Patient Practices and Beliefs Concerning Disposal of Medications

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Background: **Clear guidance for how patients should dispose of unused and expired medications is lacking. Medications improperly disposed of can make their way into groundwater, surface water, and even drinking water. Incineration is the best disposal option currently available for waste medications. Although a few pharmacies will facilitate proper disposal of unused and expired medications, the majority will not.**

Methods: **A total of 301 patients at an outpatient pharmacy completed a survey about medication disposal practices and beliefs.**

Results: **More than half of the patients surveyed reported storing unused and expired medications in their homes, and more than half had flushed them down a toilet. Only 22.9% reported returning medication to a pharmacy for disposal. Less than 20% had ever been given advice about medication disposal by a health care provider. Previous counseling was highly associated with returning medications to a pharmacy (45.8% vs 17.1%, $P < .001$) and was the variable most associated with returning medications to a provider (28.8% vs 10.0%, $P < .001$). Previously counseled respondents were significantly more likely to believe that returning medications to a pharmacy (91.5% vs 60.3%, $P < .001$) or a medical provider (74.6% vs 47.3%, $P < .001$) was acceptable.**

Conclusion: **The results of this study suggest that there is a role for patient education about proper disposal of unused and expired medications. (J Am Board Fam Med 2006;19:542–7.)**

Patients may not use all the medications dispensed to them due to side effect intolerance, dosage changes, discontinuation of the medication, or medications reaching the expiration date. Therefore, it is not uncommon for patients to be in possession of unused or expired medications. When this happens, patients need clear guidance on how to dispose of these medications. Consumer education materials are available with recommendations for disposing unwanted medications.[1,2] The extent to which the public is aware of and adherent to these guidelines has not been well studied.

Unused and expired medications are likely managed in a wide variety of ways. Hoarding expired medications in the home or giving them to friends and family may increase the risk of accidental or inappropriate ingestion. Disposal of unwanted medications by rinsing them down a sink, flushing them down a toilet, or throwing them in the trash may also be common.[3] Although a few pharmacies will take unused and expired medications back to facilitate proper disposal of them, the majority will not.[4]

Numerous medications have been found in trace amounts in groundwater, surface bodies of water, and drinking water,[5] and in recent years, the existence of pharmaceuticals and their metabolites in water has been recognized as potentially dangerous.[6,7] Acetaminophen, verapamil, and estradiol are just a few of the chemical routinely found in American waterways.[4]

Unfortunately, current water treatment systems do not remove many pharmaceuticals from drinking water.[7,8] Usually the concentration of these medications are negligible; however, long-term exposure to even low levels of multiple medications could be hazardous.[5,9,10] Excretion, through urine and feces, is the primary way in which medications and their metabolites enter the water system. The improper disposal of unused and expired medica-

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tions represents another easily preventable source of pharmaceuticals entering water supplies.

The outpatient pharmacy at Madigan Army Medical Center, on Fort Lewis, WA, has a policy of allowing patients to "return" unused or expired noncontrolled medications to facilitate disposal of these medications by treating them as medical waste. Patient instruction sheets provided with each medication identify this as the preferred method of disposal. Patients at Madigan may also return unused or expired noncontrolled medications to a provider for proper disposal. This study was conducted to identify patients' disposal habits and explore patient's beliefs about disposal methods.

Methods

Permission to conduct this study was granted by the Institutional Review Board of Madigan Army Medical Center.

A convenience sample of patients was obtained using the outpatient pharmacy waiting room at Madigan. Patients entering the pharmacy were invited to complete an anonymous 22-question survey on computerized kiosks in the waiting room. Before answering questions, the program informed subjects that, for the purposes of this survey, the term "medication" meant prescription medications, over-the-counter medications, supplements, vitamins, and herbals. The program encouraged all questions to be answered, thereby minimizing missing data. All respondents were either active duty military personnel, retired military, or military family members.

The collected data were downloaded into SPSS version 12.0 for data analysis. Descriptive statistics were used to categorize patients' habits and beliefs. Categorical responses were dichotomized to allow hypothesis testing due to the small numbers of some responses. χ^2 analysis was used for comparative statistics.

Results

A total of 301 surveys were completed. The number of patients who entered the waiting room during the data collection period was not obtained, so a response rate was not calculated. Table 1 gives details on the respondent population. The majority of respondents were non-Hispanic whites, and almost one third were older than 60 years of age. Most respondents were taking five or fewer medications, and most had five or fewer unused or expired medications in their homes. Less than 20% reported ever having been given advice about proper medication disposal by a health care provider.

Table 1. Demographic Data for Survey Responders

Variable (Number)	Number (%)
Gender (301)	
Male	144 (48.0)
Female	156 (52.0)
Age (301)	
18–39	87 (28.9)
40–49	58 (19.3)
50–59	57 (18.9)
≥60	99 (32.9)
Race (300)	
Non-Hispanic black	36 (12.0)
Non-Hispanic white	179 (59.7)
Hispanic	21 (7.0)
Asian	18 (6.0)
Other	21 (7.0)
I prefer not to answer	25 (8.3)
Current number of medications (299)	
0	13 (4.3)
1–5	206 (68.9)
6–10	67 (22.4)
≥11	13 (4.3)
Unused or expired medications in home (298)	
0	130 (43.6)
1–5	143 (48.0)
6–10	19 (6.4)
11–25	4 (1.3)
≥25	2 (0.7)
Visits to pharmacy in prior 3 months (299)	
0	39 (13.0)
1	64 (21.4)
2	70 (23.4)
3	53 (17.7)
≥4	73 (24.4)
Had ever been given advice on medication disposal by a medical provider (299)	
Yes	59 (19.7)
No	240 (80.3)

Table 2 contains responses concerning past medication disposal practices and beliefs about disposal. More than half of all respondents reported storing unused or expired medications in their homes, and more than half reported flushing medications down a toilet. Fourteen percent reported returning unused or expired medications to a health care provider, and only 22.9% reported returning medication to a pharmacy.

Table 2. Respondents' Prior Practices and Beliefs Concerning Unused and Expired Medication Disposal

	Number (%)
Patients who have disposed of medications by (number):	
Rinsing down a sink (301)	
Yes	106 (35.2)
No	195 (64.8)
Storing in the house (301)	
Yes	163 (54.2)
No	138 (45.8)
Returning to a pharmacy (301)	
Yes	69 (22.9)
No	232 (77.1)
Flushing down a toilet (301)	
Yes	162 (53.8)
No	139 (46.2)
Giving to friends or family (299)	
Yes	33 (11.0)
No	266 (89.0)
Returning to a health care provider (300)	
Yes	42 (14.0)
No	258 (86.0)
Patients who believe it is acceptable to dispose of medications by (number):	
Rinsing down a sink (300)	
Yes	63 (21.0)
No	151 (50.3)
Unsure	86 (28.7)
Storing in the house (300)	
Yes	45 (15.0)
No	213 (71.0)
Unsure	42 (14.0)
Returning to a pharmacy (300)	
Yes	200 (66.7)
No	37 (12.3)
Unsure	63 (21.0)
Flushing down a toilet (300)	
Yes	107 (35.7)
No	130 (43.3)
Unsure	63 (21.0)
Giving to friends or family (301)	
Yes	8 (2.7)
No	285 (94.7)
Unsure	8 (2.7)
Returning to a health care provider (300)	
Yes	159 (53.0)
No	56 (18.7)
Unsure	85 (28.3)

In contrast, two thirds of respondents answered that it was acceptable to return medications to a pharmacy, and more than half believed that it was acceptable to return medications to a provider. More than 35% believed that it was acceptable to flush medications down a toilet, and 21% thought it was acceptable to rinse them down a sink.

Age, gender, race, number of recent visits to the pharmacy, number of unused or expired medications in the home, and number of medications patients were taking generally did not affect respondents' past disposal habits or beliefs. Notable exceptions to this finding included: non-Hispanic whites were much more likely to report storing medications in their homes (63.7% vs 39.7%, $P < .001$) and more likely to believe that it is acceptable to rinse medications down a sink (24% vs 16.7%, $P = .04$) than other races. Patients who had two or more visits to the pharmacy in the previous 3 months were more likely to report returning medication to the pharmacy (28.6% vs 12.6%, $P = .002$), were more likely to report flushing medication down a toilet (58.2% vs 44.7%, $P = .03$), and were more likely to believe that it was acceptable to return medications to the pharmacy (73% vs 54.5%, $P = .004$).

Previous counseling by a health care provider on how to properly dispose of medications and having more recent visits to the pharmacy were highly associated with returning medications to a pharmacy (see Table 3). Previous education about medication disposal was the variable most associated with returning medications to a medical provider ($P < .001$; see Table 3). Having fewer medications in the home and currently being on more medications were also positively associated with returning medications to a provider, while more recent visits to the pharmacy was nearly statistically significant ($P = .05$).

Previous counseling about medication disposal was positively associated with several beliefs that are consistent with Madigan's policies (see Table 4). Previously counseled respondents were significantly more likely to believe that returning unused or expired medications to a pharmacy or a medical provider was acceptable and were significantly less likely to believe that storing medications in their homes was acceptable. The belief that it was not acceptable to rinse medications down a sink was also associated with previous advice on medication disposal ($P = .06$).

Discussion

Of the currently available means, the most environmentally sound way of disposing of pharmaceutical

Table 3. Percentage of Respondents Who Had Previously Returned Medications to a Pharmacy or Medical Provider

Variable (number)	Number (%) Yes	Number (%) No	*P* Value
Percentage of respondents who had previously returned medications to a pharmacy			
Gender (300)			.43
Male	36 (25.0)	108 (75.0)	
Female	33 (21.2)	123 (78.8)	
Age (301)			.15
<50	28 (19.3)	117 (80.7)	
≥50	41 (26.3)	115 (73.7)	
Race (300)			.34
Non-Hispanic white	44 (24.6)	135 (75.4)	
Other	24 (19.8)	97 (80.2)	
Unused or expired medications in home (298)			.10
0	36 (27.7)	94 (72.3)	
≥1	33 (19.6)	135 (80.4)	
Visits to pharmacy in previous 3 months (299)			.002
≤1	13 (12.6)	90 (87.4)	
≥2	56 (28.6)	140 (71.4)	
Previously educated about medication disposal (299)			<.001
Yes	27 (45.8)	32 (54.2)	
No	41 (17.1)	199 (82.9)	
Medications current taking (299)			.16
≤5	46 (21.0)	173 (79.0)	
≥6	23 (28.8)	57 (71.3)	
Percentage of respondents who had previously returned medications to a medical provider			
Gender (299)			.21
Male	24 (16.7)	120 (83.3)	
Female	18 (11.5)	137 (87.8)	
Age (300)			.08
<50	15 (10.3)	130 (89.7)	
≥50	27 (17.3)	128 (82.1)	
Race (299)			.33
Non-Hispanic white	28 (15.6)	151 (84.4)	
Other	14 (11.6)	106 (87.6)	
Unused or expired medications in home (297)			.03
0	25 (19.2)	105 (80.8)	
≥1	17 (10.2)	150 (89.8)	
Visits to pharmacy in previous 3 months (298)			.05
≤1	9 (8.7)	94 (91.3)	
≥2	33 (16.9)	162 (83.1)	
Previously educated about medication disposal (298)			<.001
Yes	17 (28.8)	42 (71.2)	
No	24 (10.0)	215 (90.0)	
Medications current taking (298)			.004
≤5	23 (10.6)	195 (89.4)	
≥6	19 (23.8)	61 (76.3)	

waste is incineration.[4,5] Some pharmacies are beginning to use this option for unused and expired medications. Unfortunately, many states have laws preventing pharmacies from accepting returned medication from the public and additional federal laws regulate the transfer of controlled substances.[4]

Table 4. Comparison of Beliefs of Respondents Who Had Previously Been Advised on Proper Medication Disposal With Those Who Had Not

Beliefs about Medication Disposal	Previously Given Advice on Medication Disposal by a Medical Provider: Yes Number (%)	No Number (%)	*P* Value
It is acceptable to dispose of unused or expired medications by (number):			
Rinsing down a sink (298)			.06
Yes	10 (17.2)	53 (22.1)	
No	37 (63.8)	112 (46.7)	
Unsure	11 (19.0)	75 (31.3)	
Storing in the house (298)			.01
Yes	7 (11.9)	38 (15.9)	
No	50 (84.7)	161 (67.4)	
Unsure	2 (3.4)	40 (16.7)	
Returning to a pharmacy (298)			<.001
Yes	54 (91.5)	144 (60.3)	
No	4 (6.8)	33 (13.8)	
Unsure	1 (1.7)	62 (25.9)	
Flushing down a toilet (298)			.14
Yes	18 (30.5)	89 (37.2)	
No	32 (54.2)	96 (40.2)	
Unsure	9 (15.3)	54 (22.6)	
Returning to a health care provider (298)			<.001
Yes	44 (74.6)	113 (47.3)	
No	12 (20.3)	44 (18.4)	
Unsure	3 (5.1)	82 (34.3)	

Thus, the overall return of medications to pharmacies for disposal is limited.

Some household hazardous waste facilities will accept unused medications. Another solution is disposal in a landfill as long as proper precautions are taken.[11,12] Our study did not explore how patients used landfills to dispose of medications. Disposal into the sewage system is the least desirable option.[4]

Our sample reported a relatively high rate of returning medications to a pharmacy. Kuspis and Krenzelok[3] surveyed 500 callers to a US poison information center, finding that only 1.4% reported returning expired medications to a pharmacy. The more typical disposal methods were throwing out in the trash (54%), flushing down a toilet or rinsing down a toilet or sink (35.4%), and not disposing of them (7.2%). A more recent study of 392 patients in southeastern England, where legal obstacles are much fewer, found that 21.8% of respondents returned unwanted medications to pharmacies.[13]

The results of this study suggest that there is a role for patient education on the proper disposal of unused and expired medications. Previous education was highly associated with the prior "return" of medications to a pharmacy or a provider for proper disposal. Since frequent visits to the pharmacy were associated with previous returns to a pharmacy and currently being on more medications was associated with previous returns to a provider, patient education may be a factor. Visits to the pharmacy can provide opportunities for patient education.

More conclusive are the findings that previous counseling by a health care provider was positively associated with the beliefs that it is acceptable to return unused or expired medications to a pharmacy or a provider and the belief that it is not acceptable to store medications in the home. Getting patients to believe that it is acceptable and desirable to return medications to the pharmacy is a necessary first step to getting patients to actually bring them back for proper disposal.

There are several possible ways that this education could be conducted. For example, providers and pharmacy personnel could discuss medication

disposal with patients, and written education could be distributed with medications in a manner similar to what was described above. Or, innovative solutions, such as placing disposal information on medication labels or pill bottles, might prove effective.[10] Future research should focus on how to most effectively educate patients on proper disposal techniques.

There are weaknesses in this study. An accurate response rate could not be calculated. It should also be kept in mind that reports of previous practices are subject to recall bias and may not be accurate. The study sample was drawn from the patients of one hospital's outpatient pharmacy. The patients were all military beneficiaries living in the Pacific Northwest. It is unclear how well these findings can be generalized to a wider population.

The presence of pharmaceuticals in groundwater, lakes, rivers, and even drinking water is a problem that will continue to grow as the population expands and more medications are dispensed. The environmental significance and human health risk that this represents is hotly debated, and the true risk may not be known for years.[10,14–18] In the meantime, it is prudent to minimize the contamination as much as possible, and the improper disposal of unused and expired medications is one area where a difference could be made. Educating patients on proper medication disposal can affect patients' beliefs about medication disposal and is the first step toward changing their behavior. For pharmacies that do facilitate the proper disposal of unwanted medications, it appears that patient education can positively affect patients' disposal behaviors.

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