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Research Brief

## Taking stock of medication wastage: Unused medications in US households

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### Abstract

**Background:** Despite the potential deleterious impact on patient safety, environmental safety and health care expenditures, the extent of unused prescription medications in US households and reasons for nonuse remain unknown.

**Objective:** To estimate the extent, type and cost of unused medications and the reasons for their nonuse among US households.

**Methods:** A cross-sectional, observational two-phased study was conducted using a convenience sample in Southern California. A web-based survey (Phase I,  $n = 238$ ) at one health sciences institution and paper-based survey (Phase II,  $n = 68$ ) at planned drug take-back events at three community pharmacies were conducted. The extent, type, and cost of unused medications and the reasons for their nonuse were collected.

**Results:** Approximately 2 of 3 prescription medications were reported unused; disease/condition improved (42.4%), forgetfulness (5.8%) and side effects (6.5%) were reasons cited for their nonuse. "Throwing medications in the trash" was found being the common method of disposal (63%). In phase I, pain medications (23.3%) and antibiotics (18%) were most commonly reported as unused, whereas in Phase II, 17% of medications for chronic conditions (hypertension, diabetes, cholesterol, heart disease) and 8.3% for mental health problems were commonly reported as unused. Phase II participants indicated pharmacy as a preferred location for drug disposal. The total estimated cost for unused medications was approximately \$59,264.20 (average retail Rx price) to \$152,014.89 (AWP) from both phases, borne largely

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by private health insurance. When extrapolated to a national level, it was approximately \$2.4B for elderly taking five prescription medications to \$5.4B for the 52% of US adults who take one prescription medication daily.

**Conclusion:** Two out of three dispensed medications were unused, with national projected costs ranging from \$2.4B to \$5.4B. This wastage raises concerns about adherence, cost and safety; additionally, it points to the need for public awareness and policy to reduce wastage. Pharmacists can play an important role by educating patients both on appropriate medication use and disposal.

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**Keywords:** Unused medication; Medication wastage; Medication disposal; Medication non-adherence; Health care management; Health economics

The potential presence of unused medications in US households has recently been receiving attention due to its implications regarding health outcomes, health care resource utilization, patient and environmental safety. In recent years, the U.S. Drug Enforcement Agency (DEA) and its state, local, and community partners have removed 1409 tons of unused medications as a part of National Prescription Drug Take-back Initiative.<sup>1</sup> First and foremost, unused medications in households “could be adopted as a direct measure of medication non-adherence by the patient population.”<sup>2</sup> Second, the impact of medication non-adherence on health outcomes and health economics is well established and needs to be addressed seriously.<sup>3</sup> Third, unused medications left in households present potential safety issues such as accidental consumption by children.<sup>3–5</sup> Lastly, unused medications that are inappropriately disposed could endanger the environment by contaminating surface and drinking water; and increase medication resistance (e.g. antibiotics), with possible genetic effects in humans and marine life in the long-term.<sup>6–8</sup>

The issue of unused medications among US households has not been studied extensively despite its potential importance. Recent reports estimated that of \$2.3 trillion annual US health care expenditures, approximately 30% (\$700B–\$750B) could be attributed to wastage owing to unwarranted use, fraud and abuse, lack of care coordination, and system and provider inefficiencies.<sup>9–11</sup> However, no breakdown was provided of wastage attributable to unused medications. Estimates of unused prescription medications varied in the literature, from 1.5 million pounds (in weight) (7–13%) in long-term care facilities to 2.8 million pounds (3%) by US customers.<sup>12</sup> The Teleosis Institute in California, which collected data on unused prescription drugs in 2007, reported that consumers

wasted nearly 45% of their medications.<sup>13</sup> Studies on unused medications among hospital, nursing home and long-term care facilities have not reported their economic value.<sup>14–18</sup> Studies conducted outside the US are not generalizable due to the differences in health care systems, payment structures, prescribing behaviors, and pattern of medication usage.<sup>19–24</sup>

Thus, a knowledge gap exists regarding the extent of and reasons for unused prescription medications among households in the US. Given that medication utilization and expenditures in the US has consistently have increased each year, the impact of unused prescription medications on health expenditure also could be substantial.<sup>25–28</sup>

Although an “in-home inventory” of prescription medications is considered an ideal method to study unused medications, resource constraints, privacy concerns and safety issues precluded this study approach. Given these challenges, web and paper-based surveys were developed and used for data collection.<sup>29</sup>

The primary objectives of this two-phased study were to examine the extent, amount, type, cost, and reasons for unused medications among US households.

## Methods

### Study design

This was a cross-sectional, observational study conducted in two phases. In Phase I, a web-based survey was conducted at one health sciences institution; and in Phase II, a paper-based survey at drug take-back events.

### Data collection tool

In this study, unused medication was defined as medication that is expired, discontinued,

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deteriorated and/or not intended for any future use at the time of survey. Households represented "all the persons who occupy a housing unit" according to the US Census Bureau definition.<sup>30</sup> The Phase I web-based survey was piloted with students and modified to include 21 questions, including two prescreening questions and an open-ended question to comment on the survey (Appendix I).

The paper-based survey (Appendix II) was used in Phase II of the study. Participants' informed consent was obtained at the drug take-back events to collect information (drug name, strength, type (brand or generic), remaining quantity, place and date of purchase) of their unused medications. Both surveys were tested for face and content validity with a panel of two experts and two lay individuals who were not familiar with the study. The study was approved by Western University of Health Sciences Institutional Review Board for exempt status. Different settings and surveys were used to compile data on medication wastage.

#### Data collection

The Phase I web-based survey was administered to the campus community between April and June 2011. Individuals having at least one prescription medication in their household and access to information on medications without privacy concerns were included.

In Phase II, a paper-based survey was conducted at three out of twenty local community pharmacies approached by the authors for participation in a drug take-back campaign. Student pharmacists on rotation with their faculty preceptors administered the surveys to pharmacy patrons who returned their unused medications (except controlled substances) for disposal.

#### Data analysis

Data were analyzed using SPSS for descriptive statistics.<sup>31</sup> Summary statistics were performed for the number, type or category of unused medications, factors contributing to their nonuse, and demographic characteristics. The Lexi-Comp's Drug Information Handbook was used to categorize the unused medications into different therapeutic classes.<sup>32</sup> The cost of unused medications was estimated using AWP for package size from Thompson Reuters Redbook and from estimates of average retail prescription prices.<sup>33, 35</sup> Unused medications were counted as one unit/package regardless of their dosage form and the remaining quantity. All analyses were conducted at the 95% significance level.

## Results

### Phase I study

The survey response rate was 14% (134/949). Average household size was 2.4, mostly White/Caucasian (68%) with more than 50% residents being female. Average household age was 36.4 years. Approximately 64% of households had an average annual income between \$50,000 and \$199,999 (Table 1).

A total of 539 prescription medications were reported, with an average of 4 per household. Approximately 7% of the unused medications were expired, and 30% were brand name. The ratio of unused to in-use medications was 2:3. Tablets, pills and liquids represented the most common dosage forms, with 67% of them in original quantity. Respondents reported storing their medications in bathrooms (59%), kitchen cupboards (35%), bedrooms (24%), and refrigerators (14%).

Table 1  
Household characteristics (Study Phases I & II)<sup>a</sup> (N = 306)

Age <sup>b</sup> (yrs)	N	Race/Ethnicity	N	Education level	N	Avg. household income (US\$)	N
<5	18	White/Caucasian	124	<12 yrs of school	62	<25,000	23
6–20	51	African-American	14	High school	62	25,000–49,999	38
21–45	204	Hispanic/Latino	30	Some college	108	50,000–99,999	65
46–60	137	Asian	67	BA/BS degree	150	100,000–199,999	53
>60	58	Other <sup>c</sup>	08	MA/MS degree	123	>200,000	15
						Don't want to disclose	25

<sup>a</sup> Numbers don't add up due to missing responses.

<sup>b</sup> Information on age was not obtained on drug take-back event survey.

<sup>c</sup> American Indian/Alaskan Native, Native Hawaiian or Pacific Islander etc.

Table 2  
Disposal of unused medications among households (phase I)<sup>a,b</sup> (N = 238)

How often do you throw out your medications	N (%)	How did/do you dispose of your medications	N (%)
Never	28 (17)	Take it to the pharmacy	18 (11.2)
Less than once a month	13 (8)	Take it to the physician's office	03 (1.8)
Once every 3 months	10 (6.2)	Throw into a trash	101 (62.7)
Once every 6 months	07 (4.3)	Flush it down the toilet	29 (18)
Once in a year	17 (10.6)	Dispose it down the sink	07 (4.3)
Just any time I feel I should	38 (23.6)	Don't dispose, store them	28 (17.4)
When medication expired	48 (29.8)	Other	13 (8)

<sup>a</sup> Numbers don't add up due to missing responses.

<sup>b</sup> These questions were not asked as a part of drug take-back event survey.

"Throwing medications in the trash" was the most common method for disposal (50%), followed by "flushing it down the toilet" (26%). No significant relationship was found between age, race/ethnicity, education, household income, insurance and the number of unused medications among the households (Table 2).

Reasons for medication nonuse included disease, or condition resolved/symptoms improved (40.4%), forgetting to take it (10.6%) or experiencing side effects (8.5%). Unused medications collected were painkillers (15%), antibiotics (6.7%), medications for cardiovascular diseases (9.7%), and medications for gastrointestinal problems and acne/skin infections (5.2%). They were

primarily paid by private insurance (38%) and through cash payment (10.4%); were purchased at walk-in (91%) and mail-order pharmacies (Table 3). The cost of unused medications among these households was \$23,724.51 (\$9093 using AWP) (Table 4).

#### Phase II study

A total of 68 patrons completed the survey at six drug take-back events. A majority of the patrons were White/Caucasian (56%) with more than high school education (76%) and had an annual income of less than \$99,000 (53%) (Table 1). Of the 776 unused medications returned

Table 3  
Reasons for unused medications and economic burden (Phase I & II)<sup>a,b</sup> (N = 306)

Reasons for unused medications	Phase I web survey (238) N (%)	Phase II <sup>c</sup> take back survey (68) N (%)	Medication paid for by	Phase I web survey (238) N (%)	Phase II take back survey (unused medications = 776) N (%)
Physician asked to stop it	06 (4.3)	17 (25)	Free sample	03 (1.8)	18 (2.3)
Experienced side effects	09 (6.5)	07 (10.3)	Medicare	07 (4.2)	268 (34.5)
Did not feel it was helping the condition	10 (7.1)	QNA	Medicaid	12 (7.1)	133 (17.1)
Condition resolved/symptoms improved	59 (42.4)	12 (17.6)	Private insurance	121 (72)	225 (29)
Forgot or did not get around to taking it	08 (5.8)	01 (1.5)	Cash/credit card	25 (14.9)	QNA
Did not believe I needed to take it	18 (12.9)	QNA	Co-pay	QNA	422 (54.4)
Person on medications no longer lives there	07 (5.0)	02 (2.9)			
Medications expired	QNA	45 (66.2)			
Other reason	22 (15.8)	QNA			

QNA = question not asked.

<sup>a</sup> Numbers don't add up due to missing responses.

<sup>b</sup> Not all questions were a part of drug take-back event survey.

<sup>c</sup> No statistically significant differences between responses to the two surveys.

Table 4  
Estimated cost of unused prescription medications in US population

Study phase	Ratio of unused to used medications	Number of unused brand name medications	Number of unused generic medications	Cost using AWP	Cost using average retail price <sup>a</sup>
Pilot student survey	2.3:3	40	89	\$18,956	\$8650.58
Phase I campus survey	2:3	73	145	\$9093	\$15,173.60
Phase II events	2:3	311	465	\$123,965.89	\$59,264.20
National projection for adults <sup>b</sup>	2:3	81,665,252.9			\$5,854,581,982.79 <sup>d</sup>
122,497,879					
Projection for above 65 years taking 1 Rx med <sup>c</sup>	2:3	22,310,981.7			\$1,599,474,280.05 <sup>d</sup>
33,466,472					
Projection for above 65 years of age taking 5 Rx medications <sup>c</sup>	2:3	34,219,296.7			\$2,453,181,378.03 <sup>d</sup>
10,265,789					
Overall national projection <sup>f</sup>	42%	1,638,000,000			\$117,428,220,000

<sup>a</sup> Average retail price of brand name medication: \$137.90; of generic medication: \$35.22.<sup>39</sup>

<sup>b</sup> Approximately 52% of adults (235,572,845) take at least 1 Rx medication.<sup>25</sup>

<sup>c</sup> Approximately 81.5% of elderly take at least 1 Rx med.<sup>25</sup>

<sup>d</sup> Calculated using average retail Rx price: \$71.69.

<sup>e</sup> One in four above 65 years of age (41,230,000) takes at least 5 Rx medications.<sup>25</sup>

<sup>f</sup> Assuming 42% of all dispensed Rx, 3.9B are unused.

for disposal, 311 (40%) medications were brand name. Nearly two-thirds (66.2%) were expired, discontinued by the physician (25%), or became unused after the patient indicated feeling better (17.6%), and more than one-third (34.5%) were paid through Medicare and 29% by private health insurance (Table 3). Most medications were purchased at independent pharmacies (28.2%) and chain pharmacies (37.7%). Nearly two-thirds of these were tablets, capsules, and liquid preparations with more than half of the quantity remaining. Approximately 17% were for chronic conditions, 8% were antidepressants/antipsychotic/anticonvulsant, 7% painkillers, and 4% electrolytes and dietary supplements. The total cost of these unused medications estimated using AWP was \$123,965.90 (Table 4). The majority of the patrons (71%) preferred pharmacy as a convenient location for medication disposal compared to other choices such as police department/fire station, hazardous waste facility, or special collection events within the community.

## Discussion

The current study explored the extent, reasons and factors contributing to the storage of unused prescription medications among a small sample of US households in two different settings. The

results were similar in terms of proportion of unused:used medications but varied in the types of drugs unused and reasons for their nonuse. The differences, although not statistically significant, are potentially attributable to the difference in demographic characteristics between the two phases and consequently the pattern of prescription medication use.<sup>26</sup>

The extent of unused medications at 42% is similar to those reported in other countries: Spain (44.7%), Iran (38.8%), Gulf countries (41.3%) Saudi Arabia (25.8%).<sup>21–23</sup> Medication disposal methods among the households were similar to those reported in the literature.<sup>33–35</sup> Despite respondents' high educational level and relationship with health care fields, a lack of consistency and knowledge about disposal of unused medication was observed. Reasons for medication nonuse such as improved symptoms or condition, lack of belief that they were needed or side effects found consistent with previous studies.<sup>36–39</sup> These results point to a need for customized education on medication use, storage and disposal.

The proportion of unused medication in original quantity found fairly high (67%), comparable to the findings of an Alberta, Canada pharmacists study where an average of 60% of the drugs were returned in original quantity (untouched).<sup>40</sup>

Although information on cost of medication and out-of-pocket expenses were not collected, use of an AWP per unused medication can estimate the cost, or wasted dollars in this study represent approximately \$150,000 for 306 households. Using a retail prescription price approximation, the total estimated wastage is approximately \$83,000.<sup>35</sup> Table 4 presents data for national projection, which ranges from \$2.4B for the elderly to \$117B, based on estimates that 42% of the 3.9B prescriptions remains unused.<sup>40</sup> These estimates are low compared to one reported by Express Scripts, which used missed doses as the metric for estimation. It is interesting to note that estimates in the current study may be understated if the emerging trend of expensive specialty medication usage (and non-usage) is incorporated. Further, auto-fill functions in mail-order pharmacies also would amplify the problem of nonuse unless patients are aware and cancel the orders for discontinued or changed medications.

Households may also have disposed some of their unused medications prior to the study, which could not be estimated and accounted for. This further suggests that the extent of unused medications among households found in this study is underestimated.

A majority of the participants at these events preferred pharmacies as their drug disposal site, possibly because patrons had easy access to these pharmacies, and/or their relationship and trust in the pharmacist. Pharmacists can take this opportunity to reach out and educate their patrons on proper medication disposal methods.

The large quantity of unused medications has been attributed to ignorance about their disposal, lack of continuity in care, and poor communication between prescribers, pharmacists and patients, compounded with system inefficiency, overuse and misuse of prescription drugs and poor medication adherence.<sup>23–26</sup> As such, to address the issue of unused medications, it would be prudent to base strategies on good prescribing practices, improving patients' medication taking behavior and adherence, increasing awareness about medication cost, and promoting pharmacist involvement in education on medication disposal.

Addressing the problem of unused medications has a potentially significant economic impact on the health care system. A recent initiative to ameliorate waste in Medicaid was estimated to save over \$2 billion taxpayer dollars over the next five years, of which \$900 million will be returned to States.<sup>41</sup>

### Implications

The results from this study provide important insights to practice and policy: 1. Pharmacists as drug experts need to educate patients on medication use and disposal. 2. Pharmacists can encourage patients for taking personal accountability for their adherence. 3. Changes in policies on take-back and disposal of unused medications might be considered. At minimum, as the study indicated, pharmacies could be advocated as safe take-back points for unused prescription medications. A combination of medication therapy management and waste disposal education may help in reducing wastage and improving appropriate use of necessary medications. This could further cut cost both by improving health outcomes through adherence, thereby improved efficiency in the health care system.

The current study contains several limitations. Self report of prescription medications consumption by respondents might have introduced some recall and non-response bias. Information provided by the respondents could not be verified or validated. Missing responses to surveys limited our analysis only to the available data. The web-based survey sample was relatively young, highly educated with medium to high income earnings, which may not truly represent the general US population. Use of a web-based survey may have limited its accessibility to people without computer and Internet access at home.

### Conclusion

This study provided estimates of prescription medications wastage ranging from \$2.4B in a subset of the population to \$117B, if a 42% waste is assumed. Our study also provided useful information on the characteristics of the unused medications among a small sample of US households and the reasons for their unuse. It is imperative for pharmacists to educate patients about medication disposal to tackle this problem and to prevent economic loss associated with unused medications.

### Acknowledgment

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## Appendix

### Supplementary data

Supplementary data related to this article can be found at <http://dx.doi.org/10.1016/j.sapharm.2014.10.003>.

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