

Title: In-Home Deactivation System for
Psychoactive Drugs (SBIR Phase 2)

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**In-Home Deactivation System for
Psychoactive Drugs (SBIR Phase 2)**

Final Report

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Summary

When consumers became aware of the Deterra System, they were enthusiastic and used the product almost immediately. 91% of all respondents were motivated by concern for the environment, with 45% citing concern about drug abuse or diversion, and 37% citing concern about accidental poisoning.

Providers of Deterra were similarly enthusiastic about the System, and indicated high concern for the environment, though a significantly higher percentage of them also cited concern for abuse/diversion and/or accidental poisoning.

The activated carbon system was highly effective in adsorbing and deactivating all of the drugs tested, with an average of 89% of API adsorbed within the first 8 hours, and 99.6% deactivated at 28 days.

Activated carbon was highly effective for all formulations, and all chemical classes of drugs tested, and data from stability studies predict >10 years stability at room temperature.

The adsorbed pharmaceuticals were resistant to leaching by water, with only trace amounts detectable after an extensive washout.

The adsorbed pharmaceuticals were resistant to leaching by a washout procedure with 30% ethanol, with few exceptions. This demonstrated that the activated carbon was effective in rendering adsorbed pharmaceuticals unrecoverable by simple means.

No product complaints or adverse events were reported

Background Information: Verde has developed an inexpensive prescription medication disposal system that provides a simple means for patients or members of their households to safely render prescription drugs unusable and effectively contained in order to minimize the potential for diversion or accidental exposure to children or pets.

The disposal system consists of a 4" x 7" polyethylene-polyethylene terephthalate composite film pouch, with a zip-type water-tight seal. Inside the bag is a water-soluble polyvinyl alcohol wrapped pod that contains 15 grams activated carbon. The bag dimensions were established to contain an estimated unused amount of an individual prescription, i.e. up to 15 tablets and approximately 50 ml of water.

In the Phase I SBIR project, Verde demonstrated the feasibility, safety and marketability of the product. The product is now in deployable form for mass- distribution.

Phase II Technical Objectives described in the contract were for Verde to conduct assays, tests and surveys to assess:

1. The degree of adherence by prescribers, pharmacies and/or home-users
2. Whether adoption and usage under normal household conditions improves outcomes
3. The classes of chemical compositions and delivery systems for which the product is most effective
4. Adverse events from the use of the product
5. The durability or shelf life of the product
6. The development of ancillary materials to support adoption and consistent use

Technical Objectives 1 and 2: To determine the degree of adherence by prescribers, pharmacies and/or home-users, and (2) Whether adoption and usage under normal household conditions improves outcomes

Deterra System Survey Results In Brief...

1700	Number of user surveys distributed
32	Number of provider surveys distributed
1% to 15%	Typical response rate for external surveys
14%	Response rate of Deterra User Surveys
64%	Response rate of Deterra Provider Surveys
3	Number of pharmacies incentivized to distribute Deterra Surveys
20%	Response rate of pharmacy customers
91%	Consumers concerned with preventing damage to the environment
45%	Consumers concerned with preventing drug abuse or diversion
37%	Consumers concerned with preventing accidental poisoning
95%	Consumers who had no difficulty using the Deterra System pouch.
96%	Consumers who will use the Deterra System within 4 weeks
0	Number of providers who recommended product improvements
100%	Providers who will continue to provide Deterra System pouche
1	Rank of comment, "What do I do with the inside bag?"

Summary

Between April 25 and May 1, 2016, a total of 1665 Deterra System User Surveys were given to 6 different providers to distribute to users, along with free samples of the Deterra pouch. Each provider of User Surveys was given Provider Surveys for staff, and Provider Surveys were also sent to current Deterra System bulk users. To date (June 20, 2016), 233 User Surveys and 18 Provider Surveys have been sent back to Verde anonymously via mail. Location responses were tracked by a small code on each survey envelope.

Survey Type	Location Type	Location Name	Code	# Supplied	# Returned	Rate of Return
User	Pharmacy	Atlantic Apothecary	DSU1	350	94	27%
User	Pharmacy	Bayard Pharmacy	DSU2	350	9	3%
User	Pharmacy	Cape Pharmacy	DSU3	350	109	31%
User	Law Enforcement	Hennepin County Sheriff	DSU4	350	0	0%
User	Law Enforcement	Eden Prairie Police	DSU5	200	10	5%
User	Various	Other	DSU6	65	11	17%
TOTAL User				1665	233	14%
Provider	ALL	Various	DSP	28	18	64%

In general, the product was well received and people seemed eager to use it. Given some comments, they also seemed eager to have another chance to use it.

Providers of User Surveys

Pharmacies:

- Atlantic Apothecary
- Bayard Pharmacy
- Cape Pharmacy

Law enforcement agencies:

- Hennepin County Sheriff
- Eden Prairie Police

Various Sources of Completed User Surveys:

- Pharmacists who were unable to distribute surveys at their place of business but wanted to take the survey
- Members of the 3M First Response Team
- Other interested parties

Potential Respondents to Provider Surveys

- Atlantic Apothecary
- Bayard Pharmacy
- Cape Pharmacy
- Hennepin County Sheriff
- Eden Prairie Police
- Allina Pharmacy

Consumer Response to Deterra System

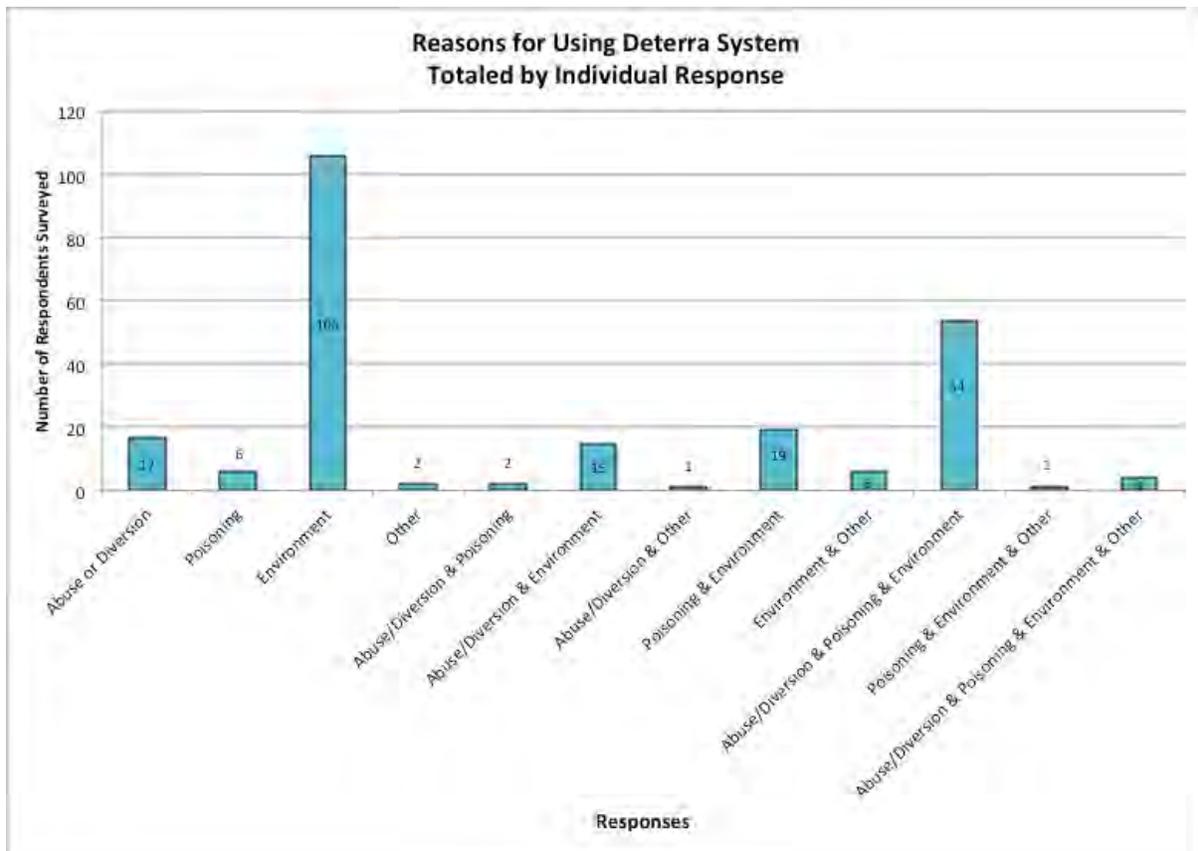
People who used the Deterra pouches to safely dispose of their unused or unwanted medications were largely enthusiastic about the product, most often citing environmental concerns as their reason for using the product and sometimes providing feedback on what would make the product better for them.

Why Did You Use This Product?

In Question 7, survey respondents were asked why they used the product and were offered 4 different answer options:

1. To lower the risk of abuse or diversion
2. To lower the risk of accidental poisoning
3. To remove prescription drugs from my home without causing environmental damage
4. Other (please specify)

The chart below shows the variety of response combinations received. The category that received more responses than any other is “Environment” (the desire to not cause environmental damage). The next most popular answer was a combination of the first three answers, including lowering the risk of abuse or diversion, lowering the risk of accidental poisoning, and preventing environmental damage.

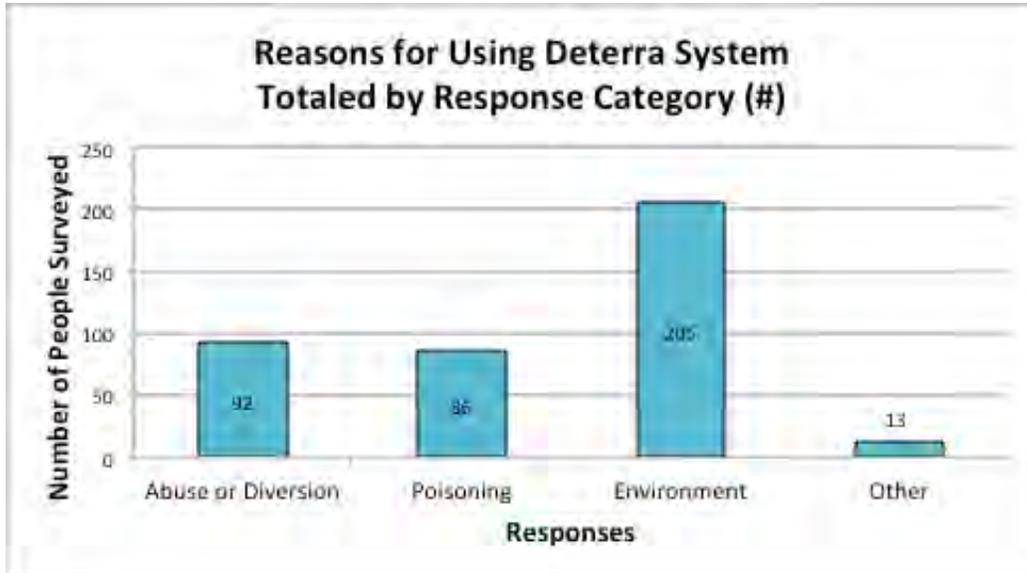


106 respondents—45%—used the product to remove drugs from home without causing environmental damage.

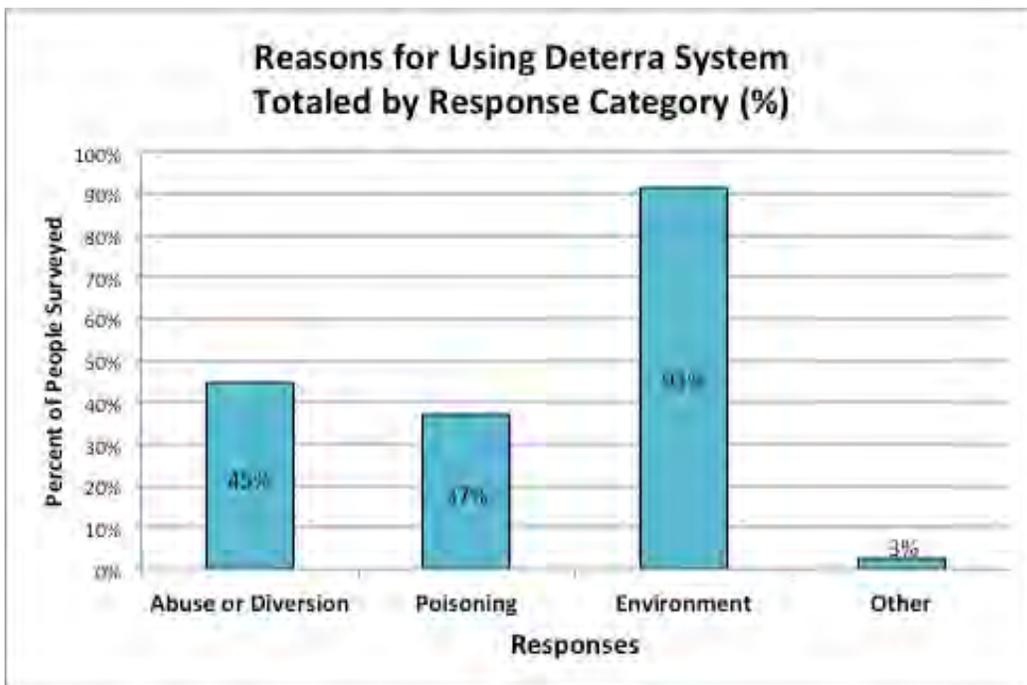
54 respondents—23%—used the product to 1) lower the risk of abuse or diversion, 2) lower the risk of accidental poisoning, **and** 3) remove drugs from home without causing environmental damage.

17 respondents received the product to lower the risk of abuse or diversion. 6 people received the product to lower the risk of accidental poisoning.

When responses are totaled by answer category rather than individual response, we can see (below) that twice as many respondents—205—cite concern for the environment over concern about abuse or diversion (92 respondents) or concern about accidental poisoning (86 respondents).



Sorting the same data by response category, we see that 91% of all respondents used Deterra out of concern for the environment, with 45% citing concern about abuse or diversion, and 37% citing concern about accidental poisoning.



Thirteen people used the product for other reasons and many made comments:

- “To make family aware to NOT put unwanted drugs in the garbage bin!”
- “Because of wife’s various medical problems—her meds are constantly changing.”
- “Expired medications disposal.”
- “Easier than waiting for police times.”
- “Convenient.”
- “Easy.”
- “Free!”
- “To keep meds out of ground water.”
- “To help keep drinking water and air cleaner.”
- “Closest disposal at county is far away.”

Conclusions

1. Consumers are very much aware of the environmental impact of improper disposal of medications.
2. Some consumers are exploring options for drug disposal, including Take-Back programs.
3. Some consumers may face prescription confusion and want to weed out unwanted drugs.
4. There is much work to be done building awareness of the danger and likelihood of abuse, diversion or accidental poisoning.

Why Did You Purchase or Receive This Product?

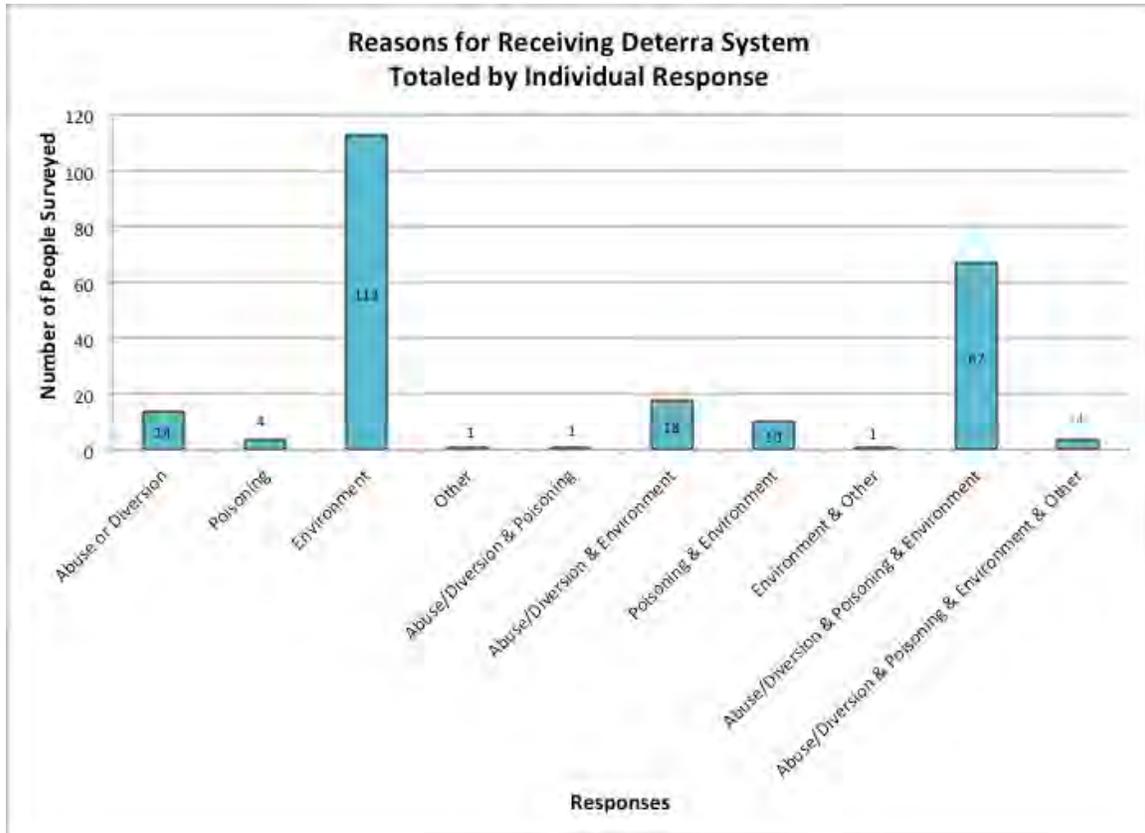
In Question 6, respondents were asked why they purchased or received the product. The phrasing of the question is a bit vague. If a consumer received the product at no charge, is the question then asking about the provider’s values? (For instance, was this product offered to me because law enforcement cares about the accidental poisoning?) If so, what is the relevance? It is also unclear how the intent of the question is different from that of Question 7.

The same answer options were provided:

1. To lower the risk of abuse or diversion
2. To lower the risk of accidental poisoning
3. To remove prescription drugs from my home without causing environmental damage
4. Other (please specify)

Most consumers answered this question in the same way they answered Question 7, but there was a slight variance. When looking at the paper surveys themselves, most people simply duplicated their answers from one question to the next.

The chart below shows the variety of response combinations received. Similar to Question 7, the category that received more responses than any other is “Environment” (the desire not to cause environmental damage). Again, the next most popular answer was a combination of the first three answers, including lowering the risk of abuse or diversion, lowering the risk of accidental poisoning, and preventing environmental damage.

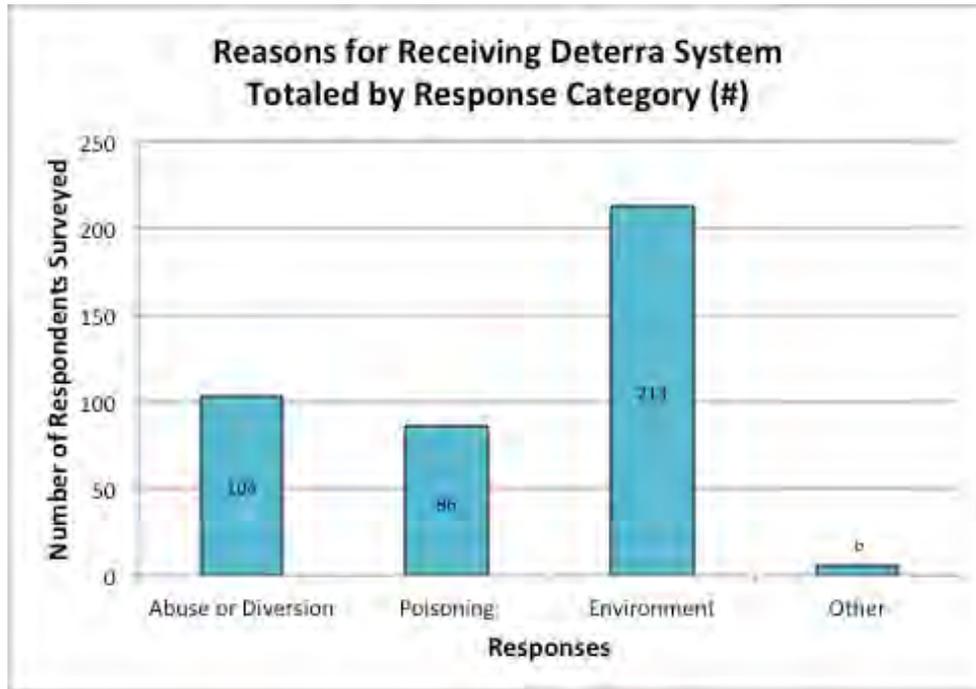


113 people - 48% of respondents - say they received the product for the sole purpose of removing drugs from home without causing environmental damage.

67 people—29% of respondents—say they received the product to 1) lower the risk of abuse or diversion, 2) lower the risk of accidental poisoning, **and** 3) remove drugs from home without causing environmental damage.

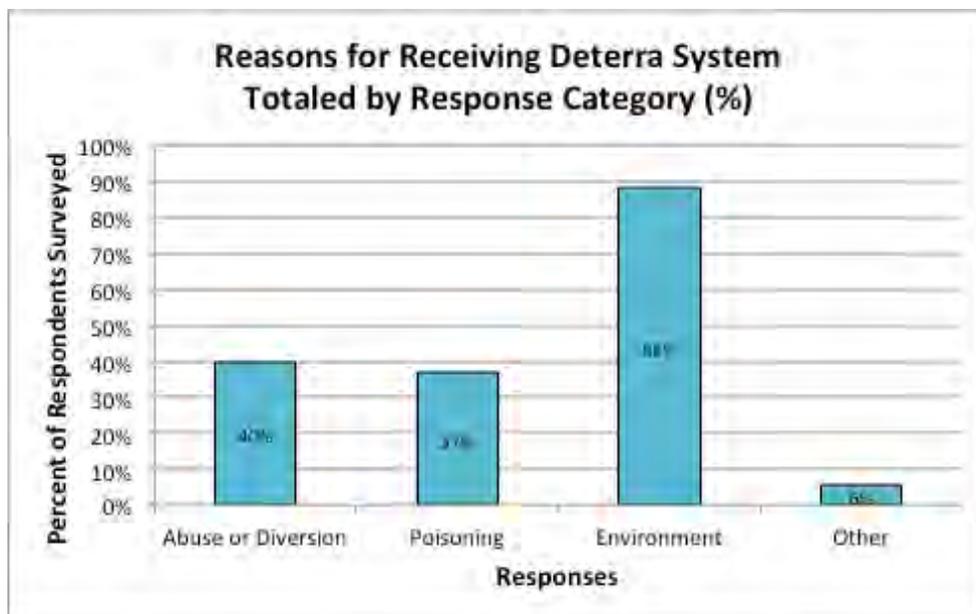
14 people say they received the product to lower the risk of abuse or diversion. 4 people received the product solely to lower the risk of accidental poisoning.

When responses were totaled by answer category rather than by individual response, we again see that 213 respondents believe they received Deterra out of concern for the environment.



Concern for the environment was two times more significant than concern about abuse or diversion (104 respondents) or concern about accidental poisoning (86 respondents).

The chart below shows response by category for the same data, but as a percent of all respondents. Of the survey respondents, 88% cited the environment, 40% cited concern for abuse or diversion, and 37% cited accidental poisoning as a reason they received the product.



Five people left comments in the “Other” category regarding their reasons for receiving the product:

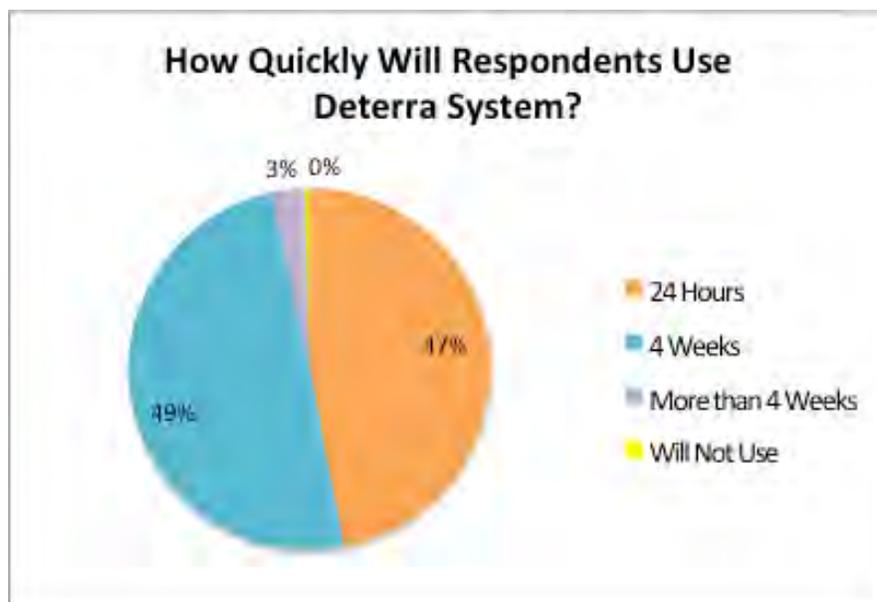
- “Facility is a pilot pharmacy.”
- “To keep medications out of ground water.”
- “To help keep drinking water and air cleaner.”
- “I have witnessed drug prescription abuse.”
- “It is difficult to dispose of medicine properly. This makes it easy!”
- “I want to try the product before introducing it to peers and clients.”

Conclusions

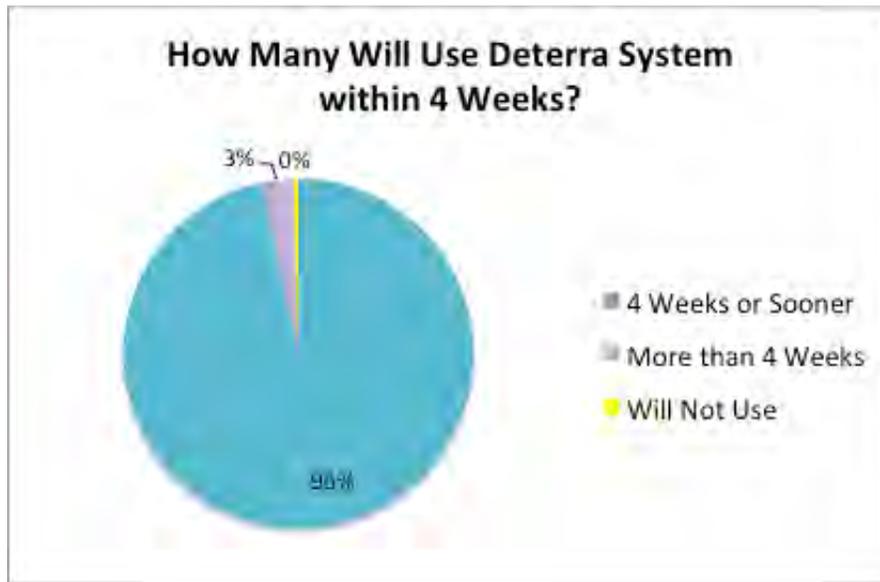
1. Consumers believe that organizations like law enforcement and businesses like pharmacies are providing products to help protect the environment.
2. Again, we see less awareness of the threat of drug abuse and diversion or accidental poisoning.

Upon Receipt of the Product, How Quickly Did You Use It?

Answers to Question 3—how soon did you use the Deterra System?—show us that 49% of consumers used the Deterra System within 24 hours of receiving it, and 47% used it within 4 weeks. A scant 3% will take longer than a month to use the product.



That means that 96% of consumers used the Deterra System in 4 weeks or less.



Only one person indicated that he/she would not use the product and instead preferred the DEA Take-Back program.

Conclusions

1. When consumers became aware of the Deterra System, they were enthusiastic and used the product almost immediately.

Using the Pouch

Question 4 asks consumers if the instructions were clear and easy to understand. Ninety-seven percent of respondents found the instructions clear and easy to understand. Three percent—8 people—did not. Their comments are about the small pouch of activated carbon within the larger pouch:

- “Pouch’ not clearly identified.”
- “What do we do with the inside bag?”
- “You need to make it clear in large letters that you don’t open the inside pocket. Does it dissolve or what?”
- “Didn’t know what to do with the inside bag—finally noticed note.”
- “Note about not opening the inside bag needs to be more prominent.”
- “If you can get it to indicate that it was successful you would have a fantastic product!”¹

¹ This comment was made on Question 7, but pertains to use of product.

Question 5 asks consumers if they had any trouble using the product. Nearly all respondents had no problems using the product. Of the 5%—11 people—who did, here's what they commented:

- “‘Pouch’ not clearly identified.” (Confusion between larger pouch and inner pouch.)
- “A little difficult to see where to tear open package.”
- “After tearing tab off, it was a little difficult to pull apart.”
- “Tore unevenly and spilled.”
- “Didn’t read directions first.”
- “Trouble sealing the bag—eventually did.”
- “Need to make clear in large letters that you don’t open inside pocket (does it dissolve or what?)”
- “What do we do with the inside bag?” (2 responses)
- “Some of the material did get on the seal, but I removed it so it would seal.”
- “I think I added too much water—couldn’t easily seal the pouch. Messy!”
- “Did not seal well, need to improve sealing mechanism.”

Conclusions

1. If 8 people did not immediately understand what to do with the smaller pouch within the larger pouch, it’s quite likely that many more had or will have the same question. The language or pictograph on packaging needs to be more explicit or prominent.
2. Tearing the package open and resealing the bag were problematic for some. Again, this may well be true for many more consumers.
3. Online FAQ should include troubleshooting tips when consumers add too much water, spill the carbon, etc.

Who Gave You the Product?

Of the 233 User Surveys received, 90% were supplied by pharmacies², 4% by law enforcement agencies, and 5% by “other,” typically co-workers or acquaintances. 3 respondents (1%) did not answer the question.

² On surveys from pharmacies where respondents selected “other” and then entered the words “pharmacy technician” or “cashier” or “store display,” their answer was categorized in the general category of “pharmacy” and not “other.”



Conclusions

None.

Did you purchase the product or was it given to you?

We know that all pouches were given free of charge, and yet 6 of 233 people marked that they had purchased the product. This result hopefully can be attributed to mis-reading of the question.

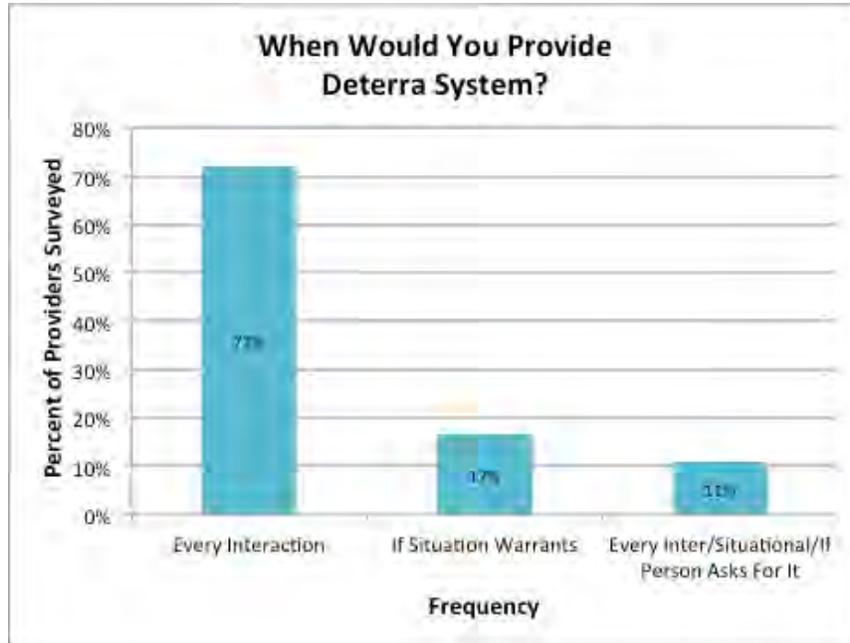
Conclusions

None.

Provider Response to Deterra System

1. When would you provide the product to client/customers/public?

Of the 18 respondents, 13 said they would provide it with every interaction. These responses may be from pharmacists who, for purposes of securing survey responses, were incentivized to provide the pouches with every interaction at no cost to themselves. Therefore, this data may be biased. One provider said he/she would provide it when there was a medication or dose change.



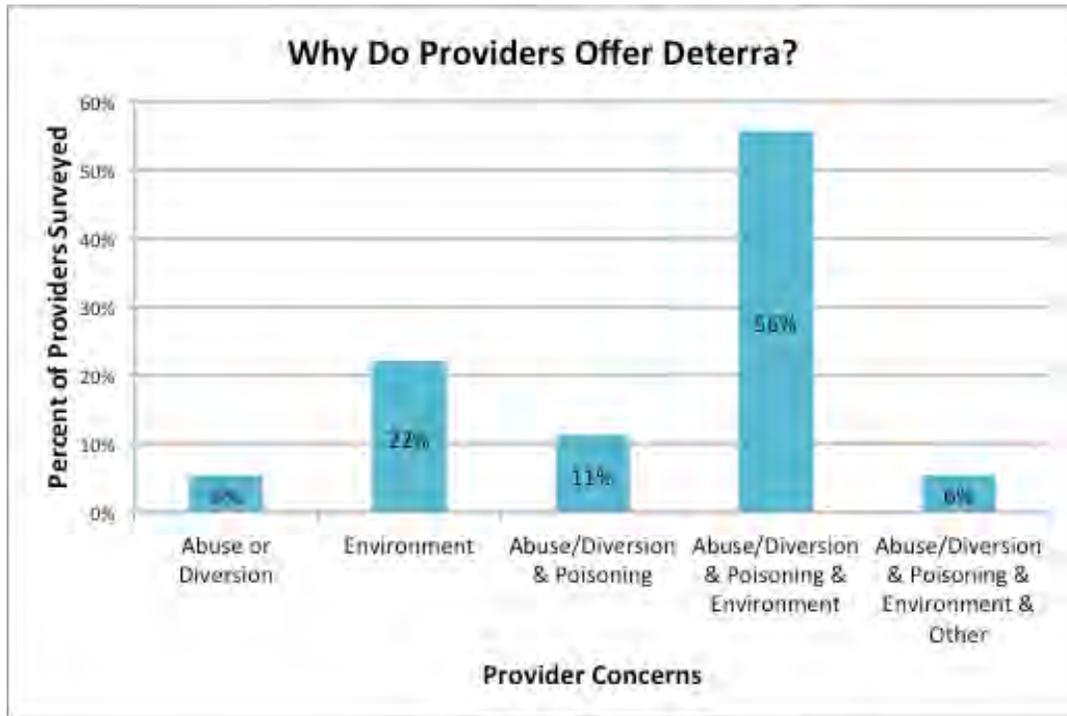
2. Do you have any suggestions for product improvement?

100% said no.³

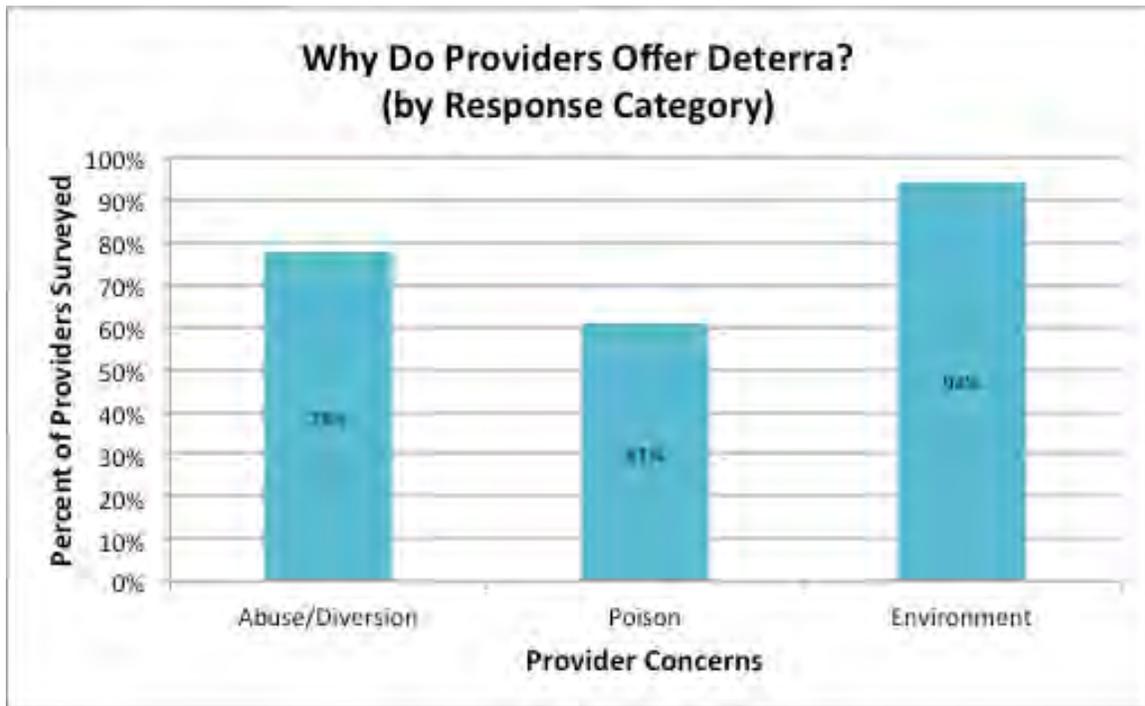
³ Two respondents suggested, “the envelope be attached to the pouch,” but since this refers to the survey and not the product, their answers were interpreted to mean that they did not have suggestions for product improvement.

3. Why did you provide this product?

56% of respondents indicated to lower the risk of abuse or diversion, to lower the risk of accidental poisoning, **and** to remove drugs from homes without causing environmental damage. 22% indicated concern primarily for the environment.



When responses were totaled by answer category rather than individual respondent, we saw that providers' concerns were somewhat more balanced between Abuse/Diversion (14 people), Poison (11 people), and Environment (17 people). Environment still led, but only by 16% over Abuse/Diversion and 33% over Poison.



We received one specific comment in the category of Other: “To prevent someone from trying to self-medicate for another illness, event/injury other than what it (the medication) was originally prescribed.”

4. Do you plan to continue to provide this product?

100% said yes. One comment promised to carry the product if it were free of charge.

5. Are you aware of any complaints or adverse events that persons have experienced using this product?

94%—17 of 18 people—said no, and one person indicated a customer complained of having difficulty resealing the package.

Survey Distribution Strategy

The biggest uncertainty in survey distribution lay with the providers. We used a mix of pharmacy staff, law enforcement and a mishmash of other interested parties to help us reach consumers. We provided brief training and signage to help them better communicate.

Pharmacies. Because Deterra has strong support from Hooshang Shanehsaz, the Director of Pharmacy at Cardinal Health, and Mr. Shanehsaz offered to help in the survey effort, 950 Deterra surveys and pouch samples were distributed to 3 pharmacies in Delaware, Mr. Shanehsaz' home state. By the end of April, staff from the three pharmacies participated in brief training via conference call or pre-recorded training on Power Point. Every member of the pharmacy team from each store won a VISA gift card. The amount on the card was determined by which store delivered the most surveys by June 10, 2016. Specifically:

1st place Atlantic Apothecary: all members of pharmacy staff won \$100

2nd place Cape Pharmacy: all members of pharmacy staff won \$75

3rd place Bayard Pharmacy: all members of pharmacy staff won \$50

Law Enforcement. Two of Deterra's largest customers and supporters are the Hennepin County Sheriff's Office and the Eden Prairie Police. Both organizations agreed to pass out User Surveys along with Deterra packets.

The Eden Prairie Police distributes Deterra pouches to people who come into the station seeking a place to dispose of their unused medications. They distribute surveys with the packets from their reception desk in their front entry.

The Hennepin County Sheriff office distributes Deterra pouches to people who attend their Town Hall meetings across Hennepin County.

Various. It seemed likely that we would come across more people who wanted to take the survey, so we created the 6th grouping of User Surveys, DSU6, or Various. We distributed 65 surveys to a variety of people, including pharmacists who were unable to distribute surveys at their place of business, members of the 3M First Response Team, and other interested parties.

Conclusions

1. Providers are generally enthusiastic about the Deterra System.
2. Similar to consumers, providers show the greatest concern for the environment, though a significantly higher percentage of them also cite concern for abuse/diversion and/or accidental poisoning.
3. When targeting new markets, it may be wise to understand the opportunities providers have for offering the Deterra System and the potential frequency. Specifically, how many touch points are there with consumers?

Technical Objective 3:

Summary Report Providing Effectiveness Results From Analysis Of A Range Of 20 Different Psychoactive Compounds

The effectiveness of the activated carbon system was tested for individual drugs according to a protocol to determine the degree of drug deactivation over a 28 day period. Intermittent samples were taken to plot the deactivation curves.

At the end of the 28 day period the carbon mixture was subjected to a washout procedure to determine the extent of leaching of drug from carbon by water, or ethanol. The Protocol procedures are shown below:

Deactivation & Desorption Protocol

Rate and Extent of Adsorption

- Placed 10 tablets, 10 suboxone sublingual films, 2 patches or 1 vial of liquid in disposal pouches
- Added 50 grams warm tap water ($110^{\circ} \pm 10^{\circ}\text{F}$) to pouches containing tabs/films/patches. For liquid medications, brought final volume to 50 ml with warm tap water
- Following addition of water waited 30 seconds then seal pouches
- Pouches were shaken 5 seconds at rate of 1 shake per second
- Ensured medications were at bottom of pouches
- Stored upright, undisturbed at room temperature until tested
- Tested duplicate pouches at 8 hours, days 1, 2, 4, 7, 14, 21, 28

Washout (desorption)

- Used 28 day pouches
- Transferred pouch contents to 500 ml bottles
- Added 200 ml water (this water may be used to wash and transfer pouch contents to bottle)
- Rocked for 1 hour (~30 cycles per minute)
- Analyzed samples after an additional 23 hours exposure (total 24 hours)
- Replaced water with 250 ml of 30% (v/v) ethanol
- Rocked for 1 hour (~30 cycles per minute)
- Analyzed samples after an additional 23 hours exposure (total 24 hours)

Note on Results:

Verde and Mercer University independently evaluated the efficacy of the activated carbon system in drug deactivation, however Verde used UV/Vis determinations, while Mercer used specific validated HPLC assays for each active pharmaceutical ingredient (API). Both analytical methods showed a high degree of concurrence. The HPLC data is considered definitive, and is presented in this report. The Verde data will be made available on request. HPLC validation data are provided in Appendix A. Individual HPLC deactivation files are provided in Appendix B. A summary table of Verde UV/Vis results is provided in Appendix C.

Summary Data:

**HPLC Results For Drug Deactivation
Over A 28 Day Period.**

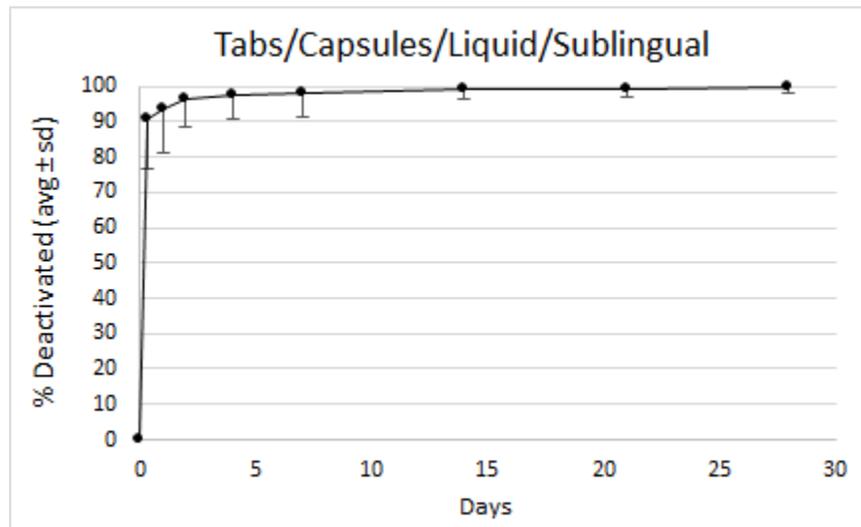
	Deactivation, Day									Desorption	
	0	0.33	1	2	4	7	14	21	28	Aqueous	EtOH
Alprazolom	0	100	100	100	100	100	100	100	100	0.0	0.0
Buprenorphine	0	96.9	96.0	99.1	99.8	99.9	100	100	100	0.0	0.1
Dextroamphetamine	0	99.9	100	100	100	100	100	100	100	0.0	9.4
Diazepam	0	46.3	50.8	72.1	73.4	74.2	90.0	94.9	99.3	1.0	1.6
Fentanyl	0	61.5	100	100	100	100	100	100	100	0.0	0.0
Fluoxetine	0	88.4	89.7	91.5	89.7	91.5	95.3	91.0	94.4	0.0	0.7
Hydromorphone	0	100	100	100	100	100	100	100	100	0.0	0.5
Ketamine	0	99.7	99.9	100	100	100	100	100	100	0.0	6.5
Lorazepam	0	70.7	79.1	87.5	96.2	99.8	99.9	99.9	100	0.3	0.3
Loxapine	0	96.9	96.5	99.6	99.6	99.6	100	100	100	0.0	0.0
Meperidine	0	97.9	99.6	99.8	99.9	99.9	100	100	100	0.0	1.4
Methadone	0	97.1	97.2	98.3	99.8	99.9	100	100	100	0.2	0.3
Methylphenidate	0	99.9	100	100	100	100	100	100	100	0.0	1.0
Morphine	0	99.8	99.9	100	100	100	100	100	100	0.0	1.6
Oxycodone*	0	84.3	85.0	86.7	92.1	97.5	100	100	100	0.1	1.6
OxyContin®	0	79.6	96.8	98.9	100	100	100	100	100	0.0	0.2
Quetiapine	0	82.9	84.0	86.4	94.4	97.5	99.9	99.3	99.6	0.0	1.2
Temazepam	0	98.5	98.5	98.5	98.7	98.8	98.6	98.9	99.3	0.0	0.0
Tramadol	0	96.3	99.0	100	100	100	100	100	100	0.0	4.8
Zolpidem	0	85.2	93.7	99.8	100	100	100	100	100	0.0	0.2
Average	0.0	89.1	93.3	95.9	97.2	97.9	99.2	99.2	99.6	0.1	1.6
SD	0	14.9	11.8	7.4	6.3	5.9	2.4	2.2	1.3	0.2	2.5

*Coformulated with acetaminophen.

Deactivation data are expressed as percent deactivated.

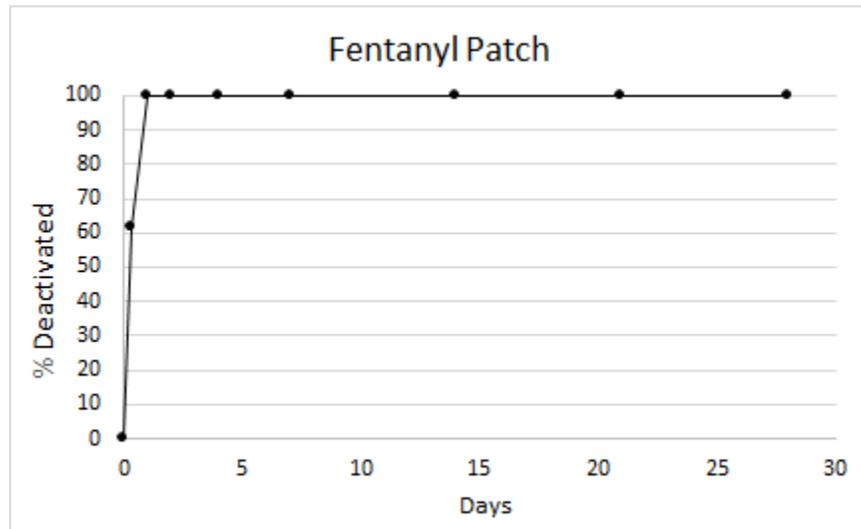
Washout (desorption) values are expressed as % recovered.

The Figure below illustrates the above data.



Fentanyl Patches were considered a special case, because the patches remained highly adhesive, and required careful handling in order to prevent the patch from sticking to the side of the pouch, or to itself, potentially affecting the deactivation process. The adhesive surface of the patch was covered with a KimWipe tissue, which adhered to the surface and allowed the free transfer of water.

Deactivation of fentanyl occurred rapidly upon release from transdermal patches:



Desorption Studies showed that water was ineffective in leaching out more than trace amounts of the API's tested.

With 30 % ethanol extraction, on average only 1.6% of the API's were recovered, however there were several agents where up to 9% of the starting dose could be recovered by this process. Considering the cost of ethanol and the time and equipment required, this method appears to be impractical for drug recovery procedures, particularly for unknown and potentially comingled drug contents.

Conclusions:

The activated carbon was highly effective in adsorbing all of the drugs tested. Data showed that an average of 89% of pharmaceuticals were adsorbed by activated carbon within the first 8 hours, and only trace amounts could be detected at 28 days.

Activated carbon was highly effective for all formulations tested, including the fentanyl transdermal patch.

Activated carbon was highly effective in deactivating all chemical classes of drugs tested over the test period. The mean deactivation of all products tested was 99.6% at day 28.

The rate of drug inactivation was relatively independent of the chemical compositions tested. Although some formulations such as liquids and sublingual dosage forms were inactivated very rapidly (>90% in 8 hours), some required several days to complete deactivation.

The adsorbed pharmaceuticals were resistant to leaching by water, with only trace amounts detectable after an extensive washout. This demonstrates the long-term effective adsorption and sequestration from the environment of the adsorbed and deactivated pharmaceutical.

The adsorbed pharmaceuticals were resistant to leaching by a washout procedure with 30% ethanol, with few exceptions. This demonstrated that the activated carbon was effective in rendering adsorbed pharmaceuticals unrecoverable by simple means.

Technical Objective 4:

Conduct Surveys to determine adverse events from the use of the product

During the reporting period several thousand pouches were distributed in the Survey, and used in deactivation studies at Verde and Mercer University, The product was also commercially available and distributed nationally.

There were no reports of product complaints and no adverse events have been reported from any source in the testing period.

Technical Objective 5:

Determine Durability Or Shelf Life Of The Product

Two studies were performed at Verde to examine stability of the product under accelerated aging conditions.

Study 1 utilized two medications examined under technical objective 3 in this contract: diazepam (10 mg tablets) and methylphenidate HCl (20 mg tablets). At each time point 10 tablets were placed in separate disposal pouches.

Study 2 utilized higher doses of over-the-counter medications in order to determine if carbon capacity diminishes over time. At each time point six tablets of acetaminophen (500 mg) or 16 tablets of naproxen (220 mg) were placed in separate disposal pouches. This resulted in a total dose of 3.5 grams API per pouch.

Accelerated Stability Protocol

- Pouches were stored at room temperature, 40°C and 50°C
- At each time point tablets were added to pouches (duplicate pouches for each medication and each temperature condition)

- 50 grams warm tap water (110° ± 10°F) was added to each pouch
- After 30 seconds pouches were sealed and placed on a rocker at room temperature
- Pouches were analyzed for drug content after 1-2 weeks

Summary Data:

Diazepam

Weeks	RT	40C	50C
0	99.9	NA	NA
8	99.7	100	100
18	100	100	100
28	100	100	100
52	100	100	100
78	100	100	100

Methylphenidate

Weeks	RT	40C	50C
0	100	NA	NA
8	100	100	100
18	100	100	100
28	100	100	100
52	100	100	100
78	100	100	100

Acetaminophen

Weeks	RT	40C	50C
0	99.2	NA	NA
8	99.6	99.7	99.7
18	99.5	99.6	99.6
28	99.6	99.5	99.7
52	99.7	99.7	99.7
78	99.7	99.9	99.9

Naproxen

Weeks	RT	40C	50C
0	99.0	NA	NA
8	100	100	99
18	99.5	99.3	99.5
28	100	100	100
52	99.4	99.3	99.5
78	99.4	99.4	99.3

Data are expressed as % deactivated

Conclusions:

Data predict a stable shelf life in excess of 10 years under room temperature condition with no deterioration in carbon capacity.

Technical Objective 6:

Development of ancillary materials to support adoption and consistent use.

Based on Survey results, product information and pouch labeling are being reviewed for revision for increased clarity of instruction. Website and product information will also be updated online.

Publications

Y. Song, M. Manian , W. Fowler, A. Korey , and A. K. Banga, Activated Carbon Based System for Disposal of Psychoactive Medications, submitted.

X. Gao, P. Bakshi, S. Ganti, M. Manian, W. Fowler, A. Korey , and A. K. Banga, Evaluation of a unique activated carbon based deactivation system for the disposal of highly abused opioids medications, manuscript in preparation

S. Ganti, X. Gao, W. Fowler, A. Korey , and A. K. Banga, Deactivation and disposal of immediate and extended release oxycodone oral dosage forms, manuscript in preparation

B. Bozorg, W. Fowler, A. Korey , and A. K. Banga, Deactivation of model CNS depressant medications using an activated carbon disposal system, manuscript in preparation.

Y. Kim, P. Bakshi, B. Bozorg, W. Fowler, A. Korey , and A. K. Banga, Activated carbon based disposal of model CNS active drugs, manuscript in preparation.

P. Bakshi, W. Fowler, . Korey , and A. K. Banga, Deactivation of fentanyl transdermal patches using activated carbon, manuscript in preparation.

P. Bakshi, W. Fowler, A. Korey , and A. K. Banga, Determination of loxapine and methylphenidate by reverse phase high performance liquid chromatography and their deactivation by activated carbon, manuscript in preparation.