NRT Quick Reference Guide: Fentanyl

GHS: Acute Toxicity, Category 1
H300 – Fatal if swallowed
H310 – Fatal in contact with skin
H330 – Fatal if inhaled

QRG PURPOSE: *This QRG is intended for use by a Federal OSC/RPM for planning and expediting decisions for consequence management for fentanyl remediation (cleanup and removal of residual contamination) in the event of a CBRN incident response for a release of fentanyl or fentanyl-related substances. Mention of trade names does not convey official approval or endorsement by NRT or any NRT member agency.*

WARNING: This QRG does not advise Federal On-Scene Coordinators (OSCs) to handle or take possession of any fentanyl pharmaceutical products or any bulk illicit fentanyl or fentanyl-related substances at any time. Federal criminal penalties for the possession of fentanyl or fentanyl-related substances may involve fines and prison sentences. Depending on state law, state criminal penalties may include fines and mandatory prison sentences. **The Federal OSC should always contact the U.S. Drug Enforcement Administration (DEA) prior to arriving on site.** DEA has statutory and regulatory authority for the handling and management of controlled substances. For state and local illicit drug seizures, DEA may not be the lead law enforcement agency and the Federal OSC should coordinate with the applicable state or local law enforcement authorities for those illicit drug sites. Fentanyl remediation (cleanup and removal of residual contamination) typically begins after law enforcement completes removing bulk fentanyl and cleaning up gross contamination at an illicit drug site and clears the site for entry.

1. Agent Characteristics

Agent Characteristics

Agent Classification:

- **Synthetic opioid drug**: Fentanyl is a pharmaceutical product regulated under Schedule II, Controlled Substances Act; DEA Controlled Substance Code Number: 9801.
- **Incapacitating or CNS-acting Agent**: Fentanyl and related opioids impact neurotransmitters within the central nervous system (CNS) and cause respiratory depression and other incapacitating CNS depressive effects. Fentanyl is highly potent; the amount of fentanyl in a lethal dose is similar to that for traditional nerve agents banned by the Chemical Weapons Convention (CWC) that act on the neurotransmitter acetylcholine. Fentanyl has thus been considered a type of chemical agent, although not currently banned as a chemical weapon under the CWC.

Notes for Federal OSCs:

- This QRG is based on the chemical compound fentanyl (CAS 437-38-7) and its salts (with various CAS numbers). The physical properties of fentanyl and its salts vary (see PHYSICAL PROPERTIES section), but this QRG assumes similar response-related activities because the exact form of fentanyl may not be known by the Federal OSC.
- There are many synthetic opioids that are structurally related to fentanyl and are referred to by terms such as fentanyl analogues, fentanyl-related substances (as defined in 21 CFR §1308.11(h)(30)(i)), and/or have "fentanyl" or "fentanil" (e.g., carfentanil) within their name. The licit (lawful) forms of these related synthetic opioids that are approved by the U.S. Food and Drug Administration (FDA) as pharmaceutical products are regulated by DEA as Schedule II controlled substances. The illicit forms of fentanyl or fentanyl-related substances are regulated by DEA as Schedule I controlled substances, which by definition have no accepted medical use in treatment in the U.S.
- The Federal OSC should seek to understand what is already known by DEA, state, or local law enforcement about the identity of substances when the presence of "fentanyl" is suspected. Law enforcement may have information resulting from the use of field tests (see FIELD DETECTION section). The Federal OSC should always contact law enforcement if any bulk fentanyl or fentanyl-related substances are encountered on site.
- Fentanyl in illegal drugs is often cut or diluted with other highly toxic substances, such as heroin, cocaine, xylazine, and methamphetamine, as well as other comparatively non-toxic substances (e.g., sugars). This QRG does not necessarily address these substances, but Federal OSCs should consider their impact on response operations.

Description: Fentanyl may be present in solutions, as powders, in pills or tablets, and in several other forms (e.g., on blotter paper, tars, pastes), depending on its legitimate pharmaceutical use or illicit preparation. As a solid, fentanyl and its salts are odorless, solid/crystalline powders that can be pebbly and white, colored, or brown. Fentanyl can be found as a free base or as salts, such as citrate and hydrochloride. As a free base, fentanyl is less soluble in water than salt forms, with the ratio of free base to salt in solution increasing with pH. Both the free base and salt are sufficiently soluble in aqueous-based solutions for delivery of lethal amounts. Fentanyl and its salts may be dissolved in a polar organic solvent, such as alcohol.

In addition to high toxicity, one of the hazards of fentanyl and its salts is that illicit manufacturing methods can lead to small particle sizes that make it easily airborne, creating an inhalation hazard when encountered as a very fine powder or aerosol (0.2-2.0 microns). Smoking of illicit fentanyl preparations can convert salts to free base present on fine particles, along with producing many combustion and/or pyrolysis products (e.g., styrene, pyridine), of varying toxicity.

Persistence: While there have been few studies investigating the environmental persistence of fentanyl, fentanyl is considered persistent on surfaces and in water under normal environmental conditions. Persistence will depend upon the method of release, environmental conditions, and the types of surfaces and materials impacted.

2. Physical Properties

Physical Properties

Fentanyl (free base)	CAS: 437-38-7
Molecular Weight: 336.47 g/mol	**Formula:** $C_{22}H_{28}N_2O$
Vapor Density: NA	**Flash Point:** 367°F/186°C
Vapor Pressure: NA	**Liquid Density:** 1.087 g/cm^3
Volatility: NA	**Aqueous Solubility:** Insoluble to slightly soluble; 0.2 g/L (77°F/25°C)
Boiling Point: 735.8°F/391°C (calculated value; would char at this temperature)	**Non-aqueous Solubility:** Alcohols
Melting/Freezing Point: 181.4-183.2°F / 83-84ºC	**Hydrolysis ($t_{1/2}$):** NA

Fentanyl Citrate (salt)	CAS: 990-73-8
Molecular Weight: 528.6 g/mol	**Formula:** $C_{22}H_{28}N_2O•C_6H_8O_7$
Vapor Density: NA	**Flash Point:** 367°F/186°C
Vapor Pressure: NA	**Liquid Density:** NA
Volatility: NA	**Aqueous Solubility:** Moderately soluble; 25 g/L (77°F/25°C)
Boiling Point: 870.8°F/466°C	**Non-aqueous Solubility:** Slightly soluble in alcohols
Melting/Freezing Point: 307-313°F / 153-156ºC	**Hydrolysis ($t_{1/2}$):** NA

Fentanyl citrate is a white crystalline solid. Fentanyl Citrate Injection, USP is a clear, non-pyrogenic, aqueous solution for intravenous or intramuscular injection. DEA controlled substance–Schedule II.

Fentanyl Hydrochloride (salt)	CAS: 1443-54-5
Molecular Weight: 372.9 g/mol	**Formula:** $C_{22}H_{28}N_2O•HCl$
Vapor Density: NA	**Flash Point:** NA
Vapor Pressure: NA	**Liquid Density:** NA
Volatility: NA	**Aqueous Solubility:** 7.9 g/L (77°F/25°C)
Boiling Point: NA	**Non-aqueous Solubility:** Slightly soluble in alcohols
Melting/Freezing Point: 429°F/220.5°C	**Hydrolysis ($t_{1/2}$):** NA

Fentanyl HCl is a white solid used as an analytical reference material categorized as an opioid. DEA controlled substance–Schedule II.
As a certified reference material (CRM) product, Fentanyl HCl CRM is a DEA-exempt preparation of a scheduled compound (100 µg/mL solution in methanol) intended for research and forensic laboratories.

Carfentanil (free base)*	CAS: 59708-52-0
Molecular Weight: 394.5 g/mol	**Formula:** $C_{24}H_{30}N_2O_3$
Vapor Density: NA	**Flash Point:** 502°F/261°C
Vapor Pressure: NA	**Liquid Density:** 1.142 g/cm^3
Volatility: NA	**Aqueous Solubility:** Low, 0.004 g/L (77°F/25°C)
Boiling Point: 946.4°F/508°C	**Non-aqueous Solubility:** Alcohols
Melting/Freezing Point: 501.8°F / 261±30°C	**Hydrolysis ($t_{1/2}$):** NA

Carfentanil is an odorless white solid. DEA controlled substance–Schedule II.

Carfentanil Citrate (salt)*	CAS: 61380-27-6
Molecular Weight: 586.6 g/mol	**Formula:** $C_{30}H_{38}N_2O_{10}$
Vapor Density: NA	**Flash Point:** NA
Vapor Pressure: NA	**Liquid Density:** NA
Volatility: NA	**Aqueous Solubility:** 3.2 g/L (68°F/20°C)
Boiling Point: NA	**Non-aqueous Solubility:** >148 mg/mL in methanol
Melting/Freezing Point: 307.4°F/153°C	**Hydrolysis ($t_{1/2}$):** NA

Carfentanil citrate is a clear, crystalline solid. Wildnil® is used as a tranquilizing agent for elephants and other large mammals. DEA controlled substance–Schedule II.

*Included because some response-specific information is available.
Note: physical properties are listed at/near STP unless otherwise indicated. NA = Not Available

3. Release Scenarios

Release Scenarios

Air release scenarios are assumed the most probable primary release/attack scenario; however, other release scenarios should be considered.

Exposures by inhalation or incidental ingestion are most likely; however, other exposure routes (e.g., dermal contact) should be considered.

Open Areas: Fentanyl can be released into outdoor air as fine particles or powders or liquid spray (aerosol). While fentanyl (free base and salts) is a solid at room temperature, it poses an inhalation or incidental ingestion exposure hazard if sufficient fine particles or powders become airborne. Fentanyl can also be dissolved in solvents and fentanyl citrate is soluble in water, which allows exposure in aerosol form. There is a potential inhalation hazard if any vigorous movement causes dust to rise or fine particles or powders to reaerosolize.

Water/Water Systems: Fentanyl free base powders could enter natural waters or a water system, but would be an unlikely exposure pathway of concern, due to their limited aqueous solubility. Salts of fentanyl, carfentanil, and other opioids, may have sufficient aqueous solubility to present a concern, if used in sufficient quantities. Aqueous solutions

of fentanyl, when found as an illicit drug in nasal sprays, eye drops, vape pen liquids, or IV bags are a potential but unlikely source of contamination to water or water systems due to their smaller volumes and concentrations of opioids.

Indoor Facility: Fentanyl could potentially be dispersed as fine particles or powders or liquid spray (aerosol) inside a building or facility using HVAC systems. Fentanyl particles are heavier than air and can accumulate in lower levels, basements, floor drains, or utility corridors inside a building and/or deposit on surfaces inside a building. Scrubbing surfaces where synthetic opioids are present can result in a turbulent air flow situation and reaerosolize particles or powders, creating an inhalation hazard.

Transit Vehicles: Fentanyl use on transit vehicles (e.g., mass transit buses, commuter trains, subway trains) could pose an inhalation or incidental ingestion exposure hazard if sufficient fine particles or powders become airborne. Smoking of fentanyl or fentanyl-related substances could lead to contaminated surfaces within the transit vehicle where drug residues, drug paraphernalia, or secondhand smoke could accumulate.

Automobiles/Trucks: Fentanyl could potentially be released inside automobiles or trucks used to carry illicit drugs or from the occupants or their clothing.

Ships/Boats: Fentanyl could potentially be released on maritime conveyances such as freighters, cruise ships, go-fast vessels, or recreational watercraft associated with illicit drug use or illicit drug operations.

Food or Agriculture: While food is an unlikely exposure pathway, if fentanyl is released into the air as fine particles or powders or a liquid spray (aerosol), it has the potential to contaminate food or agricultural products.

Clandestine Laboratories/Illicit Drug Cutting Operations: Illicit drug operations present multiple exposure pathways. Federal OSCs may encounter packaged powder, loose powder, pill mills, aqueous liquids, and hardened (described as concrete-like or "rocks") fentanyl or fentanyl-related substances. Fentanyl may be mixed with heroin, cocaine, methamphetamine, and other illicit drugs, and the Federal OSC should plan for their possible presence when responding to incidents associated with illicit drug operations involving fentanyl or fentanyl-related substances.

Other: Fentanyl pharmaceutical products are sold and prescribed for medical treatment under various brand names and in various forms. These licit (lawful) fentanyl pharmaceutical products may be diverted and found at sites where illicit drug use occurs or at illicit drug operations where users cut up them up to smoke, extract the fentanyl from them, or crush them for illicit pill manufacturing operations. Caution about drug diversion: Federal OSCs should be aware that FDA regulations (21 CFR §290.5) require that when any DEA Schedule II, III, or IV controlled substance is dispensed to or for a patient, the label includes a warning that federal law ''prohibits the transfer of the drug to any person other than the patient for whom it was prescribed."

4. Health Effects

Health Effects

4.1. Potency: Fentanyl has a relative potency 100 times greater than morphine and carfentanil has a relative potency of up to 100 times greater than fentanyl.

4.2. Onset: Onset of symptoms is dose and route dependent. Even a relatively low dose exposure to fentanyl can be fatal and immediate administration of an antidote is critical (see First Aid under PERSONNEL SAFETY section below).

- Inhalation of fentanyl results in rapid absorption.
- Oral exposure occurs in two phases. Initial exposure from absorption through mucosal membranes in the mouth will occur within a few minutes, with absorption through the intestinal tract occurring over 2 hours.
- Dermal exposure to powder fentanyl on intact skin results in slow absorption over hours to days; with very low risk of exposure through intact skin.
- After intravenous (IV) administration, peak analgesia occurs within several minutes of injection. The duration of analgesia is 30-60 minutes after a single dose of up to 100 μg. With rapid IV administration, rigidity of the chest muscles ("wooden chest syndrome") may be produced, which interferes with normal breathing. Reversal may be achieved by medical use of an IV neuromuscular blocker in cases of severe muscular rigidity to assist the controlled ventilation support treatment. A rise of blood pressure within the brain (intracranial hypertension) and muscle rigidity and spasms have been reported following fentanyl use.

4.3. Signs/Symptoms: Initial symptoms will vary depending on dose and exposure route. Fentanyl can produce delayed reduced respiratory function (respiratory depression) and respiratory arrest. The following is a general list of possible symptoms from short-term (less than 8 hours) exposure.

- **Inhalation and ingestion:** Contracted or pinpoint pupils (miosis) (may later become dilated), reduced level of consciousness (CNS depression), reduced respiratory function (respiratory depression), reduced blood oxygen content (hypoxia), accumulation of acid in the blood (acidosis), low blood pressure (hypotension), slow heart rate (bradycardia), shock, slowing of muscular movement of the stomach (gastric hypomotility) with intestinal obstruction due to lack of normal muscle function (ileus), accumulation of fluid in the lungs (pulmonary edema), lethargy, coma, and death.
- **Skin:** All of the above, although absorption increases with skin temperature (based on medical use of transdermal patch). Absorption through the skin may contribute to whole body (systemic) toxicity.
- **Eyes:** The extent of ocular absorption of fentanyl is not well studied. Irritation may occur.

4.4. Exposure Routes:

Inhalation: A primary exposure route; inhalation of very small concentrations can produce health effects. Inhalation of fine particles or powders is the most likely route that leads to immediate adverse health effects.

Ingestion: Incidental ingestion is the most likely route of oral exposure for fentanyl. Ingestion of very small concentrations can produce adverse health effects.

Skin: Direct contact with damaged skin is a potential exposure route; however, incidental skin contact is unlikely to produce immediate adverse health effects and would allow time for removal (e.g., washing hands). Sweaty skin or skin damage may increase the rate of skin absorption and susceptibility to adverse health effects from dermal exposure. Select solvents and the pH of a solution in contact with the skin may also increase the rate of skin penetration from dermal exposure. The use of alcohol-based hand sanitizers is not recommended because these products may increase the absorption and penetration of opioids through the skin barrier.

Eyes: Eyes can be a sensitive target organ for signs/symptoms of systemic fentanyl exposure (from other exposure routes). Miosis (reduction in pupil size) will typically be one of initial signs of exposure. Absorption of fentanyl through the eyes has not been well documented.

5. Effect Levels

Effect Levels

Air (inhalation hazard): Acute Exposure Guideline Levels (AEGLs) for general population one-time exposure emergency scenarios are not available (NA) for fentanyl (complete definitions are available at: https://www.epa.gov/aegl).

AEGL Level in mg/m^3, at various exposure durations	10 min.	30 min.	1 hr.	4 hr.	8 hr.
AEGL 1: Threshold mild effects	NA	NA	NA	NA	NA
AEGL 2: Potentially irreversible effects or impaired ability to escape	NA	NA	NA	NA	NA
AEGL 3: Threshold for severe effects/medical needs/increasing potential for lethality	NA	NA	NA	NA	NA

American Industrial Hygiene Association (AIHA) Emergency Response Planning Guidelines (ERPG™) are not established/determined for fentanyl.

6. Exposure Guidelines

Exposure Guidelines

6.1. Airborne Exposure Limits (AELs): There are no established federal occupational exposure limits for illicit drugs. Alternative exposure values, such as ACGIH TLVs (Section 6.2 below) or Draft PALs developed by EPA (Section 6.3 below) may be available for site Health and Safety officers.

6.2. Occupational: (NA = not available)

NIOSH IDLH = NA	**ACGIH TLV-TWA** = 0.1 µg/m^3, inhalable particulate matter, as fentanyl
NIOSH REL-TWA = NA	**ACGIH TLV-STEL** = 0.2 µg/m^3, inhalable particulate matter, as fentanyl
NIOSH REL-STEL = NA	**ACGIH TLV-SL =** 1 µg/100 cm^2, as fentanyl (measured on a surface)
OSHA PEL = NA	**ACGIH skin notation:** indicates potentially significant contribution to overall exposure through dermal (cutaneous) route

More information about ACGIH TLVs for fentanyl and fentanyl citrate, as fentanyl, can be found at: https://www.acgih.org/fentanyl-and-fentanyl-citrate/.

6.3. Population:

Soil: USAPHC Health Based Environmental Screening Levels (HBESL) = Not established/determined.

Air/Inhalation: EPA Draft PALs; see below for more information.

Drinking Water/Ingestion: EPA Draft PALs; see below for more information.

EPA Provisional Advisory Level (PAL): PALs represent chemical concentrations in air or drinking water above which varying health effects (PAL1, PAL2, PAL3) are expected. They are developed for 24-hour, 30-day, and 90-day exposure durations. They are advisory levels for exposure to the general public, including susceptible and sensitive sub-populations. (Note: PALs are not intended to define cleanup levels.)

EPA DRAFT* Air/Inhalation PALs	**µg/m^3**
24-Hour (≤ 24-hour exposure) PAL 2 (serious, possibly irreversible health effects)	0.0037
24-Hour PAL 3 (lethal effects)	0.011
EPA DRAFT* Water/Ingestion PALs	**mg/L**
24-Hour PAL 1 (mild, transient, reversible health effects)	0.03
24-Hour PAL 2 (serious, possibly irreversible health effects)	0.23
30-Day (>24-hour, ≤30 days) PAL 1	0.03
30-Day PAL 2	0.23
90-Day (>30 days, ≤90 days) PAL 1	0.03
90-Day PAL 2	0.23

*As of November 2024, the PALs provided above for fentanyl are DRAFT values. For more information, if needed, contact EPA PALs program (PALs@epa.gov).

7. Personnel Safety

Personnel Safety

Note: Personal Protective Equipment (PPE) selection (levels A-D), medical surveillance requirements, First Aid options, and personnel decontamination may vary depending upon the amount and purity of agent, site conditions, and the release scenario. Check with the site Health and Safety Officer about PPE and other safety measures included in the site-specific Health and Safety Plan (HASP). Additional information on personnel safety and PPE selection criteria can be found at: www.cdc.gov/niosh/ershdb. Responders should always check their own internal procedures (i.e., SOPs), if applicable.

Advisory:

- CDC NIOSH provides information and recommendations in NIOSH ERSH-DB to address a wide-area release of fentanyl, which are available at: https://www.cdc.gov/niosh/ershdb/emergencyresponsecard_29750022.html.
- CDC NIOSH provides separate guidance and recommendations for emergency responders (e.g., law enforcement, EMTs) responding to fentanyl use as an illicit drug, which can be found at: https://www.cdc.gov/niosh/substance-use/fentanyl-emergency-responders/?CDC_AAref_Val=https://www.cdc.gov/niosh/topics/fentanyl/risk.html. **Note:** Local emergency responders typically do not have access to CBRN PPE that is readily available to Federal OSCs.

7.1. Medical:

Pre-incident: Must have current medical and respiratory clearances as part of an Occupational Medical Surveillance Program according to OSHA HAZWOPER and Respiratory Protection Program (29 CFR 1910), as per 29 CFR 1910.120 and 134. Responders who need to wear respirators must be medically cleared, trained, and fit-tested for respirator use.
During Incident: Conduct periodic on-site medical monitoring, observe for any signs and symptoms as per HEALTH EFFECTS section above and treat accordingly as per First Aid section below.
Post-incident: Perform post-incident medical surveillance, as per 29 CFR 1910.120.

7.2. First Aid: After donning appropriate PPE, immediately assess person (evaluate respiratory function and pulse), administer emergency treatment (as needed), then remove person from the source of exposure or affected area, and remove contaminated clothing and articles.

Emergency treatment consists of aggressive support of respiratory function and administration of the antidote naloxone (see below). Because the depression of breathing caused by opioids can last longer than the action of the antidote, further medical evaluation at a hospital is required.

After administering first aid, seek immediate medical attention for person treated.

Any on-site response personnel treated with antidote and any patients/victims exhibiting reduced respiratory function (respiratory depression) or any other complicating factors of opioid toxicity (e.g., decreased consciousness, increased drowsiness), should be evaluated at a hospital.

ANTIDOTE: Naloxone blocks or reverses the effects of opioid exposure, including extreme drowsiness, slowed breathing, or loss of consciousness. It has been recommended for treatment of opioid overdose in doses of 0.4 to 2.0 mg. Administer naloxone under a physician's direction or by following applicable SOPs. The onset of effect following intravenous naloxone administration is 1 to 3 minutes; maximal effect is observed within 5 to 10 minutes. Doses may be repeated as needed to maintain effect. **Fentanyl and fentanyl-related substances may require multiple administrations of naloxone** to minimize fatalities in the event of an overdose. Administration of naloxone may also reverse chest wall rigidity known as "wooden chest syndrome." **DEA recommends that responders have portable naloxone intranasal spray kits (NARCAN®, Revive™, KLOXXADO®) with them and be trained in their administration.**

Illicit opioids are sometimes combined with other drugs that also cause overdoses, such as xylazine (a non-opioid veterinary tranquilizer and CNS depressant), or may be used with other drugs that increase the risk of overdose, such as benzodiazepines (sedative and CNS depressant). Because xylazine and benzodiazepines are not opioids, naloxone does not address their impacts on breathing, which may render naloxone less effective for overdoses from xylazine-containing fentanyl or for overdoses if a person using benzodiazepines is exposed to opioids.

FIRST AID:

Ingestion:	Seek medical attention. Ensure that the patient/victim has an unobstructed airway. Do not induce vomiting (emesis). Do not give anything by mouth to an unconscious person. Call a POISON CONTROL CENTER for additional expert guidance (1-800-222-1222).
Inhalation:	Assess person (evaluate respiratory function and pulse), administer emergency treatment (as needed) including administration of the antidote naloxone (see above), then move to fresh air. Ensure that the patient/victim has an unobstructed airway. If shortness of breath occurs or breathing is difficult, administer oxygen if available. Assist ventilation as required and always use a barrier or bag-valve-mask device. If breathing has ceased, provide cardiopulmonary resuscitation (CPR) if trained appropriately, with only artificial ventilation using a barrier or bag-valve-mask device. Monitor the patient/victim for signs of whole body (systemic) effects. If signs of whole body (systemic) poisoning appear, see Ingestion in this section for emergency treatment recommendations. Note that respiratory depression can progress to cardiopulmonary collapse (cardiac arrest). If the patient/victim becomes or is found to be pulseless (cardiac arrest) additionally provide chest compressions using standard CPR techniques and administer naloxone.

Skin:	Gently wash bare skin (avoid abrading skin) thoroughly and immediately with water, or warm, soapy water if available, at normal household pressures (~50-60 psi) for three minutes, ensure thorough soaking for at least 15 minutes. **Do not use hand sanitizers**; they may contain alcohol that may increase fentanyl absorption.
Eye:	Rinse eyes with potable water for 15 minutes.

After administering first aid, provide clean clothing, and send person for follow-up medical attention and evaluation, which may require a hospital Emergency Department visit. If cleared to resume work, continue to monitor for signs/symptoms and treat accordingly.

7.3. Potential Exposure Levels:

Evaluation of potential exposure levels by the site Health and Safety Officer will be site-specific and documented in the HASP. The potential exposure level initially selected can change and PPE should be adjusted accordingly. Higher levels of PPE may be necessary to protect from exposure to other hazards (e.g., decontamination chemicals).

PPE selection should be based on CDC NIOSH potential exposure levels for fentanyl or fentanyl-related substances, which are defined as follows for Federal OSCs:

- **Minimal:** Response to a situation where it is suspected that illicit drugs may be present, but no illicit drug products (e.g., pills) are visible. Example Federal OSC job tasks: clearance sampling, other non-intrusive activities. **Level C or modified Level C PPE is recommended** (see PPE Section 7.4 below).
- **Moderate:** Response to a situation where small amounts of illicit drugs in liquid or powder form are visible. Example Federal OSC job tasks: decontamination of illicit drug residues after law enforcement clears a site for entry. **Level B or modified Level C PPE is recommended** (see PPE Section 7.4 below).
- **High:** Response to a wide-area incident where large amounts of fentanyl may become airborne, or to a situation where large amounts of illicit drugs in liquid or powder form are visible. Example Federal OSC job tasks: activities associated with initial entry by Federal OSCs after law enforcement has completed removal of bulk fentanyl or fentanyl-related substances and cleanup of gross contamination at an illicit drug site. **Level A or B PPE is recommended** (see PPE Section 7.4 below).

For more information on CDC NIOSH potential exposure levels for fentanyl or fentanyl-related substances, refer to: https://www.cdc.gov/niosh/substance-use/fentanyl-emergency-responders/ppe.html.

7.4. Personal Protective Equipment (PPE):

GENERAL INFORMATION: Appropriate engineering and administrative controls, work practices, and PPE should be employed for liquids, dusts, particulates, and powders of fentanyl or fentanyl-related substances that can be aerosolized.

Federal OSCs are trained and equipped to use NIOSH Approved® Chemical, Biological, Radiological, Nuclear (CBRN) Self Contained Breathing Apparatus (SCBA), NIOSH Approved Air Purifying Respirators (APR) or Powered Air Purifying Respirators (PAPR), and protective clothing. All PPE should be used according to OSHA PPE standard (29 CFR 1910.132). Pre-incident training and exercises on the proper use of PPE are recommended.

CAUTION:

- Use of a specific decontamination agent (e.g., activated peroxyacetic acid or other product) in a confined indoor area or unventilated space may require modifying PPE in accordance with IDLH and AEGL values established for such decontamination chemicals.
- No IDLH or AEGL values exist for fentanyl (see EXPOSURE GUIDELINES section above) to assist in making decisions about respirator use for protection from fentanyl exposure.
- In the absence of an IDLH or any established federal occupational exposure guidelines for fentanyl, Federal OSCs may use NIOSH Approved CBRN SCBA for additional protection.
- When required, respirator use should comply with requirements of OSHA Respiratory Protection Program (29 CFR 1910), including OSHA respiratory protection standard (29 CFR 1910.134).

LEVEL A: NIOSH Approved CBRN SCBA [or NIOSH Approved SCBA] with Level A suit that provides protection against CBRN agents. Level A provides the greatest level of skin (totally-encapsulating chemical protective suit and chemical-resistant inner and outer gloves, along with chemical-resistant boots with steel toe and shank), respiratory (SCBA), and eye protection when the contaminant identity or concentration is unknown. Select Level A when the agent concentration is unknown, and when there is a potential of ocular or dermal exposure.

LEVEL B: NIOSH Approved CBRN SCBA [or NIOSH Approved SCBA] with Level B protective suit that provides protection against CBRN agents. Level B provides the highest level of respiratory protection (SCBA) when a lesser level of skin protection is required. Select Level B when the agent concentration is unknown, and when dermal exposure is less of a risk. Level B differs from Level A in that it typically incorporates a non-encapsulating, splash-protective, chemical-resistant outer suit that provides protection against most liquids but is not vapor tight (hooded chemical-resistant outer suit and chemical-resistant inner and outer gloves, along with chemical-resistant boots with steel toe and shank). EPA recommends a **modified Level B PPE** ensemble for most response activities to a known fentanyl release or entry into a confined indoor area with indication of likely synthetic opioid contamination (e.g., a laboratory or opiate/opioid handling area)—**modified Level B** includes a hooded chemical-resistant outer suit with **integrated taped seams or encapsulated with no exposed skin** that provides additional dermal and ocular protection against fentanyl liquids, dusts, particulates, and powders that can be aerosolized.

LEVEL C: May be selected when the contaminant identity and concentration are known and the respiratory protection criteria factors for the use of APR or PAPR (i.e., warning properties) are met. Level C still incorporates hooded chemical-resistant outer suit that provides protection against CBRN agents, chemical-resistant inner and outer gloves, and chemical-resistant boots with steel toe and shank. EPA recommends a **modified Level C PPE**—a hooded chemical-resistant outer suit with **integrated taped seams with no exposed skin** that provides additional dermal and ocular protection against fentanyl liquids, dusts, particulates, and powders that can be aerosolized.

- EPA recommends the use of a NIOSH Approved CBRN PAPR with a tight-fitting full-facepiece and a filter or a combination chemical cartridge/filter. The use of a tight-fitting, full-face PAPR provides a higher Assigned Protection Factor (1000) than a full-face APR (50).
- If a CBRN PAPR is not available, a NIOSH Approved CBRN tight-fitting full-face APR with organic vapor/acid gas/P100 cartridges/canisters can be used.

EPA recommends that **modified Level C** is appropriate when decontaminating personnel or equipment at a fentanyl-contaminated incident where the types and concentrations of the contaminants are known.

LEVEL D: Select Level D when the contaminant is known and the concentration is below the appropriate occupational exposure limits for the stated duration times. PPE includes coveralls or other work clothes, boots, and gloves, and high-visibility vest (when outdoors). Responders must continue to wear nitrile gloves or equivalent in an area where fentanyl or other synthetic opioids may have been handled. Responders can further reduce the potential for dermal exposure by taping the wrists and ankles similar to the process recommended for Levels B and C above.

Downgrading PPE levels can be considered only by the site Health and Safety Officer when the identity and concentration of the contaminant and the risks of airborne and dermal exposure are known.

8. Personnel Decontamination

Personnel Decontamination

8.1. Personnel Decontamination Procedure:

Tents, berms, and collection vessels should be able to maintain copious amounts of wastewater in a contained and safe manner. Procedures should be in place to treat and replace contaminated materials used during the decontamination process as well as replace necessary chemicals and decontamination solutions.

Prior to entering the hot zone, all personnel are required to familiarize themselves with the site-specific personnel decontamination procedures.

CAUTION: Consider the corrosivity and toxicity of the liquid decontaminants and potential degradation/breakdown products used for personnel decontamination. Do not use hand sanitizers that contain alcohol, which may increase the rate of skin penetration from dermal exposure. Any cleaning compounds that contain solvents (e.g., alcohols) could increase risk of dermal exposure to fentanyl. Do not use bleach solutions to clean skin that may have come into contact with fentanyl.

Personnel decontamination should take place in a decontamination area comprised of two decontamination corridors (one for entering and one for exiting). Position corridors upwind and uphill of release area; exit should be upwind and uphill of entrance. Appropriate decontaminants, water, and durable 6-mil polyethylene bags should be provided.

Personnel decontamination area workers should wear appropriate modified Level C PPE with no exposed skin as indicated in PERSONNEL SAFETY section (see PPE Section 7.4).

Recommended Personnel Decontamination Options

Note: Dirt, grime, organic load, or cutting agents may reduce the efficacy of decontamination.

- Physical Removal: Water and detergent solutions (e.g., dishwashing soap) have been demonstrated to physically remove fentanyl from PPE surfaces with high efficacy for 5-minute contact times. However, the aqueous waste solution (runoff) will contain fentanyl due to its stability in water under many environmental conditions. Aqueous waste solution may also contain undissolved fentanyl.
- Chemical Degradation: Decontamination using chemical-based decontaminants can allow for degradation of fentanyl on surfaces and may generate aqueous waste with no or minimal amounts of fentanyl. Chemical degradation can produce byproducts with unknown toxicity. The proprietary decontamination technology Dahlgren Decon® (activated peroxyacetic acid product) in four-fold (1:4) diluted solution has been demonstrated to be highly effective in degrading fentanyl on PPE surfaces with 5-minute contact times. No additional efficacy data are available for other products with similar degradation chemistries.
- Emergency Response Personnel: Spray PPE with detergent and water or four-fold (1:4) diluted Dahlgren Decon® solution in a downward motion from head to toe, getting into all folds. Repeat rinsing until thoroughly clean. Recommend wiping to remove excess liquid from PPE. Remove PPE by rolling downward from head; avoid pulling PPE over the head. Remove respirator last, and place all PPE in polyethylene bags.
- Patient/victim: Remove all clothing down to at least undergarments, and place in polyethylene bags. Thoroughly wash and rinse skin with soap and water solution, taking care not to abrade the skin and covering all open wounds. Cover patient/victim (e.g., blanket, towels, Tyvek) and move to treatment area.

DO NOT BEGIN ANY WORK UNTIL A COMPREHENSIVE WASTE MANAGEMENT PLAN HAS BEEN DEVELOPED AND APPROVED (see WASTE MANAGEMENT section below). All waste/trash generated from personnel decontamination procedures must be disposed of as outlined in the site-specific Waste Management Plan.

8.2. Personnel Decontamination Procedures by Zone/Step: (attendants will verbally direct personnel through each step)

Conducted in Exclusion Zone (Hot Zone)

1	Equipment Drop	Place equipment taken into the hot zone on a plastic covered table or container provided prior to entering the contamination reduction corridor. Equipment will either be reused if more than one entry is planned or will be decontaminated later.

Conducted in Contamination Reduction Zone (Warm Zone)

2	Sample Drop	Place samples in a container provided for sample decontamination. Care needs to be taken to ensure that workers maintain chain-of-custody of samples. It is recommended that samples are decontaminated in a separate decontamination line.
3	Outer Boot and Glove Wash	The purpose of this step is to enable physical removal of gross contamination if contamination is visible. If gross contamination is not visible, this step may be skipped. Wash outer boots and then outer gloves using designated decontaminating agents as specified in HASP (e.g., soap and water, activated peroxyacetic acid-based decontaminants).
4	Glove, Boot, and Suit Wash	Wash all outer surfaces in a contained area (e.g., kiddie pool) using a pressurized spray with designated decontamination solution. Start with decontaminating boots and gloves, then work on suit from the top down, including SCBA/PAPR/APR casing. Decontamination personnel should conduct this step. Care should be taken to ensure that all areas are decontaminated, including around zipper, arms, front torso, and any other area that could have come in contact with contamination. The solution used for decontamination should be contained, collected, and disposed of properly from the decontamination line.
5	Outer Glove, Boot, and Suit Removal	While sitting on a stool, remove outer boots and outer gloves. Undo the SCBA/PAPR belt and hold in hand. While touching only the inside of suit, carefully roll suit in an outward motion from shoulders down to feet. Dispose of boots, gloves, and suit in a designated container. This step may require decontamination personnel to assist either by holding SCBA/PAPR/APR unit or assisting in suit removal.
6	Facepiece Removal	With inner gloves, remove the facepiece. Remove cartridge filters and place into designated container. Put facepiece into facepiece wash. Decontamination personnel will clean each facepiece and SCBA/PAPR/APR assembly prior to return to service.
7	Inner Glove Removal	Remove inner gloves by only touching outside of first glove and then only inside of second glove. Place gloves into designated container.

Conducted in Support Zone (support Cold Zone)

8	Quadrant Monitoring	Using appropriate surface monitoring equipment, screen personnel for residual contamination by dividing body into 4 sections: upper right and left sides of the body, and lower left and right sides. If positive, perform spot decontamination immediately and direct person to showers.
9	Personal Shower	Personnel should shower using copious quantities of soap and water for a minimum of 5 minutes and change into clean clothes. If a personal shower is not immediately available then, at the minimum, hands and face should be washed thoroughly.
10	Medical Monitoring	Report to medical monitoring station for post-entry monitoring and report to appropriate personnel for debriefing. Observe for any obvious sign of fentanyl exposure. Using criteria listed above in PERSONNEL SAFETY section of this QRG, administer naloxone antidote and notify site Health and Safety officer.

Emergency Egress Corridor: Establish an emergency egress line to use for quickly decontaminating personnel who have medical emergencies while in the hot zone. Personnel must be decontaminated prior to receiving treatment from emergency medical technicians or transported to a hospital.

Hand-Wash Station: A hand-wash station should be available for personnel to clean up following entry. However, this may not be available initially at the scene or weather conditions may prohibit their use. If a hand-wash station is not available, personnel should wash their hands and face as soon as possible.

9. Field Detection

Field Detection

Advisory: DEA discourages field testing by response personnel of containers or bags that could possibly contain opioids, including fentanyl, because the opioids may become airborne when the containers/bags are opened. Field screening or sampling may be considered if response personnel are appropriately outfitted as indicated in the PPE section (see Section 7.4 above) to minimize exposure risks. Response personnel should always use routine air monitoring [photoionization detector (PID), flame ionization detector (FID), and/or combustible gas indicator] for detection of volatile organic compounds that might be used in the illegal manufacture of drugs or other illicit drug operations.

Field Test Kits: When appropriately outfitted as indicated in the PPE section (see Section 7.4 above), response personnel may use field test kits to screen for fentanyl. Note that field test kits will only ***presumptively*** identify the possible presence of substances that are indicated in the manufacturer's test kit specifications. Many fentanyl-related substances will not be detected because they are newly developed, unregulated, and/or the field analytical methods are not designed to detect them. Conversely, some non-fentanyl compounds are improperly "detected" and yield false positives. As a result, response

personnel should proceed with caution because hazardous compounds or fentanyl or fentanyl-related substances may be present in the samples.

Some presumptive field tests that are sold only to law enforcement include, but are not limited to:

- NARK® II Fentanyl Reagent (10 tests/box): https://www.sirchie.com/forensics/narcotics-investigation/fentanyl-heroin-identification.html.
- NARK Fen-Her™ Fentanyl/Heroin Test Kit (5 tests/box): https://www.sirchie.com/fen-her-fentanyl-heroin-test-kit-5-tests.html.
- BTNX Rapid Response™ Fentanyl Test Strip Kit (5 tests/box): https://www.btnx.com/subcategory/fentanyl-test-strips-and-kits#.

Raman Spectrometers: In some situations, Raman spectrometers can ***presumptively*** identify the possible presence of substances even within containers. Use with caution because the standard Raman does not perform well when a synthetic opioid concentration is less than 10% due to the presence of cutting agents.

FTIR Spectroscopy: FTIR (Fourier-Transform Infrared) Spectroscopy uses infrared light and an interferometer to collect spectral information called an interferogram. The interferogram is mathematically processed to generate a sensitive, high-resolution infrared spectrum. FTIR can identify a variety of fentanyl or fentanyl-related substances or other synthetic opioids along with additional compounds used to cut or dilute them. FTIR analyzers are typically non-destructive and often used as a non-contact detection method with sensitivity in the high parts-per-million, at low opioid concentrations.

MX908, 908 Devices Inc.: A handheld high-pressure mass spectrometer that uses sequential fragmentation to identify compounds based on their mass fragments. Proprietary wipes can be used to investigate surfaces for the presence of synthetic opioids based on matches in the MX908 spectral library. Individual compounds or classes of compounds can be identified, according to published vendor information; identification limits for fentanyl, carfentanil, and other synthetic opioids are in the 20-50 nanograms (ng) range. MX908 has several modes of operation allowing analysis of surface, solids, liquids, vapors, and aerosol samples.

CAUTION: A forensic analytical laboratory is required to definitively qualitatively and quantitatively identify an unknown synthetic opioid substance. Law enforcement may have forensic laboratory results available for some sites.

Coordination with DEA: DEA evaluates detection devices for use in field testing of evidence for the presence of fentanyl or fentanyl-related substances. For assistance with the examination or field testing of suspected fentanyl or a fentanyl-related substance, contact the nearest DEA Division or Domestic Office: https://www.dea.gov/divisions. DEA has over 200 Domestic Offices throughout the U.S.

10. Environmental Sampling and Analysis

Environmental Sampling and Analysis

CAUTION: Environmental sampling and analytical methods specifically for fentanyl or fentanyl-related substances have not been established by OSHA or CDC NIOSH at this time. Analytical methods that are used for environmental decontamination and cleanup may need modifications to achieve clearance goals. *Note: This section on sampling contains general guidelines and does not replace the need for a site-specific sampling plan.*

10.1. Sampling Concerns: Detection, sampling equipment and procedures, and analytical techniques will be site-specific and depend on: 1) physical state of the agent; 2) type of surfaces contaminated (e.g., porous vs. non-porous); 3) the purpose of sampling (e.g., characterization, decontamination efficacy, and clearance); and 4) specific laboratory requirements.

10.2. Sample Locations and Planning: **CAUTION:** Air monitoring may not be adequate to determine the presence of airborne synthetic opioids to ensure worker safety or to determine if there are airborne synthetic opioids that could impact other areas. Characterization sampling is initiated by targeted or judgmental sampling to identify "hot spots," potential agent environmental flow paths, and media or objects potentially acting as deposition sinks. Additional biased (non-random) or random sampling can be used to determine the extent of potential contamination or to verify the efficacy of decontamination. More thorough probabilistic sampling (e.g., grid, statistical approach) may be required for the clearance phase or if there are large uncertainties about the area impacted or the amount released. Because fentanyl is a solid and is considered a persistent agent, sample priorities should include surfaces that are potentially contaminated with particulates (e.g., release site, low lying areas, HVAC, utility corridors) and areas that people are likely to contact or where food or agricultural products are present. This includes potential surface contamination from particulates from fentanyl-contaminated liquids, dusts, and powders that can be aerosolized.

Note: Fentanyl or fentanyl-related substances can be mixed with other substances, such as cutting agents and other illicit drugs (e.g., cocaine, heroin), which can significantly alter their appearance and physical properties. Surface wipes may be the more appropriate option for environmental sampling for analysis of residual contamination at an illicit drug site. Environmental sample analysis should also include other illicit drugs, if known, to ensure the complete remediation and decontamination of the residual contamination at an illicit drug site. Some preparation techniques are available in EPA's Sample Information Collection Documents (SCID) (https://www.epa.gov/esam/sample-collection-information-documents-scids). These provide general information regarding sampling procedures for different media, sampling supplies, sample size, container, holding time, preservation, packaging, and shipping, supporting collection of samples.

10.3. Types of Samples:

Packaged Material: If possible, do not take environmental samples from packaged materials (e.g., bags, containers) if fentanyl or fentanyl-related substances are suspected. Opening a package could aerosolize contaminated particles and cause exposure. Submit the material(s) directly to the laboratory for analysis and clearly indicate on the submission paperwork it contains an item suspected of containing fentanyl or fentanyl-related substances. This will alert laboratory personnel to take the necessary safety precautions during the handling, processing, analysis, and storage of the material(s).

Air (particulates): If air sampling is conducted, the analytical method will be specific to the air sampling medium used. Particulate sampling may have limited utility during remediation and decontamination of the residual contamination at an illicit drug site.

Surface Wipes and Liquid Samples: EPA methods that may be applicable are EPA Method 3520C (SW-846): Continuous Liquid-Liquid Extraction, or EPA Method 3535A (SW-846): Solid Phase Extraction. For more information on these EPA methods for fentanyl, see EPA's Environmental Sampling and Analytical Methods (ESAM) (https://www.epa.gov/esam). Other methods that may be applicable include:

- NIOSH Method 9106: Methamphetamine and Illicit Drugs, Precursors and Adulterants on Wipes by Liquid-Liquid Extraction.
- NIOSH Method 9109: Methamphetamine and Illicit Drugs, Precursors and Adulterants on Wipes by Solid Phase Extraction.

Solids: EPA methods that may be applicable are EPA Method 3541 (SW-846): Automated Soxhlet Extraction, or EPA Method 3545A (SW-846): Pressurized Fluid Extraction (PFE). For more information on these EPA methods for fentanyl, see EPA's ESAM (https://www.epa.gov/esam).

Soil or Water: See EPA's SCID (https://www.epa.gov/esam/sample-collection-information-documents-scids) for important considerations, including that, since fentanyl is sensitive to oxidants, appropriate preservation may be necessary.

Other Sample Matrices: If sampling of matrices for food or agricultural products may be required, conduct in cooperation with other federal agencies (e.g., U.S. Department of Agriculture, FDA).

10.4. Laboratory Analysis:

CAUTION: Many labs may not be able to perform analysis on all matrices (e.g., air, water, soil). Laboratories that analyze samples for controlled substances may need DEA Registration, which allows the laboratory to lawfully possess, handle, store, and dispose of controlled substances in laboratory samples. A certified laboratory is preferred. Some states have used commercial laboratories that are accredited for analyzing samples from methamphetamine clandestine laboratories for analyzing fentanyl samples for site characterization and cleanup. At present no recognized analytical methods for fentanyl or fentanyl-related substances have been established by any federal agencies.

- EPA's ERLN (https://www.epa.gov/emergency-response/environmental-response-laboratory-network) can be used to identify environmental laboratories with capabilities to analyze fentanyl-contaminated samples using analytical methods from EPA's ESAM (https://www.epa.gov/esam). For information about ERLN laboratories or the ESAM for analysis of fentanyl-contaminated samples, contact the EPA's CBRN Consequence Management Advisory Team (CMAT) Phone Duty Officer at 202-250-8770.
- Information to assist with identification of accredited forensic analytical laboratories can found through the ANSI National Accreditation Board (ANAB) Directory of Accredited Organizations (https://search.anab.org/).

Consensus Standards:

In July 2021, ASTM International published three new standards for the detection of fentanyl and fentanyl-related substances using field instruments. ASTM noted these instruments can also be used in a laboratory setting.

- ASTM E3243-21, Standard Specification for Field Detection Equipment and Assays Used for Fentanyl and Fentanyl-Related Compounds (https://www.astm.org/e3243-21.html).
- ASTM E3289-21, Standard Guide for Using Equipment and Assays for Field Detection of Fentanyl and Fentanyl-Related Compounds (https://www.astm.org/e3289-21.html).
- ASTM 3290-21, Standard Test Method for Establishing Performance of Equipment and Assays for Field Detection of Fentanyl and Fentanyl-Related Compounds (https://www.astm.org/e3290-21.html).

11. Packaging/Shipping: Opioid Environmental Samples for Site Characterization

Packaging and Shipping: Opioid Environmental Samples

The packaging and shipping of environmental samples potentially contaminated with fentanyl or fentanyl-related substances would be subject to complex and restrictive regulations established primarily by DOT for ground transportation (49 CFR Parts 171-180), and by DOT, ICAO, and IATA for air transportation (in addition to other regulations by CDC, USPS, OSHA). Contact the laboratory receiving the sample to determine any additional packaging, shipping, or labeling requirements. Transportation of fentanyl-contaminated waste for treatment and disposal is covered under the WASTE MANAGEMENT section below.

Samples can be collected from environmental media that include surface and subsurface soil, groundwater, surface water, drinking water, dust, air, and solids other than soil (e.g., building materials). Given the wide range of potential environmental media and complex regulatory requirements, the approach would likely be situationally dependent.

CAUTION: Environmental samples potentially contaminated with an unknown opioid substance should not be introduced into commercial transportation as an undeclared hazardous material. Hazard classification, packaging, and hazard communication are the shipper's responsibility under DOT's Hazardous Materials Regulations (49 CFR Parts 171-180).

A summary of key packaging and shipping considerations for environmental samples with unknown concentrations of a potential unknown opioid substance is:

- Samples containing or suspected to contain hazardous materials, as defined in 49 CFR §171.8, must be assigned a UN ID number, proper shipping name, hazard class, and packing group (PG) from the Hazardous Materials Table in 49 CFR §172.101. The table will then direct the shipper to packaging provisions and requirements needed to transport the sample in commerce.
- There are no entries for fentanyl or fentanyl-related substances in the Hazardous Materials Table. The most likely classification for pure fentanyl would be UN2811 Toxic solids, organic, n.o.s. (fentanyl), 6.1, PG I.
- Samples for which the hazard class is uncertain and must be determined by testing may be classified and transported in accordance with 49 CFR §172.101(c)(11). For example, a wipe sample containing unknown concentrations of a potential unknown opioid substance may be tentatively classified and transported as UN2811 Toxic solids, organic, n.o.s. (opioid sample), 6.1, PG I. Similarly, a water sample may be tentatively classified and transported as UN2810 Toxic liquids, organic, n.o.s. (opioid sample), 6.1, PG I.
- Shippers must be trained in accordance with 49 CFR Part 172 Subpart H.

Use of Mobile labs: Another consideration would be use of an on-site mobile laboratory for fentanyl (and other synthetic opioids) analysis. This could eliminate the shipper's responsibility for transporting the collected samples containing a potential unknown opioid substance to an off-site laboratory. In addition, there may be public concern about shipping samples off-site, or reluctance of commercial shipping companies to accept and transport samples from a known fentanyl-contaminated site. EPA maintains mobile laboratory assets (PHILIS mobile laboratories: https://www.epa.gov/emergency-response/philis-portable-high-throughput-integrated-laboratory-identification-system) in NJ and CO that are capable of analyzing pharmaceutical-based agents, including fentanyl and other synthetic opioids, in environmental matrices. Access to the PHILIS mobile labs for a fentanyl incident can be obtained from EPA HQ/EOC at 202-564-3850. EPA also has access to the US Army CBRNE assets, including shipping and analysis, through inter-agency agreements as described in the COORDINATION WITH OTHER AGENCIES section below.

12. Coordination with Other Agencies: Opioid Field Activities

Coordination With Other Agencies: Opioid Field Activities

Numerous agencies other than EPA may be involved in a chemical agent response incident. The Federal OSC should make every attempt to coordinate assets and activities throughout all phases of the response, amongst all agencies involved.

Civilian: The National Guard Civil Support Team (CST) and the U.S. Coast Guard "Strike Teams" deploy survey teams, response vehicles, and mobile labs to hazardous chemical (HAZMAT) incidents throughout the United States. Many CSTs and Strike Teams have the capabilities to sample, prepare, and analyze certain types of environmental samples for opioid analysis. CSTs have analytical equipment that can provide screening or presumptive data results for opioids. The Federal OSC should discuss site-specific types of samples, data quality, and chain-of-custody requirements with Strike Teams and CSTs before integrating their capabilities into the overall opioid response. Other agencies, such as the FBI, may be present on site for performing tasks, such as evidence retrieval, which are specific for their agency.

Military: EPA's Special Teams (ERT and CMAD) have access to Department of Defense (DOD) assets through Inter-Agency Agreements (IAA) with the US Army's Combat Capabilities Development Command, Chemical Biological Center (CBC) at Aberdeen Proving Ground, MD. Access to EPA's IAA for support to Federal OSCs at a CBRN or opioid response or incident can be arranged through EPA/HQ-EOC at 202-564-3850. Consultation or training for EPA personnel and partners that do not need to go through EPA/HQ-EOC can be arranged via the IAA with EPA's ERT-Special Team at 732-321-6660. Additional response support can be obtained via the IAA with EPA's CMAD-Special Team, including support for chemical (including opioids), biological, and radiological agent response through EPA/HQ-EOC at 202-564-3850.

13. Environmental Decontamination/Cleanup for Residual Contamination

Environmental Decontamination/Cleanup for Residual Contamination

NOTE: This QRG does not intend this information to set, establish, or promote quantitative cleanup standards but rather to provide guidance and information for Federal OSCs. Federal OSCs should also consult the appropriate state and local requirements or guidelines for fentanyl remediation. Typically, fentanyl remediation (cleanup and removal of residual contamination) does not begin until law enforcement has completed removal of bulk fentanyl or fentanyl-related substances and cleanup of gross contamination at an illicit drug site and cleared the site for entry for the Federal OSC to begin the process for remediation of any fentanyl residues prior to a return to normal use of the site.

13.1. Decontamination/Cleanup Planning:

Once environmental site controls are in place, develop a site-specific decontamination/cleanup plan. Environmental decontamination may require a "tiered approach" using a variety of techniques and products. Contact the EPA/HQ-EOC at 202-564-3850 for more information. Due to structural similarities among fentanyl and related synthetic opioids, decontamination/cleanup planning may be similar, even if the specific opioid compound(s) present are not known.

However, a universal approach to decontamination/cleanup should not be assumed given the very large number of potential synthetic opioids with unknown toxicity and due to the presence of potentially highly toxic cutting agents found in illicit preparations. The environmental decontamination information below is based on laboratory experiments that involved cleanup of materials contaminated with a fentanyl salt, namely fentanyl hydrochloride (HCl). Chemical reactivity of related synthetic opioids may be similar, although this can be difficult to predict precisely. However, the chemical reactivity of related synthetic opioids may be sufficiently similar to enable decontamination and other response actions.

General Considerations: A cost vs. benefit evaluation should be undertaken for each decontamination strategy and approach that considers public safety, total cost, impact on the area, wastes generated, time the area or item will be inaccessible and/or out of service, as well as any socioeconomic, public health, and/or security impacts that may result. Large volumes of decontamination wastes may be generated that will need to be collected, treated, and disposed of properly. Waste handling and disposal must be addressed as early in the decontamination and cleanup process as possible (see WASTE MANAGEMENT section below).

Disposal Option: The urgency to restore an area or item as quickly as possible may result in the outright and timely removal and disposal of contaminated materials. Certain materials may be impacted by the decontamination products, and/or may be cheaper to discard and replace than to decontaminate and restore.

Monitored Natural Attenuation: Not recommended. Fentanyl does not volatilize or degrade appreciably over weeks to months under typical environmental conditions. Hydrolysis of some related synthetic opioids, such as remifentanil, occurs within a day under some environmental conditions, but the toxicity of hydrolysis products has not been established.

Fix-in-Place Option: The contaminated area may be resistant to decontamination products or may be impossible or impractical to mitigate or treat. Physical barriers can be used to prevent the contaminated area from coming into contact with the environment or the public. This can be a temporary or permanent solution.

13.2. Decontamination Strategy:

A decontamination strategy can be developed by designating areas based on the visible presence of powders or residues following initial physical or mechanical removal of low-level fentanyl contamination, although visual cues may be highly subjective.

- **Strategy for Removal of Visible Solids:** The spread of fentanyl can be minimized though the use of negative air machines (NAM) to control the air flow from a contaminated area. Residual fentanyl may be cleaned up by dry vacuuming with HEPA filtration. Only manufacturer-certified HEPA vacuum equipment should be used, and HEPA function of certified equipment should be verified. **Under no circumstances should a non-HEPA vacuum or a broom be used to remove solids.**
- **Strategy for Physical Removal of Residual Fentanyl on Materials:** Water and detergent solutions will help to physically remove fentanyl from hard, non-porous surfaces. However, the waste solution will contain fentanyl due to its stability in water under many environmental conditions. Waste solution may also contain undissolved fentanyl. Cleaning porous surfaces with water and detergent solutions is also possible but may potentially transfer fentanyl further into the porous material, making it more difficult to thoroughly decontaminate.
- **Strategy for Surface Decontamination via Chemical Degradation:** Ideally, decontamination using efficacious chemical-based decontaminants will result in degradation of fentanyl on surfaces and will generate aqueous waste with no or minimal amounts of fentanyl. Appropriately chosen decontamination formulations produce decontamination byproducts with expected lower toxicity, although some byproducts themselves may be DEA controlled substances. The current literature on byproduct formation following oxidation is limited due to the variety of potential oxidants and application conditions.

CAUTIONS:

- Because the potential for inhalation exposure exists during decontamination/cleanup activities, proper exposure controls should be used to minimize risk. In addition to appropriate PPE, the use of NAMs and other engineering and work practice controls commonly used for asbestos or lead abatement should be considered to mitigate the spread of airborne particulates.
- Decontamination products may have unique safety/PPE requirements due to their own toxicity or that of degradation or breakdown products during use (e.g., use of pH adjusted bleach results in release of chlorine vapors). Strong oxidizers, such as hypochlorite, may react violently with organics.
- Dirt, grime, and other coatings (organic load) can reduce the efficacy of decontamination; pre-cleaning surfaces with soap and water may be needed before the application of decontamination formulations but resulting pre-cleaning rinsates require containment to avoid fentanyl spread.
- As a common type of organic load, fentanyl preparations may contain a substantial fraction (even greater than 95%) of other substances, such as other illicit drugs, cutting agents, or diluents, that effectively compete for the active oxidant in decontamination solutions. This organic load is mixed with the fentanyl so it cannot be pre-cleaned. Sufficient oxidant must therefore be applied to degrade both the fentanyl and the cutting agents and/or other substances. In practice, it can be difficult to estimate the total amount of oxidant needed for a particular site, i.e., for the total amount of fentanyl and other substances. Decontamination solutions are often tested for comparative efficacy between decontaminants, not efficacy per amount fentanyl and other substances present.
- Another property of fentanyl influencing chemical degradation is the pH of the overall solution because the aqueous solubility of fentanyl changes by a factor of ~100 as it converts from free base to salt form as pH changes. Dissolved

fentanyl can be more reactive than undissolved fentanyl, so site-specific conditions leading to high pH may result in slower degradation. Visual dissolution of a powder may provide some indication of degradation but is not necessarily reliable.

Application of the following decontamination solutions and formulations may be efficacious by following applicable manufacturers' directions. It is important to note that manufacturers' directions may result in physical removal (e.g., washing) without chemical degradation of fentanyl, and it may not be clear if a particular decontamination product results in physical removal and/or chemical degradation. This occurs because active ingredients in a product are sometimes unclear, and also because a manufacturer's directions sometimes do not allow separation of physical from chemical processes. Physical removal may be sufficient, even desirable, in some cases, although the resulting aqueous solution may then be treated further (see Section 13.3 Aqueous Solutions below).

- **Hypochlorite-containing solutions:** Hypochlorite can be corrosive to certain surfaces and materials and should be rinsed thoroughly afterwards. Household bleach solutions (≥5% sodium hypochlorite) are less effective for fentanyl degradation on surfaces likely due to lower solubility of fentanyl at high pH when the amount of fentanyl is greater than the amount that can be readily dissolved. Degradation was ~70% after 1-hour contact time with full strength bleach. Adjusting pH to neutral or more acidic pH=5 using water and vinegar significantly improves efficacy to better than 95% after 1-hour contact time on non-porous materials. pH 5 bleach can also be prepared from commercially available bleach products at neutral pH bleach using less vinegar. Lowering the pH of bleach solutions will lead to release of chlorine gas, requiring appropriate PPE. Calcium hypochlorite, present in commercial products, such as HTH (10% hypochlorite solution) has higher pH and therefore will lower the solubility of fentanyl.
- **Activated hydrogen peroxide-containing products:** Proprietary decontamination technologies, such as EasyDECON® DF-200 and Decon7 (D7^{TM}), are highly effective in degrading fentanyl with better than 99% efficacy after 1-hour contact time on non-porous materials for amounts of fentanyl that are soluble at the near neutral pH of these solutions.
- **Peroxyacetic acid-containing products:** The proprietary decontamination technology Dahlgren Decon® is highly effective in degrading fentanyl with better than 99% efficacy after 1-hour contact time on non-porous materials for amounts of fentanyl that are soluble at the near neutral pH of this solution. Four-fold (1:4) diluted Dahlgren Decon® solution can be 90% effective in degrading fentanyl in less than five minutes for amounts of fentanyl that do not exceed the oxidant available in the diluted solution. Other peroxyacetic acid-containing products that are available for use such as MINNCARE® Cold Sterilant, Oxonia Active®, and Peridox RTU®, may not be effective due to the lack of an activating chemical as present in Dahlgren Decon® formulation.
- There are other cleaning products that are not efficacious in degrading fentanyl. Products containing surfactants and hydrogen peroxide without activator are unlikely to be efficacious with possibly more than 60% of fentanyl remaining on the surface after 1-hour contact time. OxiClean™ generates a low (less than 1%) hydrogen peroxide solution and does not degrade fentanyl appreciably after a 1-hour contact time on non-porous materials.

Large Volumetric Spaces: This category is for areas larger in size but with lower levels of agent contamination. These areas may require less aggressive but more broadly applied decontamination products and methods. Commonly used volumetric technologies include (modified) vaporous hydrogen peroxide and chlorine dioxide (ClO_2). Early research results indicate that these technologies are not effective against fentanyl on surfaces due to the inherently slow interaction rate between a solid and a vapor/gas compared to a liquid and a vapor/gas.

Sensitive Equipment or Items: For difficult-to-clean equipment that may be contaminated with small amounts of fentanyl, options for consideration include flushing with soap and water. Proprietary decontamination technologies EasyDECON® DF-200, Decon7 (D7^{TM}), and Dahlgren Decon® have shown a combination of high efficacy and good material compatibility, although material compatibility for specific items should be verified.

13.3. Decontamination Strategy for Aqueous Solutions and Water Systems:

Aqueous Solutions: Fentanyl may be removed from water by adsorption processes, although the adsorption process should be verified for site-specific conditions such as pH and other substances that may compete for the adsorbents. A simpler approach can be addition of reactive decontaminants, such as those mentioned above in Section 13.2 for surface decontamination strategies. Of these, hypochlorite bleach may be readily and economically available and can be used without pH adjustment. While pH adjustment improves efficacy during practical contact times (~1 hour) for surface decontamination strategies, the contact time for treatment of aqueous solutions in containers can be much longer (days). Accordingly, the use of amounts of hypochlorite bleach that provide forcing conditions, up to 50% by volume, can lead to degradation of fentanyl, byproducts, and precursors, along with cutting agents and other substances often present. Lower percentages can be used if the fentanyl purity is known. Because fentanyl formulations can contain very large quantities of substances that compete for oxidant and because some byproducts may be DEA controlled substances, it may be necessary to ensure adequate contact time and ensure adequate bleach levels to ensure sufficient degradation for site-specific goals.

Water Systems: The solubility of fentanyl in water may result in its efficient removal by flushing and lessen the likelihood that fentanyl will adhere to water system components, but fentanyl may persist in hydraulic dead ends and other areas of low flow. It may be necessary to isolate potentially affected portions of the system to evaluate them and implement decontamination. Oxidative treatment steps within drinking water and wastewater plants and systems may help degrade fentanyl, but complete degradation should not be assumed. Reaction with residual oxidant, like hypochlorite, in drinking water distribution systems may help degrade fentanyl, but residual oxidant levels can vary

substantially throughout the system and may be minimal in some locations. These residual oxidant levels are typically around 1mg/L, orders of magnitude lower than the oxidant levels for surface decontamination strategies, resulting in slow degradation.

Verification of Decontamination: Site and situation specific. Please contact EPA/HQ-EOC at 202-564-3850 for further assistance.

14. Waste Management for Residual Contamination

Waste Management for Residual Contamination

NOTE: This section addresses waste management for fentanyl remediation (cleanup and removal of residual contamination). Fentanyl remediation typically begins after law enforcement has completed removal of bulk fentanyl or fentanyl-related substances and cleanup of gross contamination at an illicit drug site and cleared the site for entry for the Federal OSC to begin the process for remediation of any fentanyl residues prior to a return to normal use of the site.

14.1. Transportation:

Federal requirements for the commercial transport of hazardous materials and procedures for exemptions are specified in How to Comply with Federal Hazardous Materials Regulations, available at: https://www.fmcsa.dot.gov/regulations/hazardous-materials/how-comply-federal-hazardous-materials-regulations.

Contact the PHMSA Hazardous Materials Information Center at 1-800-467-4922 or infocntr@dot.gov to discuss specific cases. Additional resources on packaging, labeling, and shipping are available at: https://www.phmsa.dot.gov/training/hazmat/how-use-hmr. Detailed state regulations can be found at www.envcap.org/.

Classification and transportation requirements will depend on the concentration of fentanyl or fentanyl-related substances and on the hazardous properties of any other materials contained in the waste. While pure fentanyl is classified as Division 6.1, fentanyl waste streams may meet the definition of different or additional hazard classes (e.g., when containing oxidizing or corrosive liquids) and must be properly classified and transported based on all hazards of the waste.

14.2. Waste Management:

Under the Resource Conservation and Recovery Act (RCRA), waste is classified as hazardous waste (subtitle C) or solid waste (subtitle D). The RCRA regulations generally define a waste to be hazardous if it is: (1) a listed waste (40 CFR §261.31-§261.32); (2) exhibits specific characteristics (40 CFR §261.21-§261.24); or (3) is a discarded commercial chemical product, off specification species, container residue, or spill residue listed in 40 CFR §261.33. Fentanyl or fentanyl-related substances are not listed under 40 CFR §261.31-33 and do not generally meet the definitions of a characteristic hazardous waste. One exception is that waste fentanyl sublingual spray (Subsys®, a DEA Schedule II controlled substance) meets the definition of an ignitable hazardous waste (D001) when disposed of because it is prepared in alcohol. Although fentanyl-contaminated wastes may not technically meet the definition of RCRA hazardous waste, due to the highly toxic nature of fentanyl and associated opioids the waste generator should consider managing such wastes as RCRA hazardous waste to ensure that they are treated and disposed of in a manner that is protective of human health and the environment. It is the responsibility of the waste generator to make a hazardous waste determination (40 CFR §262.11).

The states (except for Alaska and Iowa) have the primary responsibility to implement the RCRA hazardous waste regulations and can impose more stringent requirements or requirements broader in scope than the federal program. It is critical to open a dialogue with state regulators as early as possible to determine any state-specific requirements with regard to fentanyl-contaminated wastes. Once identified, potential waste management facilities should also be contacted to determine their waste acceptance criteria.

Management of toxic decomposition products, associated residual decontamination solutions, local waste acceptance criteria, and transportation and handling requirements should be considered. High pH aqueous decontamination solution waste may be considered corrosive hazardous waste, chemical code D002, if it has a pH greater than or equal to 12.5 (40 CFR §261.22).

EPA also recommends the creation of pre-incident waste management plans as a preparedness measure for chemical agent releases, and has created an **All-Hazards Waste Management Planning Tool** to help state, local, territorial, and tribal waste management officials coordinate and prepare these plans. Access to the All-Hazards Waste Management Planning Tool requires pre-registration (https://wasteplan.epa.gov/).

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