation ($\chi^2 = 13.292$, $p = 0.039$). Additionally, approximately one-third of the respondents claimed to frequently receive more medications than needed and approximately one quarter (23 %, n = 94) frequently received medications from other people. Similarly, in 2017, a study of 5584 subjects revealed that 89.1 % of them had real concerns about medication wastage, given that returned tablets (78.7 %) and capsules (75.1 %) could be used [50]. Thus, the sharing or reuse of medications seems to be acceptable among many populations. Obtaining medications by pressuring doctors or pharmacists was reported by some respondents (17 %, n = 71) in the present study. This may explain how respondents receive more medications than needed.

Psychosocial influences may affect the decisions of some patients regarding the necessity of obtaining unnecessary medications. The notion "pill for every ill" [51] may be the reason that only 42 % (n = 172) of the respondents in the current study frequently checked whether they have medications, before receiving their supply. Furthermore, checking the medications' expiry date upon receiving them was not practiced by 38 % of patients in a previous study [4]. Some researchers have positively related socio-economic status to the hoarding of medications at home [52]. In the current study, 83 % (n = 341) of the respondents infrequently received medications based on what they read in books, magazines, the internet, and other media. Thus, pharmaceutical propaganda via these means needs to be censored.

Patients in Austria copaid a fee of only € 4.80 in 2009 per prescribed medication; thus, they may not be price-sensitive [53]. Similarly in Qatar, free/subsidized medications could be a reason for their unnecessary accumulation. Most respondents (70 %) in the current study made partial payments to receive medications, and approximately half of them have unused medications in their homes. The free healthcare and its association with polypharmacy should be explored further [54], as it would help minimize unused medications and subsequent waste.

In the current study, the most popular reasons for keeping more medications at home were possible future use (79 %), fear of medication shortage (40 %), belief in medications (23 %), and sharing them with somebody else (20 %). Such practices were observed among those with an educational background lower than university, who were non-adherent, who increasingly exchanged medications with others, and who stored expired medications [55]. Current practices toward unused medications were negatively associated with age group 40–49 years (−0.786, SD 0.312, $p = 0.012$) and the presence of HCPs in the household (−0.848, SD 0.237, $p < 0.001$). However, it was positively associated with Indians (1.727, SD 0.502, $p = 0.001$), Filipinos (2.418, SD 0.581, $p < 0.001$), and Nepalis (2.046, 0.559, $p < 0.001$). A meta-analysis revealed that individuals from Southwest Asian countries had the highest prevalence of storing and wasting medications. This high storage was associated with individuals' income, education, age, female gender, chronic diseases, and medical insurance [56]. The sharing of unused medications could be the cause behind the prevalence of this commodity at home. This form of altruism is common among Qatar residents who are mainly from middle and far-east nationalities. A collective-cooperative attitude was noted by Hofstede in 1980 among individuals of Asian, Hispanic, and Black backgrounds rather than among their Anglo fellows [57]. This may explain the sharing of unused medications among the respondents of the current study. Similar findings indicate that medications at home are either used, saved for future use, or shared with others [58].

More than half of the respondents (57 %) in the current study found no source informing them about what to do with unused medications. However, pharmacists (27 %), doctors (20 %), nurses (17 %), the internet (16 %), and friends (11 %) represented the remaining sources. A previous study identified the main sources of drug information as relatives, friends, and self-experiences [59].

Future studies should explore how to improve patients' practices toward medication supply and disposal and why community pharmacies do not accept returned unused medications. Further investigation is also required with regard to the effect of pharmaceutical propaganda on the prevalence of unused medications at home.

4.1. *Importance of the findings*

Primarily, the findings of this study imply that policy makers and HCPs can positively channel patients toward the rational supply and use of medications, and appropriate disposal of unused medications. There seems to be a need to further raise patients' awareness and sensitize them to the health, economic, ethical, and environmental impacts of unused medications and their inappropriate disposal.

Free/subsidized medications generally seemed to go unused, perhaps due to underestimation of their values. These findings may help develop a suitable national medication supply policy.

4.2. Strengths and limitations

This study was conducted in a multi-ethnic country, which may allow the generalization of the findings. In addition, the study questionnaire was developed, translated, and validated in a similar multi-ethnic population to obtain valid and reliable results. The face-to-face survey in this study helped clarify patients' doubts and thus, obtained more accurate and complete responses. As this study was conducted in different public and private healthcare facilities, including primary, secondary, and tertiary hospitals and centers all over Qatar, it had the power to recruit diverse kinds of patients.

With the outbreak of the COVID-19 pandemic, accessing healthcare facilities and surveying patients became difficult. Moreover, patients' response rate and cooperation could have been better if incentives were included [60]. The "snapshot" nature of cross-sectional research may provide different findings in different timeframes [61]. Although the surveyors of this observational research requested respondents' frankness and assured data confidentiality, respondent bias may have occurred. Some respondents complained about the length of the questionnaire.

5. Conclusion

This study explored patients' knowledge and attitude toward unused medications, and their practices toward medication supply and disposal (KAP) in Qatar. Generally, the respondents exhibited good knowledge toward different aspects of unused medications but were unaware of the "unwanted medication return policy" in Qatar'. This should be improved by awareness campaigns and public education, for instance. The respondents' attitude toward unused medications was generally good, with most of them believing that pharmacists and doctors can educate people about medication waste and its various health, economic, and environmental impacts. On the other hand, the respondents' practices toward medication supply and disposal were poor.

By considering the KAP theory approach, the study identified interventions that may help curb the magnitude of unused medications and consequently their various impacts. In addition to improving patients' and HCPs' awareness, these interventions include encouraging rational drug supply, use, disposal, prescribing, manufacturing, and promotion. Implementing incentivization and penalty policies on prescribers and manufacturers where appropriate would help reduce the accumulation of medications on patients' end. Healthcare authorities need to monitor and organize pharmaceutical propaganda and thus engulf the prevalence of accumulated medications on patients' hands. However, enforcing prescribing, disposing, and disposal policies should be applied wherever possible, and the utilization of modern technologies such as smart medicine cabinets to store and remind patients to take medications can improve medication adherence, which subsequently reduces unused medications. Permitting the return of unwanted medications to community pharmacies could encourage patients to cooperate and thus reduce harm to households and the environment.

Ethical approval

Prior to the commencement of this study, approval was obtained in Qatar by the research ethical committees of:

i. Ministry of Public Health, reference no. March/1/2020
ii. Medical Research Center at HMC, reference no. MRC 01/18/237
iii. Research Section at PHCC, reference no. PHCC/IEC/19/01/001

The respondents were provided an explanation of the goals of the study, and written consent was obtained from them prior to data collection.

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Data availability

The data that support the findings of this study are available in the supplementary material/referenced in the article.

CRediT authorship contribution statement

Mutaseim Makki: Writing – review & editing, Writing – original draft, Validation, Resources, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Asrul Akmal Shafie:** Writing – review & editing, Supervision, Methodology, Conceptualization. **Ahmed Awaisu:** Writing – review & editing, Writing – original draft, Supervision, Methodology, Formal analysis, Data curation, Conceptualization. **Rabia Hussain:** Writing – review & editing, Supervision. **Moza Al Hail:** Methodology, Conceptualization. **Walid Mohammed ElMotasim:** Visualization, Project administration, Investigation, Data curation. **Mohamed Yousif Mohamed Ali Taha:** Investigation, Formal analysis, Data curation, Conceptualization. **Einas Abdoun:** Investigation, Data curation. **Noriya Mohd J. Al-Khuzaei:** Investigation, Data curation, Conceptualization. **Gamila Salama:** Project administration, Investigation, Data curation. **Abdulrouf Pallivalapila:** Writing – review & editing, Methodology, Data curation. **Wessam El Kassem:** Investigation, Data curation. **Binny Thomas:** Writing – review & editing, Methodology, Investigation, Data curation.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary data

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