



The Assessment and Cleanup of an Opioid Contaminated Site and Establishment of California's Standards

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USEPA - Voluntary Guidelines for Methamphetamine and Fentanyl Laboratory Cleanup (REVISED EDITION AUGUST 2021)



“...Properties may be contaminated by hazardous chemicals used or produced in the manufacture or packaging of fentanyl where those chemicals remain and where the contamination has not been remediated.”

The Current Situation and Problems...

- Residual opioid contamination can be left behind following law enforcement and first responder activities.
- Elevated contaminant residues have the potential to be harmful where potentially “lethal dose” levels are found on surfaces that remain (as seen within our case study).
- Awareness of such potential contamination is important and the assessment and decontamination of sites contaminated with opioids and other illicit drug residues is warranted.



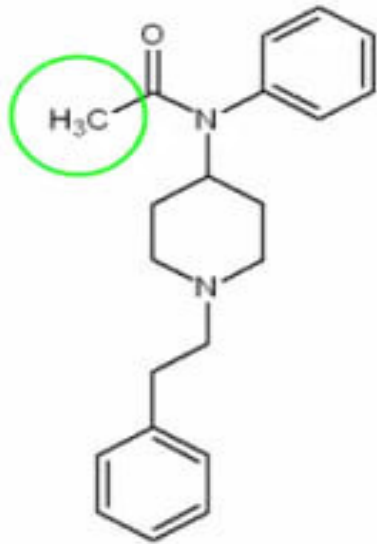
This is a lethal dose of Fentanyl (only 2 – 3 milligrams)



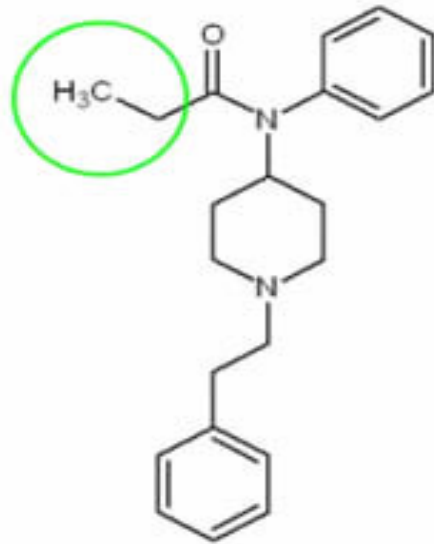
Relative lethal doses of Heroin (50 mg), Fentanyl (2-3 mg), and Carfentanil (0.02 milligrams = 20 ug)



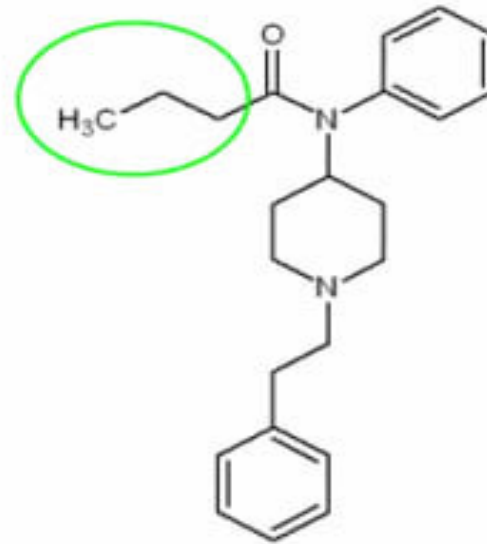
Fentanyl analogs.... (similar structures)



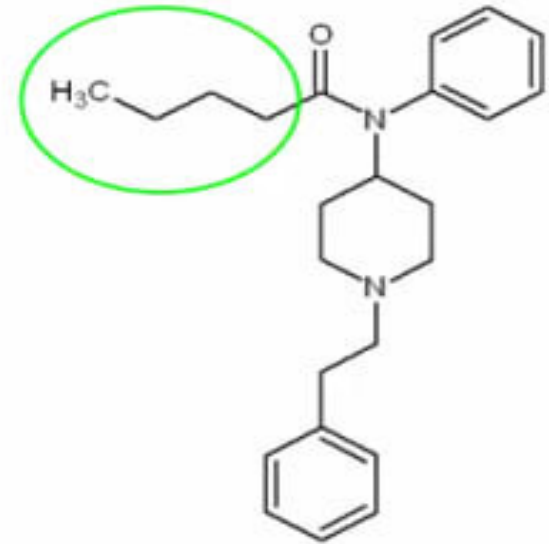
Acetyl fentanyl



Fentanyl



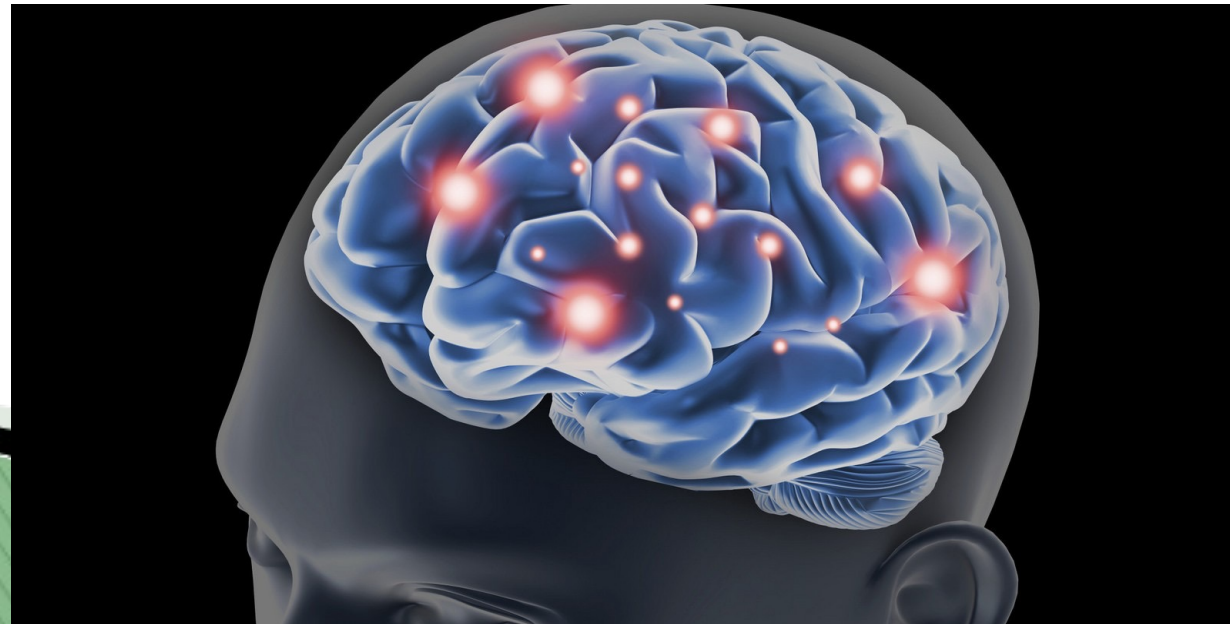
Butyryl fentanyl



Valeryl fentanyl
(Pentanoyl fentanyl)

How Fentanyl affects the brain...

- Like heroin, morphine, and other opiate drugs, fentanyl works by binding to the body's opioid receptors in the brain that control pain, pleasure, and emotions.
- Drives up levels of dopamine in the brain's "reward" centers and produces feelings of euphoria and relaxation



Fentanyl at Higher Doses...

- The high potency increases the risk of overdose (especially if user is unaware)
- Opioid receptors in brain also control breathing rate
- At higher levels... drowsiness, nausea, confusion, respiratory depression, respiratory arrest, unconsciousness, coma, and death!
- “Impairment” dose levels are important and are much lower



About Fentanyl...

- Fentanyl was originally synthesized by Paul Janssen in 1959 and was introduced in 1960 as an analog to pethidine (aka Demerol) ...*which killed Michael Jackson*
- Brand names include Actiq, Duragesic, Subsys, and Sublimaze
- Fast acting (in about 5 minutes) depending on route (oral, inhalation, injection or transdermal patch)
- Wears off quickly (lasting only about an hour)
- Although widely prescribed, however fentanyl was never intended for treating chronic pain.



Fentanyl's "Legal" Uses...

When prescribed by a physician (to treat acute pain), fentanyl is often administered by:

- Injection and/or IV drip
- Oral pill or capsule
- Dermal with transdermal patch
- Sublingual – Lozenge
(US Army - Sufentanyl)

WMD considerations...

2002 Moscow Theater Incident...



(40 insurgents and 200+ hostages were killed out of 700). *Carfentanil and Remifentanyl*

Fentanyl Bought and Sold on the Street...

- Fentanyl is typically pre-synthesized and “cut” into heroin, cocaine, and methamphetamine to increase potency, ...and lethality!
- Added into illicit “fake” pills like Percocet, Oxycontin, Xanax, in pill presses ...*making the drugs easy to hide/disguise*
- The inclusion (and high potency) of fentanyl greatly increases risk of overdose
- Varying doses of fentanyl within “fake” pills
- Fentanyl can be injected, snorted, swallowed, absorbed through mucous membrane (blotter paper), and free-based



Illicit Uses and Habits are Changing...

2021 study on fentanyl use in the SF Bay Area found drug users were switching from injecting tar heroin to smoking fentanyl, citing benefits such as lower cost and less social stigma by reducing visible “track marks” from injections.



The Perfect Storm...

- Over Prescription and Use (>85 % of world's opioids are used in the US)
- Addiction and Abuse (“dependency” versus “recreational” use)
...Creating an Economic Need/Demand
- Illegal Activities and Importation Occur to Supply the “Demand”



Fentanyl Overdose...

- Research shows that the potency of fentanyl is more likely to trigger an overdose than other opioids.
- While a heroin overdose can progress to cardiac arrest in 30 minutes, with fentanyl it can happen in a few minutes.



Sobering Facts...

More people have died of synthetic-opioid overdoses than the number of U.S. military personnel killed during the Vietnam, Iraq and Afghanistan wars combined.

Fentanyl is now the [leading cause of death for Americans ages 18 to 49](#), according to a Washington Post analysis of death data since 2021 from the Centers for Disease Control and Prevention (CDC).



Famous People Who Have Died from Overdose:

- Hank Williams 1953 morphine
- Jimmy Hendrix 1970 barbiturate
- Janis Joplin 1970 heroin
- Jim Morrison 1971 heroin/cocaine
- Elvis Presley 1977 codeine
- John Belushi 1982– heroine and cocaine “speedball” 1982
- Heath Ledger 2008 – opioids (oxycontin, Vicodin, Xanax, and valium)
- Michael Jackson 2009 - Demerol
- Paul Gray (bassist for Slipknot 2010 morphine and fentanyl)
- Prince – 2016 fentanyl
- Tom Petty 2017 fentanyl
- Rapper Mac Miller 2018 fentanyl, cocaine, and ethanol
- 2021 Comedians Fuquan "Fu" Johnson and Enrico Colangeli as well as actors Logan and Michael Williams
- Actor Matthew Perry Ketamine 2023



The Opioid and Illicit Drug Trade...

In 2023, the U.S. Customs and Border Protection (CBP) seized 27,000 pounds of fentanyl... Enough fentanyl for 6,123,000,000 lethal doses!



Other Illicit Drugs Seized by CBP in 2023...

- 140,000 pounds of methamphetamine
- 1,500 pounds of heroin
- 81,000 pounds of cocaine
- 7,800 pounds of ketamine



The Source of illicit Fentanyl...

- A complex web of illicit activities...
- According to current DEA statistics... Most illicit fentanyl is manufactured in China and India which is shipped to Mexico mainly via container ships or sent through US Mail.
- Cartels re-synthesize the drug to produce powders, bricks, and “fake” pills labeled as Percocet, Oxycontin, Xanax, Adderall, etc.



Busts in the News...

- Riverside, California: 46 pounds (21 kg) of carfentanil seized. This represents ~ 1 Billion lethal doses of Carfentanil
Carfentanil (used as an elephant tranquilizer) is 100 times more lethal than fentanyl. (20 ug = lethal dose)
- San Leandro, California: 19 pounds fentanyl (8.6 Kg) seized in pill press operation ~ 4.3 million lethal doses
- Others...





Surfer 5

1 2 3 4 5 6 7 8 9 10 11 12

The DEA has launched multiple nationwide campaigns to increase awareness about the increasing prevalence of criminal drug networks mass-producing fake pills.

In 2022, DEA seized more than 59.6 million fentanyl-laced fake pills and more than 13,300 pounds of fentanyl powder. The 2022 seizures are equivalent to more than 398 million lethal doses of fentanyl.



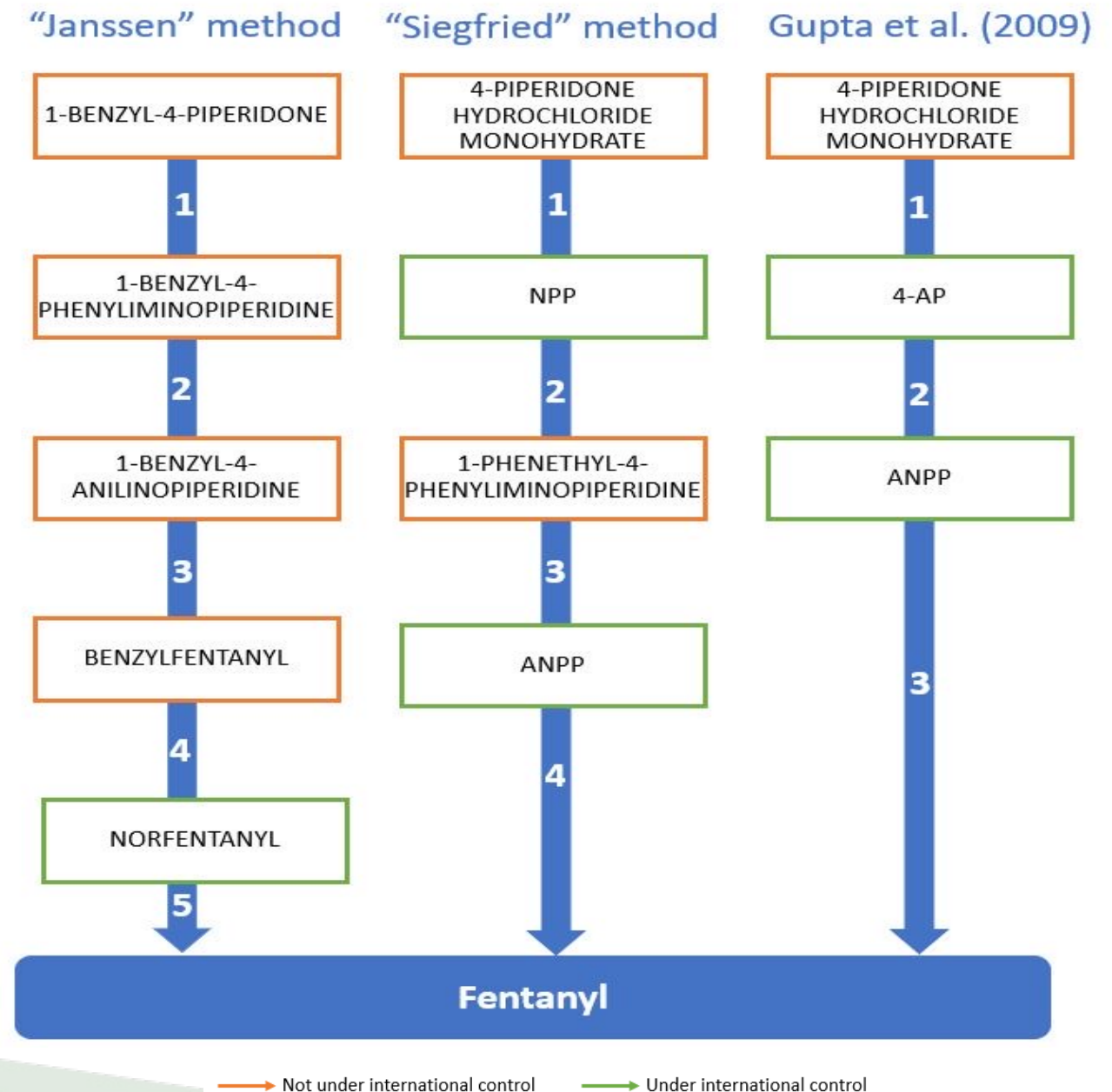
- Fentanyl doesn't require farmland, sunshine, rain or field hands and is easily synthesized or converted with few ingredients in a lab... making fentanyl a drug trafficker's dream. (*3 methods...*)
- Overdose death rates are similarly increasing exponentially year after year
- Illegal profits are staggering...



Current Methods of Synthesis...

Organic Chemistry Precursors...

- N-Phenethyl-4-piperidone (NPP)
- 4-anilino-N-phenethylpiperidine (ANPP)
- Tert-Butyl-4-piperidine-1-carboxylate (4-AP)



1 Kilogram (2.2 lbs.) of Pure Fentanyl Can Kill 500,000 People...

1 Kg “brick” of pure fentanyl (cost \$3K-\$5K) produces 1 million (1 mg) pills. Equaling 4-10 million dollars in revenue at \$4-\$10 “street value” per pill...



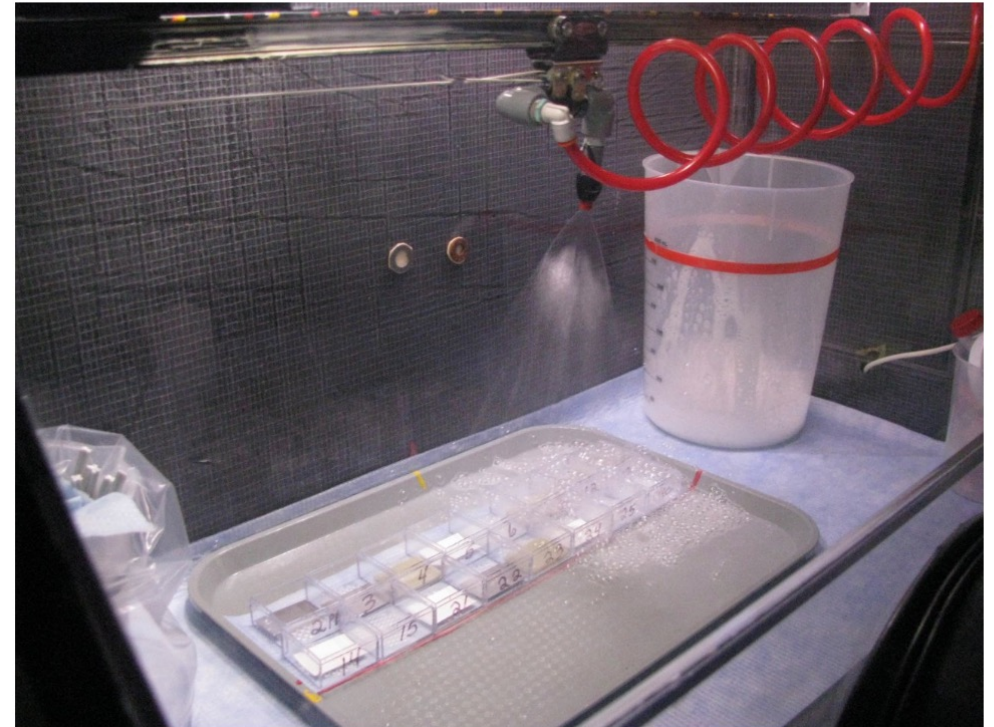


Remediation of Fentanyl Contaminated Indoor Environments

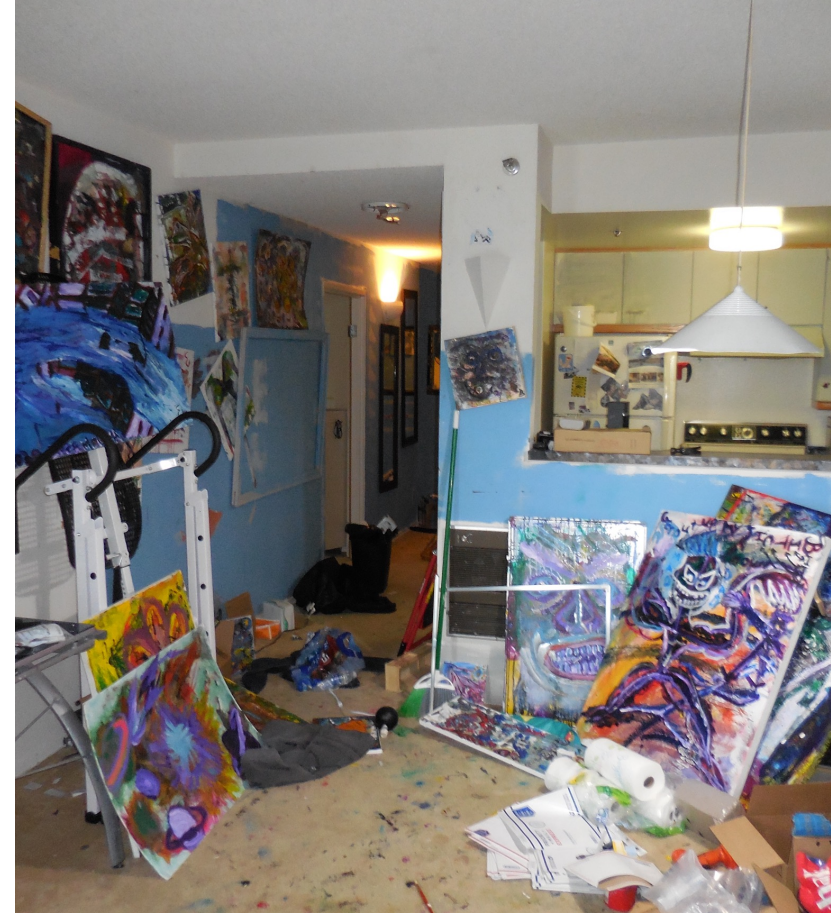
Published November 29, 2022

In March 2016, the Drug and Enforcement Administration (DEA) issued a nationwide alert about fentanyl stating that overdoses were occurring at alarming rates and represent a significant threat to public health and safety. [Recent research has shown](#) the nation's COVID19 pandemic has made the drug overdose epidemic worse. Since a small amount of fentanyl can be deadly, emergency responders, hazmat teams, and law enforcement are concerned about their potential exposure while responding to incidents at mixing houses, pill factories, or in makeshift laboratories that may be found in apartments, hotels, houses, garages, and storage facilities.

The use and production of various fentanyl-containing products can lead to extensive distribution of fentanyl within homes, vehicles, and clandestine drug laboratories. Drug-contaminated structures, homes or buildings pose a threat to human health, threaten community revitalization efforts, and pose challenges for federal, state, local, and Tribal governments and first responders. The lack of information on how to decontaminate structures and determine a safe level for re-occupancy has resulted in condemned properties, and EPA's On-Scene Coordinators (OSCs) across the country are increasingly being asked to provide technical assistance to state and local entities for fentanyl incidents.



Uncontrolled Site Conditions...



Case Study - Subject Property...

- Illegal opioid compound mixing operations discovered by law enforcement (DOJ and DEA) within an apartment
- Bulk Fentanyl and Carfentanil was mixed with other “controlled substances” for distribution and sale
- Paraphernalia associated with manufacturing, mixing, distribution, and use present on site
(Scales, tableting “pill press” machines, packaging, etc.)
- Bulk opioids purchased using “cryptocurrency” and shipped via USPS from China to apartment “community” mailbox





Regulatory Standards and Guidance...

- At the time of incident, NO formal regulatory standards or guidance in California requiring the assessment and/or cleanup of property contaminated with opioids. *(only meth standard existed in 2018)*
...Now HSC 25400.12-46 is established in California to include fentanyl
- DEA sent letter to local County Health Department informing that quantities of fentanyl and carfentanil were identified at the scene.
- County contacts BioMax to determine appropriate course of action
- County Health Department “Posts” residence as a precautionary measure and requires a Preliminary Sampling Assessment



Interim DRAFT Fentanyl Protocol...

Protocol based on recent similar opioid contamination case in San Francisco (SFDPH)

Assessment and Cleanup Protocol included...

- Posting of site to preclude access and occupancy
- CIH to perform an inspection and Site Sampling Assessment
- Development of Mitigation Work Plan created by CIH
- Contractor decontamination and cleanup of site (overseen by CIH)
- Post Mitigation "Clearance" assessment verification performed by CIH
- Clearance Criteria Goal set at ≤ 0.10 ug/100cm² for Fentanyl
and ≤ 0.010 for Carfentanil **by Dr. Charles Salocks CalEPA/OEHHA**
- Post Mitigation Clearance Report by CIH





DO NOT ENTER UNSAFE DO NOT OCCUPY

WARNING:

This structure has been seriously damaged and is unsafe. Do not enter. Entry may result in death or injury. A Building Permit will be required for all repair work.

Comments:

*Premises
enter. DO
H.*

Building Address: *1304 Whipple Ave. #103*

Date: *8/18/17* Time: *2:00 PM*
Inspector: *M. Hernandez*

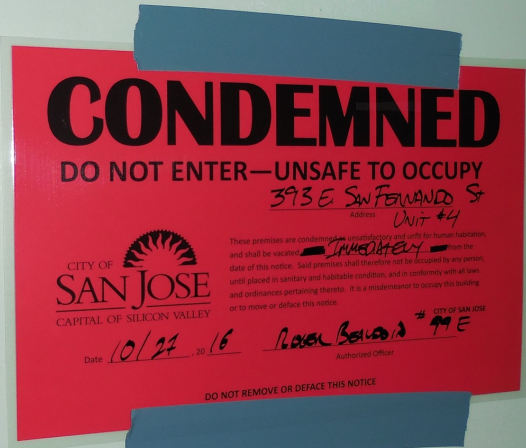
BUILDING & INSPECTION



PELIGROSO, NO
Para mas info
llamar: (650) 7

DO NOT REMOVE THIS PLACARD
FOR FURTHER INFORMATION TELEPHONE: (650) 7

Required Postings...



25th California Unified Program
Annual Training Conference
March 20-23, 2023

Preliminary Site Assessment (PSA)...

Inspection and evaluation includes surface residue sampling of representative interior surfaces and materials. (Analysis for fentanyl and carfentanil)

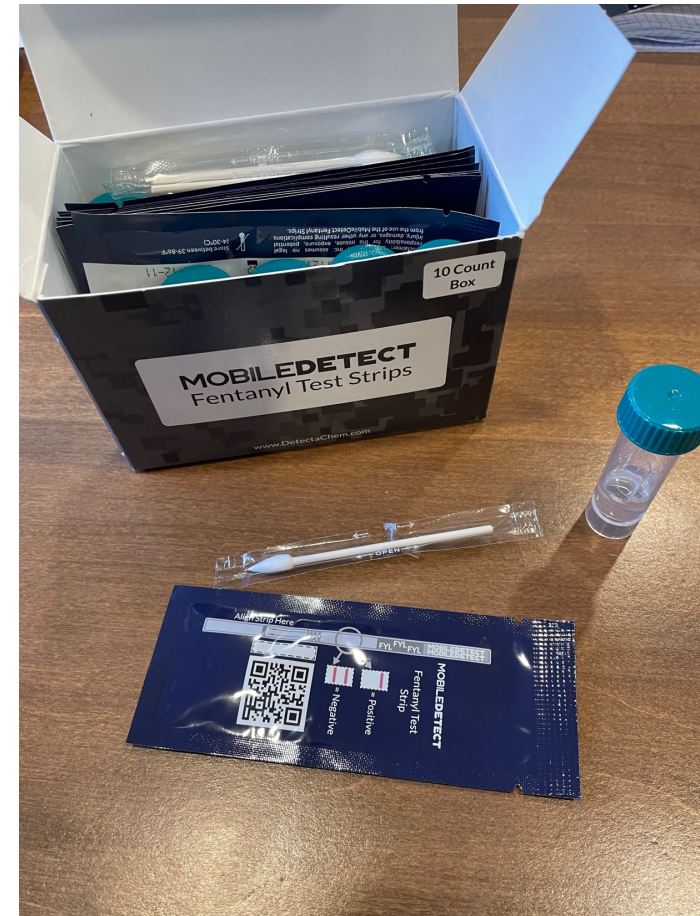


Surface Sampling Methods...

- Sterile gauze pads wetted with appx. 3 ml of analytical grade methanol and uniformly wiped over 100 cm² surface. (template)
- Detection and quantification performed by analytical laboratory.



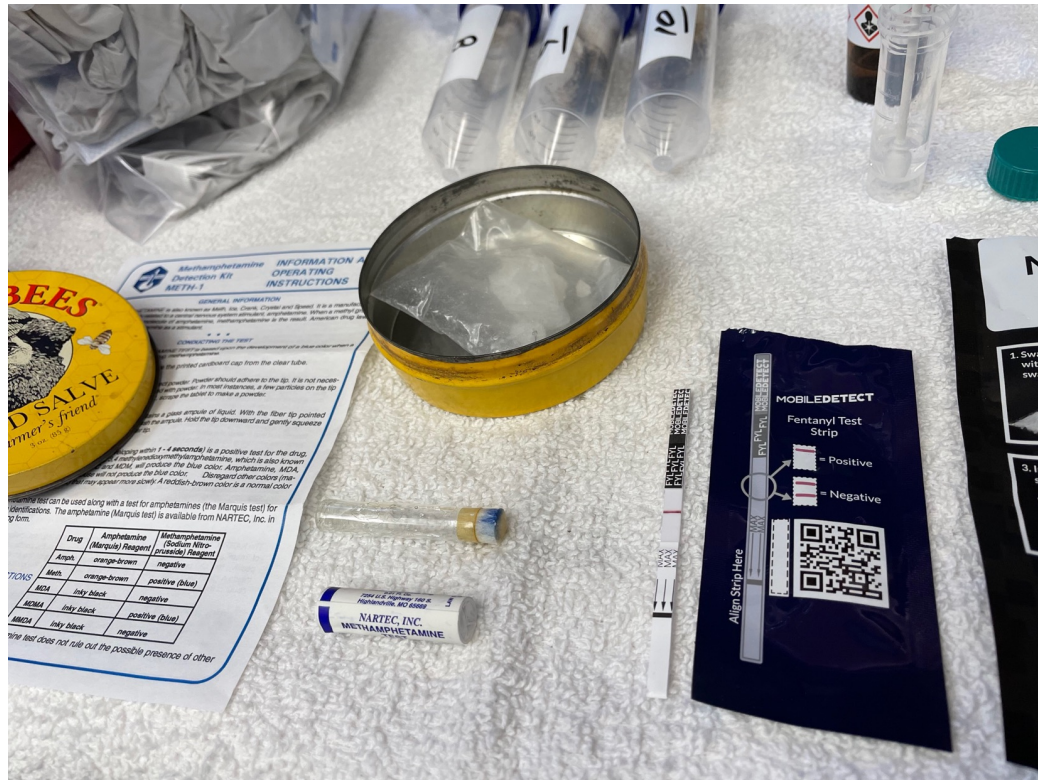
Field Test Kits Available... for detection on site



Rapid Response test kits used for preliminary (+ / -) determination of bulk and “suspect” materials of concern:



Use of Field Test kits...



Test Strip Analog Detection Sensitivity:

SPECIFICITY	
Fentanyl Analogue	Cut-off
Fentanyl	100 ng/mL
Acetyl Fentanyl	75 ng/mL
Furanyl Fentanyl	350 ng/mL
p-Fluoro Fentanyl	100 ng/mL
Ocfentanil	150 ng/mL
Valeryl Fentanyl	500 ng/mL
3-Methyl Fentanyl	350 ng/mL
Cyclopropyl Fentanyl	400 ng/mL
Butryl Fentanyl	500 ng/mL
4-Fluoroisobutyryl Fentanyl	500 ng/mL
Carfentanil	4,000 ng/mL
Remifentanil	75,000 ng/mL
Sufentanil	75,000 ng/mL

Surfaces Sampled...

to identify and quantify invisible levels of opioid residues on surfaces:

- Walls, Ceilings, Floors
- Appliances
- Countertops
- Furnishings, clothing, personal items
- HVAC systems/units (supply and return if present)
- Ceiling Fans *



Bulk Material Sampling... e.g. "carpeting"



Air Sampling at Contaminated Sites:

Relevance for assessment, cleanup workers, and future tenants (?)...

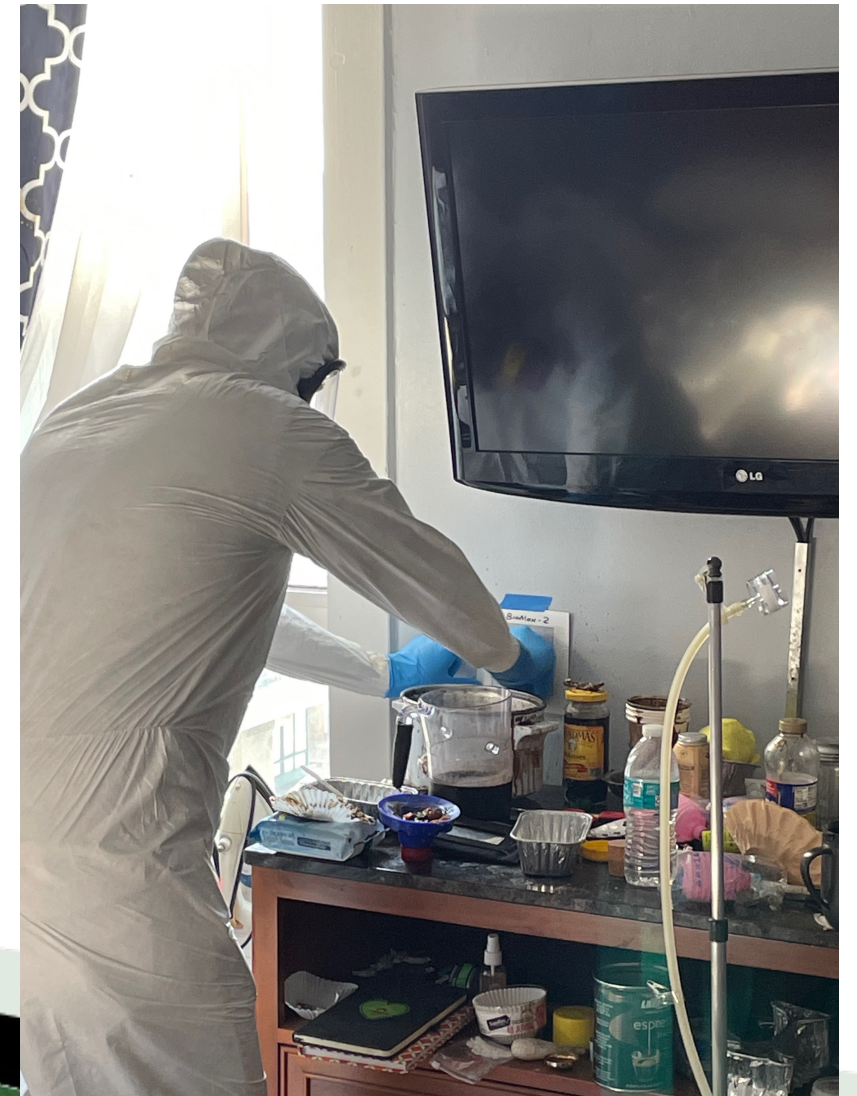
Current Standards / Guidance Levels for workers:

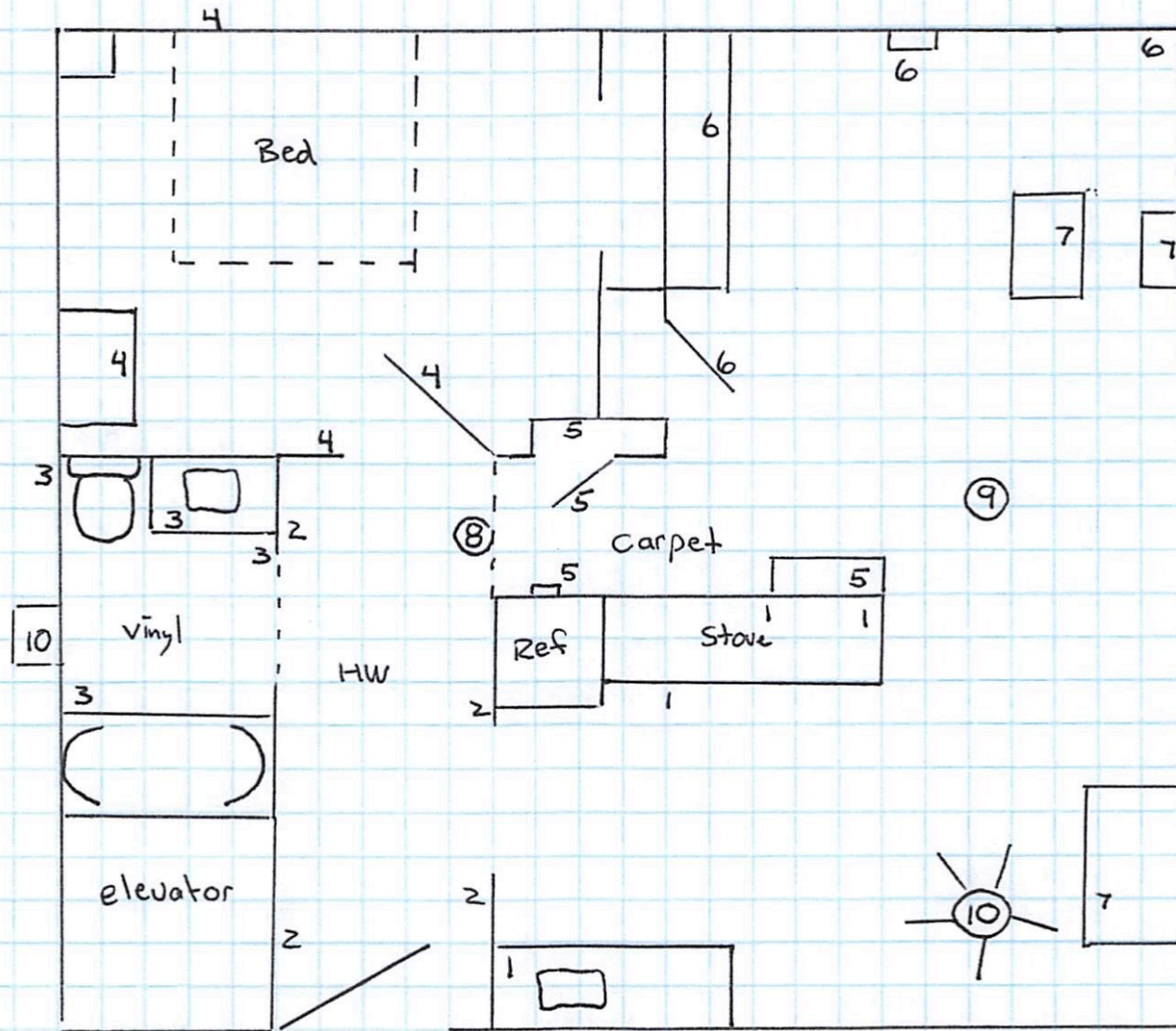
- No Current Permissible Exposure Limits (PELs)
- Pharma OELs exist... 8-hr TWA (0.1 - 0.7 ug/m³) and STEL/C (0.2 – 2.0 ug/m³)
- ACGIH TLVs (2024): Adopted Final Threshold Limit Values (TLVs)...
 - TWA-8 0.1 ug/m³
 - STEL 0.2 ug/m³
 - TLV –SL (Surface Limit). 1 ug/100cm²
- Ongoing Research within AIHA Opioid WG and Pharma



What we are finding during PSA...

- Airborne findings of detectable fentanyl ranging from 0.08 – 0.5 ug/m³...





⑪ FCB

PSA Findings (*Lethal dose of Carfentanil = 20 ug*)

Sample Number	Sample Location / Description (surface area/volume sampled)	Fentanyl (ug/sample)	Carfentanil (ug/sample)
1	Kitchen surfaces composite	< 0.010 (ND)	0.68
2	Hallway walls and floors	ND	2.7
3	Bathroom surfaces	ND	1.4
4	Bedroom surfaces	ND	10
5	Hallway to Family Room	ND	7.8
6	Family Room 1	ND	7.8
7	Family Room 2	ND	21
8	Hallway carpet bulk sample (1 x 1 inch)	ND	2.5
9	Vacuum cleaner dust/debris (1 x 1 inch)	0.11	220
10	Dining Room ceiling fan top surface	12	1,400
11	Field Method Control Blank (QA/QC)	ND	ND



BREAK TIME!



**26th California Unified Program
Annual Training Conference**
February 26-29, 2024

Cleanup and Decontamination...

The Mitigation Work Plan (MWP) is developed by CIH and cleanup performed by a 40-hour HAZWOPER certified contractor

- Careful planning, preparation, staging, and sequencing
- Aggressive procedures designed to minimize exposures from...
 - dermal contact
 - Inhalation
 - Ingestion
 - Injection and others?



Controls of Hazards...

Engineering Controls, Administrative Controls, Personal Protective Equipment (PPE):

- Negative pressure containments and “critical control barriers”
- Site-specific project hazard controls
- HAZWOPER trained personnel
- PPE... including respiratory and dermal protection
- Worker and equipment decontamination methods
- No use of Alcohol wipes.... Detergent and water only!



Narcan (Naloxone Hydrochloride): Opioid antidote may be administered by injection or by intra-nasal (nose spray)... may require multiple doses.





CIHC Conference 2022



Preliminary Mitigative Cleanup Actions...

- Establish and use negative pressure and critical containment barriers
- #1 Gross debris and furnishing removal using wet methods to reduce generation of airborne particulate hazards
- #2 Structural demolition and physical removal and disposal of all porous and semi-porous materials (including shelving, built-in cabinets, interior doors, baseboards, carpeting, appliances, etc.)
- Utilization of HEPA filtered vacuum equipment and portable air scrubbing units



Negative Pressure Barriers...



Decontamination and Treatment Methods...

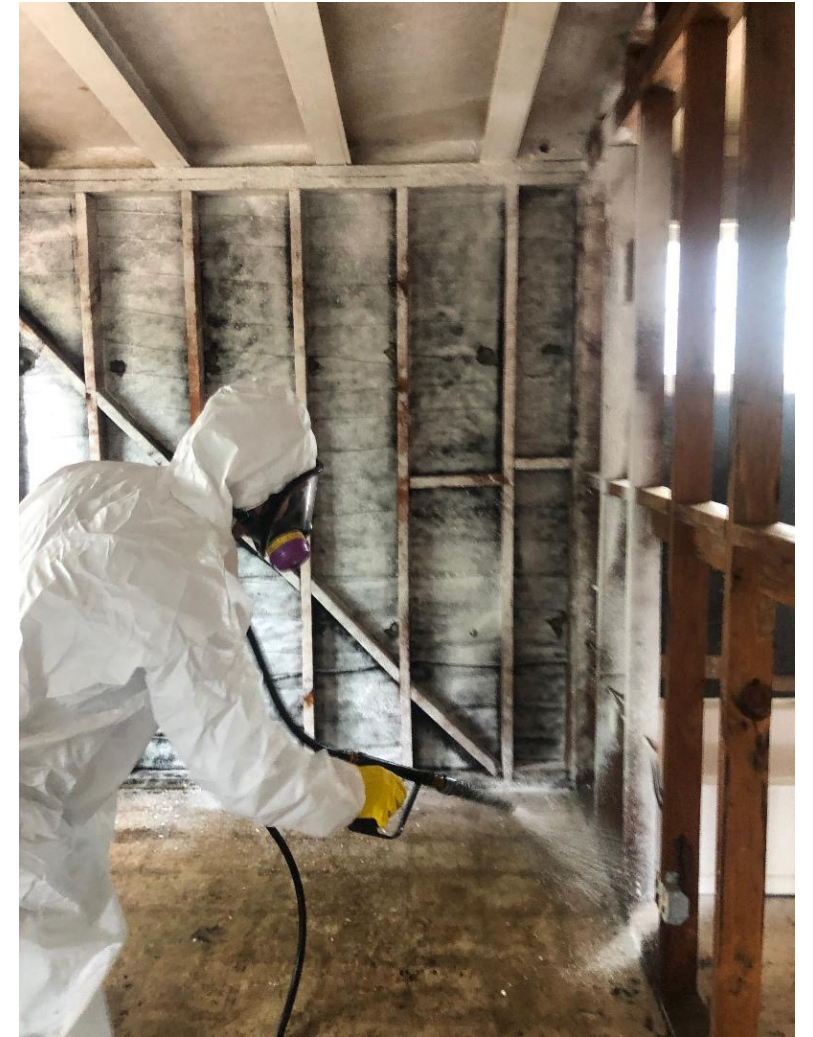
- Interior treatment spray applications using Hydrogen Peroxide (H₂O₂) and Trichloroisocyanuric acid (TCCA) based solutions onto surfaces
- Aggressive wipe (and extraction) removal methods employed using detergent solutions (Formula 409, Simple Green, etc.)



Wet methods with adequate dwell time (> 1 hour) necessary to achieve neutralization...



Foaming agents sometimes used for porous surfaces...





Ongoing Surface Decontamination Research

Dr. Lukas Oudejans (September 2021)



- Decontamination Solutions Listed in order of increasing Efficacy...
- Water
- Percarbonate (OxyClean)
- Hydrogen Peroxide (Meth Remover, ZEP)
- pH Adjusted Bleach Solutions
- Activated Peracetic Acid (EasyDecon DF 200, Dahlgren Decon)
- Others.... TBD



Post Mitigation Clearance Assessment...

Performed to verify the “successful” completion of cleanup including...

- Visual inspection of residence to verify targeted procedures, containments, and removal of selected surfaces has been achieved
- Post-mitigation surface sampling and verification of mitigative cleanup and treatment
- Clearance criteria (as *established for this case*):
 - < 0.10 ug/100cm² (Fentanyl)
 - < 0.010 ug/100cm² (Carfentanil)
- Current California regulatory cleanup standard set at “detection limit”



Post Mitigation Assessment Findings...

Sample Number	Sample Location / Description (surface area sampled = 100 cm ²)	Fentanyl (ug/sample)	Carfentanil (ug/sample)
1	Dining Room window sill	< 0.010 (ND)	0.017 *
2	Family Room wall at closet	ND	ND
3	Hallway wall at floor	ND	ND
4	Bathroom floor	ND	ND
5	Bedroom closet wall	ND	ND
6	Family room subflooring	ND	ND
7	Kitchen wall at baseboard	ND	ND
8	Kitchen ceiling sheetrock	ND	ND
9	Field Control Blank (QA/QC)	ND	ND
10	Covered misc. surfaces (composite)	ND	0.012 *

Community/Apartment Mailbox...





Fentanyl and Carfentanil Contaminants Detected in Apartment Mailboxes...

- Box 103:
(Unit of concern) Fentanyl 0.041 ug
Carfentanil 0.0048 ug
- Box 106:
(Above/Right) Fentanyl 0.031 ug
Carfentanil – ND
- Box 104:
(Below) Fentanyl 0.0082 ug
Carfentanil - ND

Results and Lessons Learned...

- The handling, mixing, packaging, and distribution of opioid compounds within this residence resulted in significant surface contamination at potentially lethal levels
- Decontamination and cleanup methods employed were successful in reaching current regulatory cleanup goals
- Importance of Assessment, Decontamination, and Clearance by trained and certified personnel
- Implementation of current regulatory standards and protocols are important...

Assessment → Decontamination → Clearance



Current Regulatory Standard in California:

Chapter 6.9.1 Section 25400.10 of Division 20 of Health and Safety Code enacted January 1, 2020.

known as...

“The Methamphetamine or Fentanyl Contaminated Property Cleanup Act”



Key Requirements of Regulation...

- Recognizes potential for residual contamination from manufacturing
- Posting of Property and engages LHO involvement and CIH review and oversight
- Expands applicability of standard to including meth, fentanyl, fentanyl analogs and related “controlled substances”
- Expands definition of “Laboratory Activity”
- Establishes Clearance Cleanup Criteria (below “detection level”)



“Fentanyl Laboratory Activity” ...

Section 25400.11 (i) “Fentanyl laboratory activity” means the illegal manufacturing or storage of fentanyl. This shall include manufacturing, compounding, converting, producing, deriving, processing, or preparing, either directly or indirectly by chemical extraction, pill pressing, distribution, cutting, diluting, synthesis, or other activity that has the potential to contaminate the property with fentanyl or any of its precursors.



“Clearance” Cleanup Criteria ...

Property contaminated by fentanyl laboratory activity is determined safe for human occupancy ...only if the level of fentanyl on an indoor surface is **below the (analytical) detection level.** HSC Section 25400.10 (d)

... (d) shall become inoperative when a health-based target remediation standard for fentanyl as adopted.



Potential Exposures...

- First Responders, EMTs, and Law Enforcement
- Secondary Exposures to...
 - Property owners and maintenance staff
 - Site assessment and inspector personnel
 - Forensic Laboratory and Evidence Storage sites
 - Contracted Mitigation Cleanup Personnel
- Tenants and Occupants... Is the property “Safe and Habitable”???
- Ongoing Research... Potential for airborne exposures exists at sites





Take Away Summary...

- This case study (and others like it) demonstrates that assessment and cleanup is needed in cases where opioids are manufactured, handled, stored or distributed.



Communication Requirements...

A Law Enforcement Officer or Investigator... “Shall notify Department, CUPA, or Administrating Agency at sites where an illegal controlled substance is or was manufactured ...

HSC 25354.5 (a)



CUPA Requirements...

- HSC 25400.17** Laboratory "Activity" = Assumed Contamination is Present
- HSC 25400.18** Notice Posted within 48 hours
- HSC 25400.19** Inspection Performed within 5 days
- HSC 25400.20** Determination of Contamination is Made



What's Next on the Street...

- Xylazine (known as "Tranq") Veterinary tranquilizer (Non opioid - Naloxone "resistant")
- Isonitazine (known as "Iso") new and very potent synthetic opioid
- Air B&B Case in Florida...
- Rainbow fentanyl...




Additional Sources of Information...

- US Drug Enforcement Agency Media Library:
[www.dea.gov/media/videos/Chasing the Dragon.mp4](http://www.dea.gov/media/videos/Chasing%20the%20Dragon.mp4)
- US Center for Disease Control:
www.cdc.gov/drugoverdose/opioids/fentanyl.html
- www.emergency.cdc.gov/han/han00384.asp
- National Institute of Drug Abuse:
www.drugabuse.gov/publications/drugfacts/fentanyl
- BioMax Environmental, Inc. web site:
www.biomaxenvironmental.com



Cleanup and Decontamination Research

Related Publications:

1. Oudejans, L., D. See, C. Dodds, M. Corlew, AND M. Magnuson. Decontamination Options for Indoor Surfaces Contaminated with Realistic Fentanyl Preparations. JOURNAL OF ENVIRONMENTAL MANAGEMENT. Elsevier Science Ltd, New York, NY, 297:113327, (2021). <https://doi.org/10.1016/j.jenvman.2021.113327> 
2. Oudejans, L. Remediation Options for Fentanyl Contaminated Indoor Environments. U.S. Environmental Protection Agency, Washington, DC, EPA/600/R-21/105, 2021. [EPA report]
3. EPA Technical Summary (cleared but not formatted yet): Decontamination Strategies, Methods, and Related Technical Challenges for Remediation of a Fentanyl-Contaminated Site; EPA Publication Number EPA/600/S-22/154



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