Surface Decontamination Options for Indoor Materials Contaminated with Fentanyl

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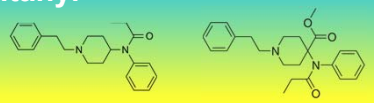


Background

Over the last several decades, as the prevalence of chronic pain and health care costs have risen, an opioid epidemic – including prescription pain relievers, heroin, and synthetic opioids, like fentanyl - has escalated, leaving adverse impacts on our communities. Fentanyl abuse, a drug 100 times more potent than morphine, and 50 times more potent than heroin, has led to a national crisis that affects public health, social, and economic welfare.

Pharmaceutical fentanyl is approved for treating severe pain, but most recent cases of fentanyl-related overdoses and deaths, according to the Department of Justice, are linked to illegally-made fentanyl. Often, it is mixed with cocaine or heroin and sold illegally. Overdoses of illicitly-produced fentanyl, and its significantly more potent analogs, have skyrocketed recently. Due to the low dose lethality and high risk exposure pathways – inhalation, ingestion, or absorption through skin – fentanyl presents a unique challenge for law enforcement and first responders who can easily become exposed, leading to serious negative health impacts, including death. If not properly cleaned up, exposure to minute residual quantities by anyone coming in contact with the drug would lead to serious health effects, especially young children.

EPA's Office of Research and Development (ORD) provided research to support the EPA Voluntary Guidelines for Methamphetamine Laboratory Clean Up originally published in 2007 and revised in 2013. EPA ORD National Homeland Security Research Center (NHSRC) is well versed in decontamination of hard to remediate contaminants including biological (anthrax spores), chemical, radiological, and nuclear. Fentanyl is different from a "regular" chemical perspective, though, because of the dust component during processing and because such a small amount can prove fatal – it is extremely important that it is cleaned up properly.

Lethal doses of heroin (left, 30 mg) and fentanyl (right, 3 mg) By New Hampshire State Police Forensic Lab/Public domain

Illicit fentanyl production in a residence Photo courtesy of Mayken Hazmat Solutions/ Restoration & Remediation, Canada

EPA researchers have provided technical support on several recent fentanyl responses, and have worked closely with EPA's emergency responders to draft the Fentanyl Fact Sheet for U.S. EPA Federal OSCs, not as official policy, but to share best known science and practices to guide responders. However, the Fact Sheet acknowledges that we have little practical information about how to clean up fentanyl.

Today, EPA's Homeland Security researchers, recognizing the gap in the clean-up science and the need for thorough guidelines, are developing remediation approaches for fentanyl. Current literature on remediation for fentanyl is presently limited to placing the fentanyl directly in a solution of the decontaminant to determine its effectiveness. This testing assesses the ability of the solution to neutralize the opioid under ideal conditions, but it does not indicate the solution's effectiveness when used in the field, or its ability to decontaminate an illicit lab.

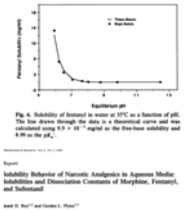
EPA Homeland Security researchers focus on developing widely accessible clean-up methods, often repurposing household or common hardware store materials, to have effective and readily available clean-up options without the need to stockpile specialized equipment or chemicals.

What do we know about building remediation options?

In the beginning....
... there is/was the fundamental fentanyl chemistry paper by Qi. et al. (2011)

- Contains valuable information on degradation chemistries of fentanyl in aqueous solutions of peroxides and hypochlorites
- Common decontamination chemistries can be derived from this study

Limitations of Qi et al. study:
- It is a wet-chemistry bench scale study
- Fentanyl is already in a methanol solution before it interacts with the oxidants
- Study does not consider that fentanyl is most likely present as a solid particulate which may not enter into an aqueous solution as suggested by Roy and Flynn (1989):



- Operational context should be addressed before recommending decontaminants for use in the field

Known research related to fentanyl remediation:
- ECBC screening of decontaminants (2017)
- Lab studies associated with vendor sponsored research
  - Dahlgren Decon (presentation at conference)
  - Decon7
- TSWG Decontamination study with Australian Government
  - Focus on PPE decontamination
- DEA
  - Unpublished results
- Bowling Green State study
  - Use of OxyClean as percarbonate example
- Others?

Complicating factors:
- Fentanyl can be found in various forms
  - Fentanyl-HCl
  - Fentanyl-citrate
  - Fentanyl as a free base

EPA Fentanyl Decontamination Research

EPA decontamination research (in progress; no data yet):

- Initial screening of commercially available decontaminants for fentanyl-HCl salt [with main active ingredient noted]
  - Bleach [hypochlorite]
  - pH amended bleach [hypochlorite; neutral pH]
  - Dahlgren Decon [peracetic acid]
  - OxiClean [percarbonate]
  - EasyDecon DF200 [hydrogen peroxide]
  - MaxBlue [trichloro-s-triazinetrione]
  - Detergent/water [physical removal only]
- Various indoor building materials [two rounds]
  - Glass (reference material)
  - Acrylic
  - Laminate
  - Painted Drywall
  - Stainless Steel (reference material)
- Start with fentanyl-HCl salt as one of most common encountered fentanyl forms
- Further optimization of successful decontaminants using fentanyl powder on 12" x 12' surfaces (various indoor materials)
  - Includes verification of physical removal component of a decontamination application

Other EPA Fentanyl Research planned/initiated

- Continuation of initial decontamination effort described above [pending funding]
- Development of sampling and analytical methods for fentanyl and relevant analogs
  - Stuart Willison (PI)
- Risk assessment / clearance goal development
  - John Lipscomb (PI)
- Connecting EPA research to support first responders (law enforcement, etc)
  - Matthew Magnuson (PI)

EPA/ORD/NHSRC will study the ability of neutralizing solutions, as well as other types of decontamination technologies, to clean up fentanyl on different types of surfaces (porous and non-porous) in realistic settings so we will be able to make clean-up recommendations and offer solutions to first responders across the country dealing with this national opioid crisis.