

Original Research

Nature and extent of direct cost of left over and expired medications: A community-based study

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Abstract

Background: Medications including unused ones, might lead to financial and environmental costs. Not only they could have economic impact but also, harm the population safety. However, the nature and extent of leftover and unused medications in Saudi families and its economic impact remain unknown. **Objectives:** The aim of this study is to assess the potential economic cost of the unused medications in Saudi households. **Method :** A cross-sectional, observational study was conducted using a snowball method for recruiting the families. Descriptive data were collected face to face using a structured questionnaire. **Result:** A total of 116 family included in the study, 536 unused medications were found in their houses during the study period (December 2021- April 2022). Approximately, 42 % (227) of unused medications were stopped due to symptoms improvement. A total of 56 types of unused medications with different dosage forms were found at houses because of receiving excess medication in the packet (17%, 90) and purchased for emergency (14% 78) use. The total cost was SR 26249. (\$ 6995.60) for the unused medications which found at 116 households. Of the total 41(34%) of the total households with unused medication have unused medication range between 1-99SR. The stoke of left over medication worth of above 500 SR for around six (5%) of the families. **Conclusion:** A significant number of unused medications were found at family's. The study also identified that there were different reasons for unused medications that can be prevented. The unused medications result in relatively high economic impact. Educational interventions are highly needed for families on unused medications.

Keywords: unused medication; cost; saudi arabia; economic impact

INTRODUCTION

Globally, it's a general practice that families store the left-over medicine over a period. Nearly one third of patients don't use every medication provided to them.¹ Approximately two of three prescription medications were reported to be unused in US Households.² Accumulated medication inventories at home can leads to various health and environmental hazards.³⁻⁸ For example, improper storing of medicines at household may increases the risk of accidental ingestion and unintentional

poisoning among young children.⁶ Similarly, inappropriate utilization of unused medications can rise self-medication practice that eventually leads to drug related problems like drug misuse and resistance.⁵ Correspondingly improper disposal of medication can be a threat to aquatic environment even in trace concentration.⁷⁻⁸ For example, low concentrations steroidal estrogens used in oral contraceptives can affect the sexual development and reproduction of fish.⁷

The impact economic waste of unused medication is a challenge faced by both developed and developing countries. In the US two separate group of investigators estimated the national level projected cost of unused medication pile up at homes is \$5.4B and \$98 million.^{2,3} The direct and indirect cost of unused prescription medicines in NHS in the UK is estimated £300million every year.⁸ In Jordan medication waste by the families accounted for an approximate cost of 8 616 204 JD million (\$12 million.⁹ Also in Thailand, average cost of unused medication per family is 0.8 Euro.¹⁰ An investigator from Saudi Arabia reported a 25.8% and 41.3% of medication wastage in Saudi Arabia and other gulf countries and that incurred a total of ~\$150 million.

Prevalence pattern of unused medications and its impacts on environmental and health hazards has well studied in Saudi Arabia.¹²⁻¹⁴ However research assessing the economic impact of unused medication in Saudi families is scant. To fill the gaps in the literature, the first objective of the study was to describe nature and extent of unused medications stored Saudi family including the number, indications, frequency of use, and reasons for storing the medication. The second objective was to estimate the potential economic cost of the unused medications stored at home.

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METHODS

Design

A cross-sectional study was conducted during December 2021-April 2022 throughout Saudi Arabia.

Study Population

The study population consisted of all family units residing in Saudi Arabia, including both Saudi nationals and expatriates, with a minimum family size of two individuals, possessing the capability to comprehend either the Arabic or English language. Households that were temporarily visiting Saudi Arabia, as well as those who were on vacation outside of the country, were excluded from the study cohort.

Data collection

Study-related information was collected through face-to-face interviews using a comprehensive validated questionnaire. The snowball method was utilized to recruit families, with three fifth-year PharmD students visiting households to gather information using the questionnaire. The survey tool was tested for both face and content validity by a panel of experts that included two clinical pharmacists, a university professor with expertise in Pharmacoeconomics, and a statistician, as well as two lay individuals who were not familiar with the study. The questionnaire in English was translated into Arabic using the parallel blind translation method by three pharmacy researchers prior to data collection. The final version of the questionnaire in Arabic was determined based on the agreed-upon translations. The questionnaire was piloted with five households, and amendments were made to improve the quality of the items.

The data collection form consisted of three sections. The first part gathered demographic details about the family, including the total number of family members, the presence of elderly and pediatric populations, family income, and monthly expenses. The second part focused on the family's health status and medication-seeking behaviors. The third section addressed unused medication practices and reasons for keeping them. The unused medication is defined as medication that had expired, been discontinued, deteriorated, and/or was not intended for any use at the time of the survey. The study was approved by the Imam Abdulrahman Bin Faisal University Institutional Review Board (Approval number: IRB-2022-05-075).

Cost analysis

All of the medications within a household were reviewed and categorized as either currently in use or not being used at the time of the study. The price listed on the drug package, or the Saudi Food and Drug Authority (SFDA) website was used to calculate the cost of all household medications. Unused or expired medications were categorized based on their dosage form, with the number of pills left being used as the unit of calculation for tablets, capsules, and other solid dosage forms, while the whole container was used for liquid, semi-solid, and gaseous dosage forms. The unused medications were further

categorized based on their pharmacologic classes using the classification of drugs adopted in the Saudi National Formulary (SNF). A subset classification was also performed based on prescription or OTC status, expiration date, and mode of payment.

Data analysis

Categorical variables were summarized with frequencies and percentages, while numerical variables were presented using either the mean and standard deviation or median and inter-quartile range. The data analysis was carried out using Statistical Package for the Social Sciences® (SPSS) for Windows version 26.

RESULTS

Out of the 116 households included in the study, the majority were Saudi families (n=103, 88.8%), and almost half of the households (n=56, 48.3%) had more than six members. As shown in Table 1 half of the households (n=54, 46.6%) reported a monthly income in the range of 10000 to 20000 SR, while a total of 35 families (30.2%) reported spending an average of 100 SR out-of-pocket for medical expenses. Additional details on the demographic characteristics of the study population are provided in Table 1.

Table 1. Household characteristic

Household characteristics		Count	%
Nationality	Saudi	103	88.8
	Non-Saudi	13	11.2
Total number of family members	2-4	35	30.2
	5-6	25	21.6
	>6	56	48.3
Geriatric people in the family	No	89	76.7
	Yes	27	23.2
Children in Family	No	49	42.2
	1	30	25.9
	≥2	37	31.9
Family members with chronic diseases	0	51	44.0
	1	39	33.6
	≥2	26	22.4
Average monthly Family income in SR	≤10000	23	19.8
	10001-20000	54	46.6
	>20000	39	33.6
Average monthly medical expense met by cash in SR	≤100	35	30.2
	101-200	30	25.9
	201-500	31	26.7
	>500	20	17.2

Recent visit to the hospital	Never	10	8.6
	1 time	27	23.3
	2-3 times	48	41.4
	≥ 4 Times	31	26.7
Buy medication from pharmacy without prescription	Never	35	30.2
	1 time	23	19.8
	2-3 times	40	34.5
	≥ 4 Times	18	15.5
Store excess medication during COVID-19	Yes	53	45.7
	No	63	54.3
Disposed/thrown out unwanted mediation within last 3 moths	Yes	59	50.9
	No	57	49.1

Medication utilization behaviors of households in last 3 months

As presented in Table 2, members of 48 households (41%) visited hospitals on average 2-3 times, and 41 families (35%) received medications from physicians. Around 53 (45%) households reported storing excess medications during the early stages of COVID-19. Surprisingly, 50.9% of the households at least once disposed of or threw away unwanted medication in the last three months.

Table 2. Medication utilization behaviors of households in last 3 months			
Medication use behaviors in last 3 months		N	%
Recent visit to the hospital	Never	10	8.6
	1 time	27	23.3
	2-3 times	48	41.4
	≥ 4 Times	31	26.7
Received a medication prescribed by a physician	Never	12	10.3
	1 time	33	28.4
	2-3 times	41	35.3
	≥ 4 Times	30	25.9
Buy medication from pharmacy without prescription	Never	35	30.2
	1 time	23	19.8
	2-3 times	40	34.5
	≥ 4 Times	18	15.5
Store excess medication during COVID-19	Yes	53	45.7
	No	63	54.3
Disposed/thrown out unwanted mediation within last 3 moths	Yes	59	50.9
	No	57	49.1

Sources of unused medication

It was found that 96 (82.8%) families reported having 536 unused medications, of which 42% (n=227) were due to medication discontinuation following symptom improvement (Figure 1). Receiving excess medication in the packet (17%, 90) and purchasing medications for emergency use (14%, 78) were other significant sources of excess medication. Details of the unused medication is presented in figure 1.

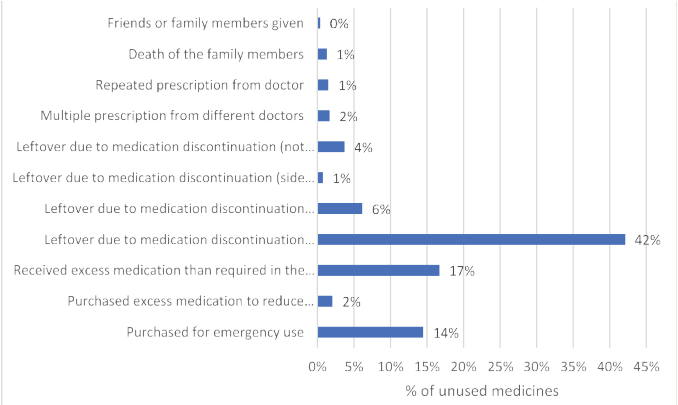


Figure 1. Source of unused medication

Reasons for unused medication storage in home

Around half of the families (50%) reported holding onto medications for future use. Forgetting to dispose of unwanted medications (21%) and keeping them for emergency use (13%) were the other reasons cited for holding onto medications (Figure 2).

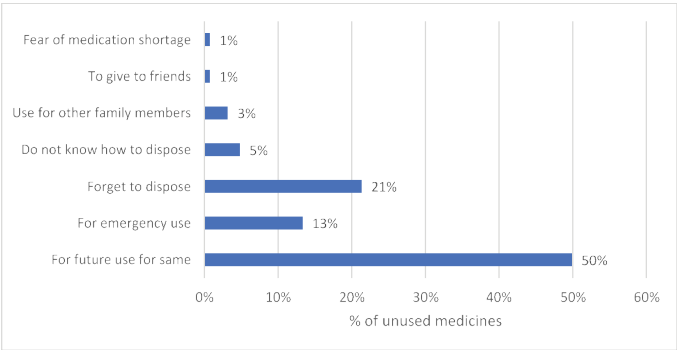


Figure 2. Reasons to stock unused medication.

Direct cost of Unused medication

Importantly, 96 (82.8%) families reported having unused medication that cost a total of SAR 26,249 (equivalent to \$6,995.60). The median cost of unused medication was SAR 98.80 (IQR: SAR26.40-181.50) per household. Among the households with unused medication, 41 (34%) had a range of unused medication costing between 1.00-99.00 SAR, while six families (5%) had a stock of leftover medication worth more than 500.00 SAR. Details of the cost of unused medication are presented in Figure 3.

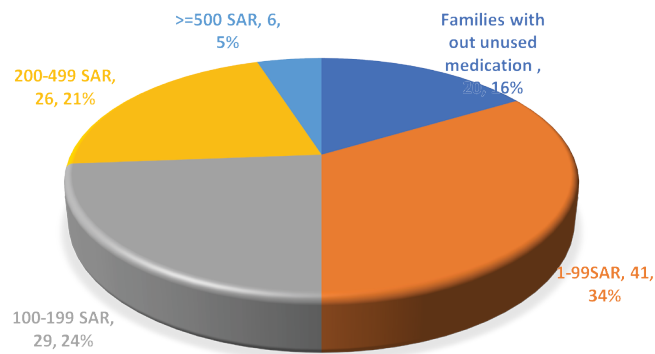


Figure 3. Cost of unused medication in Family

Details of unused medications cost

Out of the total cost of unused medications, SR 11,374.55 (\$3031.36) was attributed to capsules, followed by SR 8464.15 (\$2255.73) for tablets. The cost of expired medications was SR 2289 (\$610.03). Details has been given in Table 3

Classes of unused medications implicated in cost.

Out of the 96 families with leftover medication, 91 reported having medications that act on the CNS system, followed by respiratory and musculoskeletal systems (77 and 71 families, respectively). The medications used for the treatment of malignant or immunosuppression were the most expensive, costing 9116.3 SAR (\$2429.53), followed by medications used for respiratory diseases and infections, which incurred costs of 2673 SAR (\$712.37) and 2566 SAR (\$683.85), respectively. Details of the class of unused medication and their costs are presented in Table 4.

Cost of current medication vs unused medication

Out of the total 1185 medications used by 116 families, 646 (54.51%) were currently in use by different members of the family. However, 536 (45.25%) medications were not being used at the time of the study. The total cost of currently used medications was SAR 49960.20 (\$13314.60). Details of the cost of current and unused medications have been presented in Figures 4 and 5.

DISCUSSION

The present study highlights the nature, extent, reasons, and factors contributing to the possession of unused medications within the eastern province of Saudi Arabia. The data were similar in terms of proportion of unused: current medications but varied in the class of drugs unused and explanations for their nonuse. According to estimates by the General Authority for Statistics in 2021 the Saudi population accounted for 63.6% of the total population, with non-Saudis at 36.4%.¹⁵ In our study the 88% of the participants were Saudi nationals. The size of the households varies noticeable, nearly half of the studied families has more than 6 members, which is in line with previously published study, where an average Saudi household size ranges from 5.5 to 8.4 with an average of 6.4.¹⁶ Greater part of our study participants regular monthly income is in range of 10000-20000 SR. which is in parallel with The Household Income and Expenditure Survey 2018 disclosed that the average monthly revenue of a family in Saudi Arabia amounted to SR14,823.¹⁷ General Authority for Statistics report that average household monthly expenditure on health is 167 SR. A comparable result has been found in this survey as well. Medical Insurance, high-income, chronic disease, educational level and chronic conditions substantially impact health-

Table 3. Details of unused medication						
	Dosage form	# of household	Sum of cost	Median cost	Percentile 25	Percentile 75
Dosage form	Capsule	67	11374.55	15.9	0	38.502
	Inhalers	14	790.6	15.65	0	107.35
	Injections	7	1403	5.7	0	237.9
	Nasal	7	73.55	0	0	26
	Powders	9	60.4	5.1	0	10.2
	Solutions	70	1888.95	15.85	4.65	39
	Suppository	16	211.05	9.525	0	18.425
	Tablet	111	8464.15	36.05	0	107.05
	Topical	46	1983.25	15.725	0	46.25
Medication expiry	Not expired	94	24132.804	114.9	54	204.2
	Expired	25	2116.7	30.7	21.85	65
RX/non-RX	OTC	93	2289.45	10.1	0	34.15
	Rx	113	23960.054	79.1	16.4	159.7
Method of pay	insurance	36	15340.7	119.7	43.7	257.55
	cash	44	6906.004	99.8	64.576	180.05
	free pay	54	4002.8	51.8	22.25	97.1

Table 4. Class of unused medications and their cost					
Class of medications	# of household	Sum of cost in SR	Median cost	Percentile 25	Percentile 75
Drugs used in the treatment of malignant disease and immunosuppression	4	9116.3	0	0	4558.15
Drugs used in the treatment of diseases of the respiratory system	77	2673.8	16.2	0	38.85
Drugs used in the treatment of infections	45	2566.45	48	12.3	78.3
Gastrointestinal system	48	2520.55	24.4	0	60.62
Drugs used in the treatment of musculoskeletal and joint diseases	71	1916.4	16.4	0	30.65
Drugs acting on the central nervous system	91	1590.9	4.65	0	18.1
Drugs acting on the skin	37	1529.6	8	0	39.9
Drugs used in the treatment of diseases of the cardiovascular system	44	1458.6	0	0	33.07
Drugs used in the treatment of disorders of the endocrine system	41	1376.7	0	0	13
Drugs affecting nutrition and blood	67	753.5	0	0	10
Drugs used in the treatment of disease of the ear, nose, and oropharynx	30	304.8	0	0	13.8
Drugs used in disorders of the obstetrics, gynecology and genitourinary disorders	3	233.85	93.7	17.25	122.9
Drugs acting on the eye	13	208	0	0	34.15

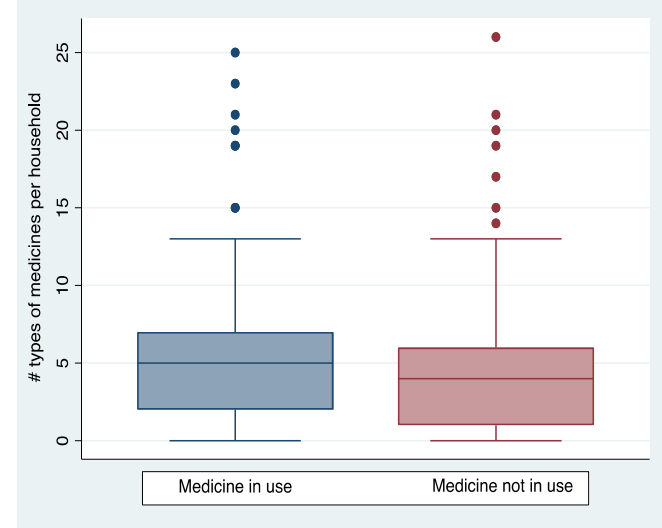


Figure 4. Number of current medication vs Unused medication

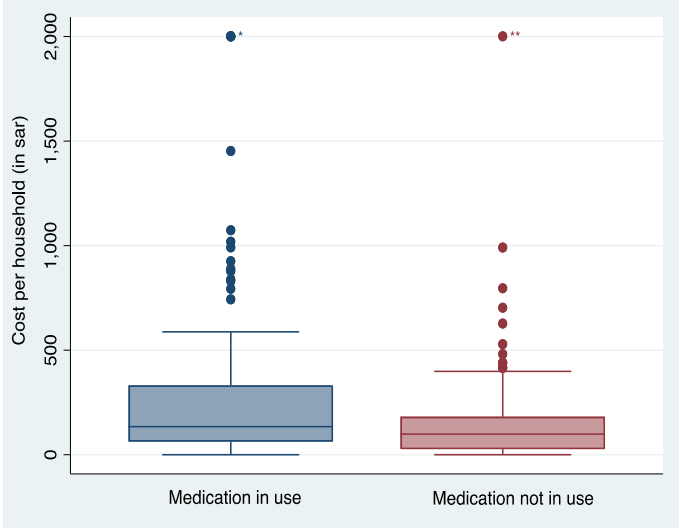


Figure 5. Cost of current medication vs Unused medication

seeking behavior.¹⁸ A greater number of the family purchase the medicines with the prescriptions; similar results were found in Kabul as well in Saudi Arabia.^{12,19} The results showed that the COVID-19 pandemic did not affect medication storage behaviors of the respondents. This result is consistent with a study that measure the self-medication behaviors during covid.^{20,22}

Little is known about the economic burden of unused or left over medications in Saudi Arabia. Surprisingly 17% of the families have discarded the medicines couple of days before the study team visiting them and 50.90% of them disposed or thrown the unwanted medication during the last three months. Extent of unused medications in our study population is 83% much higher than reported in other countries.^{22,23} This is probably could be due to the small sample size and different methods of data collection as this study concentrate only on

one city. However, a similar frequency is observed in a recent study conducted in the nearby city of Saudi Arabia.¹² Details for unused medication such as improved symptoms or condition found consistent with previous studies.^{1,2,10,12} These results point to a need for customized education on medication use, storage and disposal.

Subset analysis of expense of unused mediations per family, class medication, dosage form, prescription and nonprescription medication as well as mode of pay were considered. The estimated cost or wasted riyals represents approximately SR26249.5 (\$6995.60). These estimates are low compared to various reports from US, for the reason that diversity in prizing system as well as variation in methodological categorization and study population. For example, preceding researchers collected records from drug-take-back trials. At the same time, assessment may be more precise than the pricing of the

present report, as they were able to match the number of units and accurate strengths of unused medications. Abou-Auda HS in 2003 reported that approximate cost of unused medication per Saudi family is 9.30 dollar. Whereas a much higher rate has been observed SR98 (\$26.12) in this report. These higher estimations may be due to the changes in the social, political and economic changes as well as health sector transformation happened in the country over the last decades.

Even though medications for malignant disease and immunosuppression were the minimally wasted, they were the expensive class (9116.3SR; \$2429.53). Drugs acting on the CNS and respiratory system were the top listed medication class piled by the Saudi families. Whereas Schuh JL et al,²⁴ reported antidepressants, antihypertensives, and anticonvulsants as top listed unused class of medication. Difference in the classification system clarify the reason, current study adopted Saudi National Formulary (SNF) classification.

Although information on cost of medication by out-of-pocket expenses were un explored area in the country. However medication purchased by cash 6906 SR incurred highest amount compared to insurance or Free government pay. On average a Saudi household waste approximately 218 SR for unused medication. Average total monthly Saudi household out of pocket health care expenditure was SAR1775 which account for SR 621 for medication.²⁵ Alarminglly 35% of the out-of-pocket expenditure on medication is wasted by a Saudi family by not using the medication. This is much lower estimation compared to the Abou-Auda, H. S.¹² report in 2003. Currently the citizens are more dependent on governments or insurance pay system compared to the last two decade due to the massive change in the health transformation. Similarly during the Abou-Auda, H. S.¹² many medicines that require a prescription in the United States (antibiotics, bronchodilators, antihypertensives) can be purchased as OTC.²⁶ Similar to the

finding of other studies the majority type of unused medication was prescription medication.^{10,27}

Surprisingly one half of the study participants disposed the unused medications within three months of the study visit , which could not be estimated and accounted for. The unused or expired medications will be divided based on their dosage form. The unit of calculation for tablets, capsules and other solid dosage forms is the number of pills left, for liquid, semi-solid, and gaseous dosage forms will be the whole container. This further suggests that the extent of unused medications among households found in this study is underestimated.

CONCLUSION

A significant number of unused medications were found at family's. The study also identified that there were different reasons for unused medications that can be prevented. The unused medications result in relatively high economic impact. Educational interventions are highly needed for families on unused medications. Policy makers should also pay high attention to this issue by implementing new policies that could help in reducing the total cost of unused medications.

CONFLICT OF INTEREST

None

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