

# Research to Inform Decontamination Strategies for Fentanyl-Contaminated Sites

Lukas Oudejans<sup>1</sup>, Matthew Magnuson<sup>1</sup>, James Justice<sup>2</sup>, and Lawrence Kaelin<sup>3</sup>

<sup>1</sup> Center for Environmental Solutions and Emergency Response (CESER), Office of Research and Development;

<sup>2</sup> EPA Region 5; <sup>3</sup> Consequence Management Advisory Division (CMAD), Office of Emergency Management.

Lukas Oudejans | [oudejans.lukas@epa.gov](mailto:oudejans.lukas@epa.gov) | 919-541-2973

## Background

Over the last several decades an opioid epidemic – including prescription pain relievers, heroin, and synthetic opioids - like fentanyl - has escalated, leaving devastating impacts on communities across the country. The COVID-19 pandemic did not end the opioid crisis. In fact, it only got worse.

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 or imported fentanyl. Often, it is mixed with cocaine or heroin and sold illicitly. Overdoses of such 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 could lead to serious health effects, especially young children.

US EPA is continuously receiving requests for technical support in cleaning fentanyl/opioid contaminated sites (warehouses, prisons, homes, apartments, etc.).

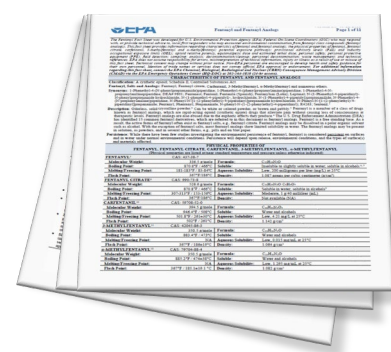
## Available Information

**EPA Voluntary Guidelines for Methamphetamine and Fentanyl Laboratory Cleanup** originally published in 2007, revised in 2013, now includes fentanyl (2021).



<https://www.epa.gov/emergency-response/voluntary-guidelines-methamphetamine-and-fentanyl-laboratory-cleanup>

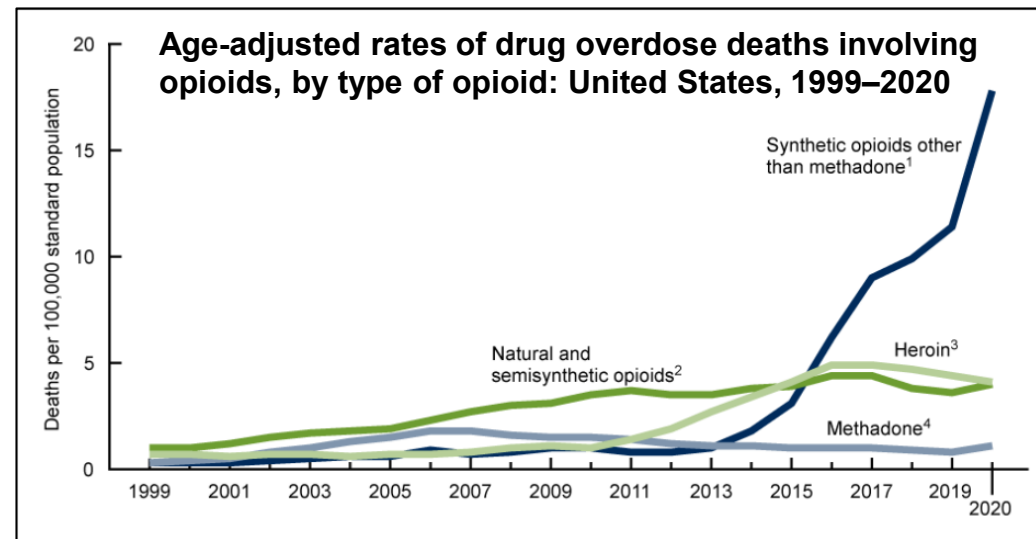
**2018 Fentanyl Fact Sheet** for U.S. EPA Federal OSCs



<https://www.epa.gov/emergency-response/fact-sheet-fentanyl-and-fentanyl-analogs>

## Fentanyl Decontamination Research Gaps/Needs

- **Lack of information on effective remediation approaches**
- Recognition that physical removal of fentanyl (powder) is very labor intensive and creates fentanyl contaminated waste that needs to be managed according to local/state guidance
- Information on chemical *in situ* degradation of fentanyl was limited to one fundamental (wet chemistry) research publication (Qi *et al.* 2011)
- Expect significant differences between wet chemistry degradation results and surface efficacy
- Identification of decontamination technologies that are effective in degrading fentanyl (analogs)



Hedegaard H, Miniño AM, Warner M. *Drug overdose deaths in the United States, 1999–2019*. NCHS Data Brief, no 394. Hyattsville, MD: National Center for Health Statistics. 2020



## Decontamination Situations

Cleanup approach depends on intended purpose:

1. Decontamination of **skin** <https://www.cdc.gov/niosh/topics/fentanyl/risk.html>
  - Wash hands with soap and water after working in an area that may be contaminated, even if gloves were worn.
  - Do not use hand sanitizer;
  - Do not use bleach on skin.
2. Decontamination of **PPE/Gear**
  - Soap and water can physically remove fentanyl
  - Chemical *in situ* degradation would need to be fast (few minutes)
3. Decontamination of **interior materials/surfaces/structure**
  - Dwell time of decontaminant with surface can be longer (hours)



## Surface Decontamination Strategies

Main approaches for surface decontamination:

- **Physical Removal**
  - Water with a household cleaner/detergent
    - Works reasonably well for nonporous smooth hard surfaces
    - Does NOT degrade fentanyl; waste will contain fentanyl
  - HEPA vacuuming of surfaces
- **Chemical Degradation**
  - Chlorine [bleach] or peroxyacetic acid-based decontaminants are effective in degrading fentanyl
- **Hybrid of Physical Removal and Chemical Degradation**
  - Spray application of efficacious decontamination solution followed by wipe removal of solution on surfaces

## EPA Fentanyl Decontamination Research

Decontamination of building materials contaminated with fentanyl salt powder at the bench-scale, yet using realistic scenario/conditions

- ❑ Various decontaminants / active ingredients
- ❑ Representative decon solution amounts
- ❑ Relevant building materials
- ❑ Impact of benign additives on efficacy



Spray application setup – EPA/Battelle



Dahlgren Decon  
Peracetic acid



EasyDecon DF200  
Hydrogen peroxide



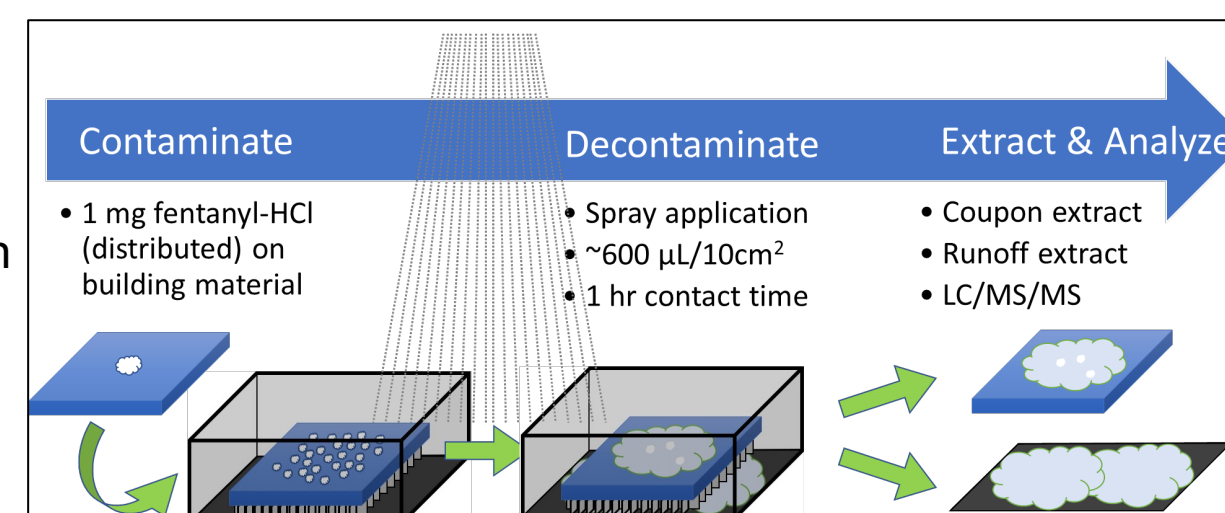
OxiClean  
Percarbonate



Bleach  
Hypochlorite

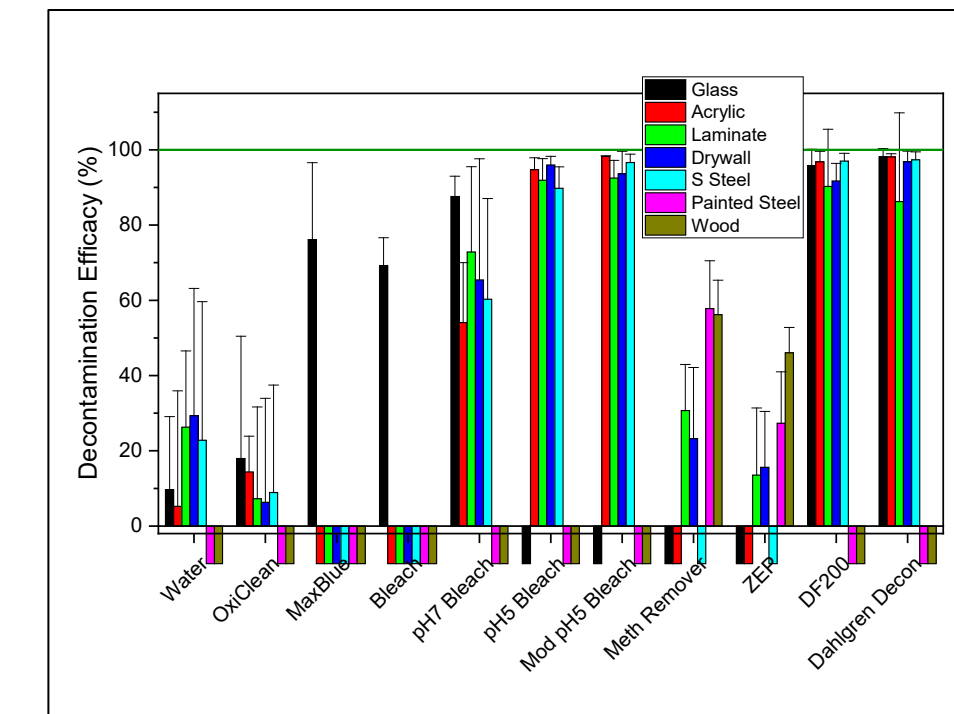


MaxBlue  
Trichlor



## Fentanyl Decontamination Efficacy Results

**Building Material**  
(1 hr contact time)

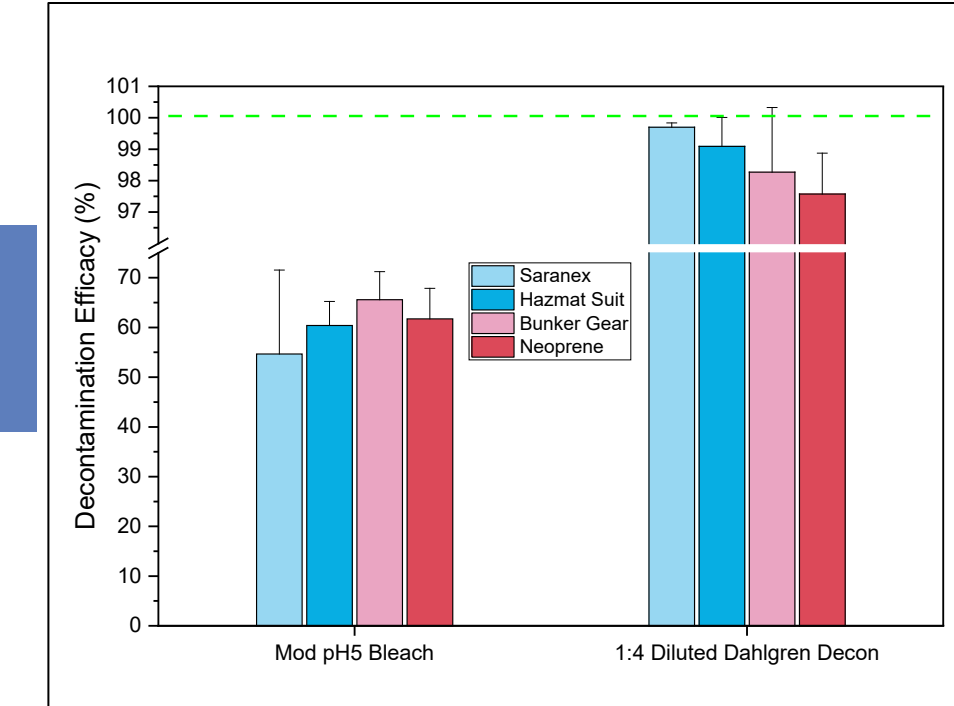


**Least Efficacious**

Water  
OxiClean  
Meth Remover  
ZEP  
MaxBlue  
pH 12 Bleach  
pH 7 Bleach  
pH 5 Bleach  
EasyDecon DF200  
Dahlgren Decon

**Most Efficacious**

**PPE/Gear**  
(5 min contact time)



**5-min contact time:**

- Approximately 60% reduction of fentanyl on surfaces using pH 5 bleach with surfactant ("Mod pH5 Bleach")
- Higher than 98% efficacy when using diluted (1:4) Dahlgren Decon

## Decontamination Risks / Implementation

Any of the cleanup approaches should consider use of proper PPE

(<https://www.cdc.gov/niosh/topics/fentanyl/risk.html>):

- Always wear nitrile gloves when illicit drugs may be present and change them properly.
- Wear respiratory protection if powdered illicit drugs are visible or suspected.
- Avoid performing tasks or operations that may cause illicit drugs to become airborne.
- Do not touch the eyes, nose, or mouth after touching any surface that may be contaminated.
- Take training on and follow NIOSH's recommended Standard Safe Operation Procedures.

## ORD/CESER Fentanyl Decontamination Publications

- **Decontamination options for indoor surfaces contaminated with realistic fentanyl preparations**  
Lukas Oudejans et al., Journal of Environmental Management 2021 Nov 1; 297: 113327
- **Remediation Options for Fentanyl Contaminated Indoor Environments**  
Lukas Oudejans, U.S. EPA Report, Washington, DC, EPA/600/R-21/105, 2021.
- **Research to Inform Decontamination Strategies, Methods, and Related Technical Challenges for Remediation of a Fentanyl-Contaminated Site**  
U.S. EPA Technical Summary, Washington, DC, EPA/600/S-22/154, 2022.

## Planned Opioid/Fentanyl Decontamination Research

- Volumetric decontamination options for indoor surfaces contaminated with fentanyl
- Decontamination efficacy studies for (more toxic) fentanyl analogs such as carfentanyl
- PPE decontamination at the pilot-scale [John Archer, CESER/HSMMD PI; [archer.john@epa.gov](mailto:archer.john@epa.gov)]

**EPA evaluates methods and technologies to clean-up fentanyl on indoor surfaces in realistic settings. These studies have led to clean-up recommendations and offer solutions to first responders across the country dealing with this national opioid crisis.**