



Contents lists available at ScienceDirect

## Journal of the American Pharmacists Association

journal homepage: [www.japha.org](http://www.japha.org)

## COMMENTARY

## Prescription drug disposal: Products available for home use

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## ARTICLE INFO

## Article history:

Received 10 September 2019

Accepted 11 January 2020

Available online 14 February 2020

## ABSTRACT

**Objective:** Unused medications in the home are often improperly stored and may lead to unintentional harm, misuse, and diversion. Single-use disposal systems products allow consumers to safely inactivate unused medication and provide an environmentally friendly alternative to flushing medication down the toilet or discarding in the trash. The objective of this commentary was to review current medication disposal options and inform pharmacists of new products that may be used by patients to dispose of medications in the home setting. **Data sources:** Current recommendations on medication disposal from U.S. regulatory agencies (e.g., the Environmental Protection Agency) were reviewed and summarized comparatively. Information on the mechanism of action, price, and method of use of 8 new single-use disposal systems suitable for outpatient use were taken from each product manufacturer's website.

**Summary:** Eight single-use disposal systems were identified. Seven products used chemical deactivation to render medication safe for disposal, and 1 product allowed consumers to mail medication to a central processing facility for incineration. Products ranged in size from 2 oz to 1 gal, offering consumers the ability to dispose of anywhere from 60 to 3000 tablets per unit, respectively. Unit costs varied widely from \$5 per single-use pouch to \$190 for a 40-gal box intended for incineration.

**Conclusion:** Pharmacists and consumers must consider cost, effectiveness, and environmental impact when recommending and selecting products for medication disposal at home. More research is needed to understand the cost-effectiveness of each disposal system and to identify strategies to encourage uptake by health systems and use by consumers. Including content on home medication disposal in pharmacist–continuing education activities and raising workforce awareness of these products are critical to improving public safety.

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## Objective

According to the Centers for Disease Control and Prevention (CDC), 58 opioid prescriptions were written for every 100 Americans in 2017.<sup>1</sup> Although a steady decline in opioid prescribing patterns has been observed since 2010, opioid-related hospitalizations, emergency department visits, and mortality have continued to increase.<sup>2</sup> From 1999 to 2017, there were more than 400,000 opioid-related deaths in the United States, with more than 70,000 in 2017 alone.<sup>3</sup> Unused and improperly

stored opioid medications are risk factors for opioid misuse and diversion. An estimated 56% of individuals who misused opioids in 2013–2014 obtained their medication from a friend or family member at no cost.<sup>4,5</sup> To combat the opioid epidemic, tools such as electronic prescription drug monitoring programs and CDC's Opioid Overdose Surveillance Program have been implemented.<sup>3</sup> In addition to improved monitoring, enabling patients to safely dispose of unused opioids can play a role in preventing opioid-related harm. Health care providers rarely counsel patients on the safe disposal of controlled substance medications. In 1 nationwide sample of chronic opioid users, only 22% of patients had received counseling on medication disposal from a pharmacist.<sup>6</sup> The objective of this commentary is to review current medication disposal options and introduce 8 new products that may be used by patients to dispose of medications in the home setting. More information on available options for medication disposal will likely pharmacists and other providers the knowledge needed to counsel

**Disclosure:** The authors declare no relevant conflicts of interest or financial relationships.

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**Key Points****Background:**

- Only 22% of patients receive counseling from a pharmacist on medication disposal.
- Educating the pharmacy practice workforce on safe and effective medication disposal practices is critical to preventing prescription drug misuse.

**Findings:**

- There are currently 8 commercially available products indicated for the disposal of medications at home. Seven of these use chemical deactivation, and 1 uses incineration to render medications inactive.
- Costs, ease of use, and availability vary widely; however, all are more environmentally friendly options when compared with flushing down the toilet and are more convenient than current Drug Enforcement Administration–sanctioned drug take-back events and drop boxes.

their patients on the importance of disposing unused medication.

**Data sources**

Regulatory agencies in the United States including the Food and Drug Administration (FDA), the Drug Enforcement Administration (DEA), and the Environmental Protection Agency (EPA) have all offered guidance on outpatient medication disposal. This commentary will compare and contrast guidance for disposal from each of these agencies and then discuss the advent of single-use disposal systems. Because these are new products, little regulatory guidance on the use of single-use disposal systems currently exists. To enable pharmacists to understand the place of these products in practice, we gathered information on each product's mechanism of action, method of use, product size, and retail pricing from each manufacturer's web page and reviewed them in the latter half of this article.

*Current drug disposal options*

FDA recommends 3 main strategies for the safe disposal of unused or expired medications: medication take-back events or kiosks, disposal in household trash, and flushing certain potentially dangerous medications down the toilet.<sup>7</sup> Periodically scheduled medication take-back events are sanctioned by DEA and provide caregivers and patients the opportunity to safely dispose of all medications, including controlled substances and over-the-counter products.<sup>7</sup> In addition to scheduled national take-back events, medications can be disposed at DEA-registered permanent collection sites located in various community pharmacies, hospitals, clinics, and law enforcement facilities, such as sheriff's departments, throughout the country. For patients and caregivers unable to participate in medication take-back events, FDA recommends that unused

medications should be mixed with unpalatable substances such as dirt, coffee grounds, and/or cat litter, sealed in a plastic bag, and disposed of in the household trash.<sup>7</sup> Finally, when medication take-back options are not available, FDA recommends flushing potentially harmful medications (e.g., opioids, benzodiazepines, barbiturates, and stimulants) down the toilet as a safe alternative to prevent accidental exposure.<sup>3,8</sup>

Similar to recommendations by FDA, EPA also endorses medication take-back events and household medication disposal as safe disposal options.<sup>9</sup> According to EPA, medication take-back events are the preferred disposal option, with disposal guidelines encouraging patients to call their local waste management providers to learn more about the availability of local hazardous waste and drug take-back events.<sup>9</sup> EPA prefers a medication take-back event, when available, because it is a more environmentally conscious method of safe disposal. However, EPA diverges from FDA recommendations and does not recommend flushing medications down the toilet as a disposal option. Flushing medications down the toilet or in drains increases chemical exposure to the aquatic system, such as lakes, streams, and rivers, and increases the risk of drinking water contamination.<sup>10–12</sup> Conflicting advice from regulatory agencies along with the scarcity of DEA-sanctioned drug take-back events and kiosks makes the need for other disposal options evident.

Health care providers play a pivotal role in encouraging appropriate medication disposal and can be instrumental in educating patients about the availability of various medication disposal products. To address concerns associated with current medication disposal practices, several safe medication disposal products suitable for home use have been developed. Most of these agents provide the convenience of home use and neutralize medications before disposal, thereby preventing potential abuse of disposed materials.

*New products for home disposal of medication**Mechanisms of action*

Two broad categories of single-use disposal systems exist: deactivation and incineration. Deactivation products use a chemical process to denature medications added to the system, rendering them inert. Products such as Deterra,<sup>13</sup> Drug Buster,<sup>14</sup> and Rx Destroyer<sup>15</sup> use activated carbon to deactivate chemical compounds present in medications through absorption into carbon particles.<sup>16</sup> Similarly, Pill Catcher contains bentonite clay, which absorbs chemical compounds in a similar manner as activated carbon.<sup>17</sup> DisposeRx<sup>18</sup> and Element MDS<sup>19</sup> use unnamed cross-linking polymers and organic plant-based powder, respectively, to sequester the combination of medications and active ingredients into a viscous gel. The active ingredient in Pill Terminator,<sup>20</sup> calcium hypochlorite, is a strong oxidizing agent that releases chloride gas upon reaction with other substances, thereby creating an unpleasant, deterrent odor to prevent abuse of disposed medications.<sup>20</sup> Finally, Takeaway Medication Recovery System uses a mail-back approach for medication incineration.<sup>21</sup>

*Directions for use*

Although there are some differences in how these products work, all are designed to be easily used by patients in the home setting. Deterra, Pill Catcher, and Pill Terminator are sold as

**Table 1**  
Single-use disposal systems

Product name	Manufacturer	Active ingredient	Mechanism of action	Directions for use	Preparations/capacity/pricing information (June 2019)	Product availability for purchase
Deterra	Verde Technologies, 12701 Whitewater Dr., Suite 280, Minnetonka, MN 55343	Activated carbon	Deactivation; deactivates and renders medication inert	1. Fill pouch with medications. 2. Fill halfway with tap water. 3. Wait for 30 s, then gently shake. 4. Dispose of sealed pouch in garbage or solid waste.	2-oz pouches • Holds 15 tablets, 60 mL, 2 patches • \$14.97/3-pack 6-oz pouches • Holds 45 tablets, 180 mL, 6 patches • \$17.97/3-pack 12-oz pouches • Holds 90 tablets, 360 mL, 12 patches • \$20.97/3-pack 60-oz pouches • Holds 450 tablets, 1.8 L, 60 patches 1.6-gal pouches • Holds 1400 tablets, 6 L, 185 patches 2.5-gal pouches • Holds 2000 tablets, 9.5 L, 265 patches Pricing from the manufacturer's website	<a href="http://www.deterasystem.com">www.deterasystem.com</a> ; <a href="http://www.amazon.com">www.amazon.com</a>
DisposeRx	DisposeRx Inc, 503 Carthage St., Suite 202, Sanford, NC 27330	Cross-linking polymer	Deactivation; sequesters into viscous polymer gel, rendering inert	1. Add warm tap water into medication vial until up to two thirds of vial is full. 2. Empty content of packet into vial, replace cap, and shake for 30 s. 3. Discard in garbage or solid waste.	30count of packets • \$33.40 100count of packets • \$127.04 600count of packets • \$646 2000count of packets • \$2200 Pricing from <a href="http://www.walmart.com">www.walmart.com</a>	<a href="http://www.dispose.rx.com">www.dispose.rx.com</a> , <a href="http://www.walmart.com">www.walmart.com</a>
Drug Buster	Medline, Three Lakes, Dr. Northfield, IL 60093	Activated carbon	Deactivation; deactivates and renders medication inert	1. Place unwanted drugs—tablets, liquids, narcotics, and transdermal patches into the bottle. 2. Invert and swish the bottle twice. 3. After 2 h or when full, discard in garbage or solid waste.	4-oz bottle • \$5.58/container • Destroys 50 tablets 16-oz bottle • Destroys 300 tablets • \$15.99/bottle 64-oz bottle • Destroys 1500 tablets • \$34.99/bottle Pricing from <a href="http://www.amazon.com">www.amazon.com</a>	<a href="http://www.medline.com">www.medline.com</a> , <a href="http://www.amazon.com">www.amazon.com</a>
Pill Catcher	The Pill Catcher, P.O. Box 700741, Plymouth, MI 48170	Bentonite clay and other unknown dry ingredients	Deactivation; absorbs and encapsulates medication, rendering inert	1. Add unwanted medications to the bottle. 2. Add tap water to the first line of the bottle. 3. Replace cap and shake for 40 s. 4. Dispose in garbage/solid waste.	Pint bottles • Holds 120 tablets/450 mL of liquid • \$4.95/bottle Quartz bottles • Holds 300 tablets/700 mL of liquid • \$6.95/bottle Gallon bottles • Holds 1500 tablets/2500 mL of liquid • \$22.60/bottle Pricing from the manufacturer's website	<a href="http://www.mcssl.com">www.mcssl.com</a>

(continued on next page)

Table 1 (continued)

Product name	Manufacturer	Active ingredient	Mechanism of action	Directions for use	Preparations/capacity/pricing information (June 2019)	Product availability for purchase
Pill Terminator	Combined Distributors Inc, 2360 Lakewood Rd., Suite 3-420, Toms River, NJ 08755	Fuller's earth, absorbent polymer, calcium hypochlorite	Deactivation; destroys medications by denaturing chemical composition	1. Place unwanted medications in container and add warm water. 2. Close with child resistant cap and shake for 5 s. 3. Dispose in garbage or solid waste and do not reopen.	300-mL bottle • Eliminates up to 300 medium-sized tablets • \$9.95/bottle Gallon size • Eliminates up to ~2000 tablets • \$24.95/bottle Pricing from <a href="http://www.amazon.com">www.amazon.com</a>	<a href="http://www.pillterminator.com">www.pillterminator.com</a> , <a href="http://www.amazon.com">www.amazon.com</a> , <a href="http://www.walmart.com">www.walmart.com</a>
Rx Destroyer	C2R Global Manufacturing Inc, 701 Blackhawk Dr. Suite A, Burlington, WI 53105	Activated carbon and proprietary agents	Deactivation; deactivates and renders medication inert	1. Load unwanted medications into bottle. 2. Tightly replace cap and gently shake to mix solution. 3. Discard contents into trash following disposal regulations as applicable.	4-oz bottle • Holds ~50 tablets 16-oz bottle • \$14.60 • Holds 8 oz of liquid/~300 tablets/patches 64-oz bottle • \$29.84 • Holds 32 oz of liquid/~1500 tablets/patches 1-gal container • Holds 64 oz of liquid/~3000 tablets/patches 5-gal container • Holds ~500 oz of liquid/~15,000 tablets/patches 30-gal drum • Holds ~90,000 tablets Pricing from <a href="http://www.amazon.com">www.amazon.com</a>	<a href="http://www.rxdestroyer.com">www.rxdestroyer.com</a> , <a href="http://www.amazon.com">www.amazon.com</a> , <a href="http://www.walmart.com">www.walmart.com</a>
Element MDS	V23 LLC, 300 North Kanawha St., Suite 201 Beckley, WV 25801	Organic plant-based powder	Deactivation; sequesters medication into viscous gel, rendering inert	1. Add unwanted medication into pouch or bottle. 2. Add water until it is just above medications and shake vigorously. 3. Reseal pouch or close bottle with cap and dispose in trash.	4-oz packs • Holds 250 tablets/5 oz of liquid • \$10/3–4-oz packs 17-oz bottles • Holds 750 tablets/17 oz of liquid • \$279.99/50 17-oz bottles Pricing from the manufacturer's website	<a href="http://www.elementmds.com">www.elementmds.com</a> , <a href="http://www.amazon.com">www.amazon.com</a>
Takeaway Medication Recovery System	Sharps Compliance, Inc, 9220 Kirby Dr. Suite 500, Houston, TX 77054	n/a	Incineration; medication is mailed back and incinerated	1. Insert medications per included instructions. 2. Seal and return via mail for proper disposal. 3. Do not include more than 4 oz of liquid per mailing.	Envelopes (prepaid postage) • \$84/12 envelopes • \$150/25 envelopes • \$300/50 envelopes • \$1375/250 envelopes 1-gal box • \$61/box 2-gal box • \$81/box 3-gal box • \$70/box 10-gal box • \$104/box 40-gal box • \$190/box Pricing from the manufacturer's website	<a href="http://www.sharpsinc.com">www.sharpsinc.com</a> , <a href="http://www.amazon.com">www.amazon.com</a> , <a href="http://www.CVS.com">www.CVS.com</a>

Abbreviation used: n/a, not applicable.

self-contained delivery systems. To use these products, the patient has to add the medication they wish to dispose directly into the pouch or bottle containing the powdered form of the disposal product, add water, and shake it vigorously to mix and deactivate the contents. The whole container is then disposed of in the regular household waste.<sup>12,15,16</sup> Also, Drug Buster and Rx Destroyer are available in liquid form and do not require additional water. Medication is added directly into the container, and when the container is full, it may be shaken to ensure that all the medication is deactivated and disposed into household waste.<sup>14,17</sup> In contrast, to use the Sharp's Takeaway Medication Recovery System, patients can purchase prepaid postage envelopes or boxes online, fill with medications (in their original containers), seal, and return for mail at local U.S. Postal Service locations.<sup>19</sup> The medication is then incinerated by the manufacturer of the disposal system. Detailed directions of use for each product can be found in [Table 1](#).

#### *Efficacy of single-use disposal systems*

Although these products have not been evaluated by DEA or EPA, many have demonstrated almost complete deactivation capacity. Several products including DisposeRx and Rx Destroyer claim to meet or exceed DEA's "nonretrievable" standard for destruction of controlled substances. Non-retrievable, for the purpose of destruction, is defined as the "condition or state to which a controlled substance shall be rendered following a process that permanently alters that controlled substance's physical or chemical condition or state through irreversible means and thereby renders the controlled substance unavailable and unusable for all practical purposes."<sup>22</sup> However, limited efficacy data are available for these products. Data are available with Deterra that show an average adsorption rate of 98.7% within 8 hours and more than 99.9% deactivated drug at the end of a 28-day study.<sup>23</sup> Toxicity characteristic leaching procedure analyses conducted with Pill Catcher to simulate leaching through a landfill showed undetectable traces of organic chemicals when tested on more than 20 organic chemicals.<sup>17</sup> High-pressure liquid chromatography conducted with the Pill Terminator showed a 45% release of morphine after 2 hours of extraction with water; however, the extraction rate declined to 2% after 30 minutes of shaking.<sup>14</sup> C2R Global Manufacturing Inc, manufacturer of Rx Destroyer, provided independent testing results on its website.<sup>19</sup> According to these results, when tested on 5 g of methamphetamine, 65% of methamphetamine was adsorbed in 2 hours, 86% in 24 hours, 94% in 4 days, and 100% by day 7.<sup>15</sup> Other chemical products such as DisposeRx, Drug Buster, and Element MDS lack readily available efficacy data. None of these products are approved by DEA or EPA or currently endorsed by any professional organization, including the American Pharmacists Association. There is a clear need for further studies assessing the comparative effectiveness of these drug disposal products and patient factors associated with their use.

#### *Cost considerations*

Unlike disposing medication in a kiosk, single-use disposal systems are consumable goods and, thus, must be purchased by either the patient or the provider because most insurance plans do not currently cover medication disposal. Prices generally range between \$5 and \$35 for smaller-sized items

and \$25–\$190 for larger, gallon plus–sized items. Smaller, 2-oz packages are large enough to dispose of 60 tablets or 60 mL of liquid and are best for individual home use. Gallon sizes hold 3000 tablets or 5 L of liquid and are suitable for use in health care facilities or nursing homes.

Items are typically available for purchase on the manufacturers' websites, through online retailers, and at local pharmacies. Costs associated with these products may pose a barrier to access for low-income individuals, and more work is needed to understand the association between cost and access to safe home disposal systems. Community pharmacies have partnered with companies that offer these disposal options to provide them at reduced or no cost to patients receiving prescriptions for controlled substances; however, it is yet to be seen if removing out-of-pocket costs is associated with increased use.<sup>24</sup> Insurance companies do not generally offer coverage for these medications; however, the prescription benefit manager for the Department of Veterans Affairs recently announced the availability of Sharps Takeaway envelopes at selected Veterans Affairs Hospital facilities.<sup>25</sup> This early commitment from a federal payer may provide the impetus needed for expanded private sector coverage.

#### *Environmental considerations*

The long-term environmental effects of drug disposal systems remain unstudied. In 2012, EPA published a memorandum recommending that medications collected by take-back events, mail-back, and other collection programs should be incinerated to minimize the potential for environmental contamination and diversion.<sup>26</sup> Unlike sewage and trash disposal, by-products of pharmaceutical incineration consist mainly of carbon dioxide and water and therefore, pose minimal environmental risk.<sup>26,27</sup> Although most of these household disposal products claim to be safe for landfills, long-term data assessing leaching potential and effect on landfill are lacking. An exception is the Takeaway Medication Recovery System, which employs incineration for the disposal of mail-back medications.<sup>25</sup>

#### **Summary**

The major distinguishing factors between the single-use disposal systems are mechanisms of action (deactivation vs. incineration), product sizes, and cost. Products that work via deactivation (all except Takeaway Medication Recovery System) pose an advantage of in-home use and disposal, thereby bypassing the need to transport medications to local U.S. Postal Service locations for eventual incineration. Smaller product sizes are more portable and are advantageous for patients with limited quantity of medications versus larger products, which are more appropriate for use in medical facilities. Costs vary by product; however, deactivation products are generally cheaper than incineration. Despite the higher costs, incineration minimizes the potential for leaching into landfills and groundwater. Reduced environmental impact may offset some of the external costs associated with deactivation. Therefore, there is a need for stringent economic analysis aimed at identifying the most cost-effective disposal option.



Pharmacists are in a unique position to counsel patients on medication disposal, however, current evidence suggests that fewer than 30% of patients receive counseling from pharmacists on medication disposal.<sup>6,26</sup> As pharmacies are widely accessible, stocking and promoting the availability of medication disposal products may increase consumer awareness of proper disposal practices and provide a public health benefit. In 2018, Walmart Pharmacy announced that they would begin including DisposeRx systems with each opioid prescription dispensed.<sup>24</sup> Although this program undoubtedly encourages disposal, no data are captured on how patients are using the disposal pouches, and it is unclear how regularly and thoroughly pharmacists are educating their patients on disposal. If these systems are not being used by patients because of inadequate education, then mass distribution may serve as a major source of medical waste. The need for health services research on the effective implementation of medication disposal programs is evident. In an example from Texas, single-use disposal pouches (both deactivation and incineration) have been distributed through partnerships with community substance abuse prevention organizations as part of the Texas Targeted Opioid Response.<sup>28</sup> Although the project is ongoing, the results are expected to help provide a framework for future disposal interventions.

Training pharmacists and other providers on appropriate disposal is necessary to bridge the gap between distribution of single-use disposal systems and realized use of the same. Recent legislation in many states mandates that prescribers and pharmacists receive training on safe controlled substance use, and FDA recommends that content on medication disposal be included in programs designed to meet the requirements of their opioid use risk evaluation and mitigation strategy (REMS).<sup>29</sup> Historically, however, regulatory agencies, including FDA, have taken a laissez-faire approach in the development of qualifying programs. FDA does not mandate that prescribers and dispensers of opioids participate in REMS training, and state boards of pharmacy vary widely in what qualifies as continuing education on controlled substance prescribing.<sup>29</sup> Without regulatory action, providers will continue to ignore the importance of medication storage and disposal when counseling patients perpetuating the cycle of improper storage and harm.

## Conclusion

Home medication disposal products are convenient, efficient, and safe options intended to help reduce harm related to the improper storage of unused medications in the home setting. Although these medications vary in mechanism of action and cost, they all offer consumers the ability to dispose of medication safely at home without the potential environmental impacts associated with flushing medication down the toilet or disposal in the household waste. Because these products are new, their use is currently limited by a lack of evidence regarding their cost-effectiveness, efficacy, and ease of use. Implementation and dissemination research on the use of single-use disposal systems is needed to improve consumer accessibility and use of these products in the outpatient setting. Over time, these products may help pharmacists

answer that constant patient question: “What do I do with these tablets?”

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