Noviryn's Fentanyl Defender

An innovative preventative measure against Fentanyl and Carfentanil

Executive Summary

The escalating opioid crisis, particularly the proliferation of fentanyl and its analogs like carfentanil, poses a severe threat to public safety and the health of first responders, medical personnel, and law enforcement. These synthetic opioids are exceptionally potent. Potential exposure through inhalation, skin contact, or accidental ingestion can result in life-threatening toxic effects, including severe respiratory depression, unconsciousness, and death. Current decontamination protocols are inadequate, leaving frontline responders vulnerable.

Noviryn's *Fentanyl Defender* offers a cutting-edge solution to mitigate the dangers of fentanyl and carfentanil exposure. Leveraging proprietary technology originally developed for chemical and biological warfare decontamination, Noviryn has designed the solution to meet FDA standards while maintaining rapid efficacy. This innovative system achieves 99.9% clearance of fentanyl and carfentanil within two minutes, ensuring responders are protected from toxic and cross-contamination risks.

Introduction

Carfentanil and other fentanyl-related compounds are a serious danger to public safety and can come in several forms, including powder, blotter paper, tablets, and spray. If not properly decontaminated, airborne powders can be inhaled and even absorbed through the skin. Numerous accounts of accidental dosage resulting in a toxic response have been documented, and the threat of passive cross-contamination is extreme. Exposure by inhalation of aerosolized powder, transdermal transportation, and accidental passage by hand to mouth are possible. The dosage necessary for a toxic response is beyond the ability of the human eye to discern, as microgram quantities can provoke toxic responses.

The Drug Enforcement Administration (DEA) has issued a public warning to the public and law enforcement nationwide about the health and safety risks of fentanyl and carfentanil. Carfentanil is a synthetic opioid that is 10,000 times more potent than morphine and 100 times more potent than fentanyl, which itself is 50 times more potent than heroin. DEA, local law enforcement, and first responders have recently seen the presence of carfentanil, which has been linked to a significant number of overdose deaths in various parts of the country. Improper handling of carfentanil, as well as fentanyl and other fentanyl-related compounds, has deadly consequences.

"Carfentanil is surfacing in more and more communities," said DEA Acting Administrator Chuck Rosenberg. "We see it on the streets, often disguised as heroin. It is crazy dangerous. Synthetics such as fentanyl and carfentanil can kill you. I hope our first responders - and the public - will read and heed our health and safety warning. These men and women have remarkably difficult jobs, and we need them to be well and healthy."

Effects on humans

Carfentanil citrate (methyl 4-(1-oxopropyl) phenylamino-1-(2-phenylethyl)-4-piperidine carboxylate-2-hydroxy-1,2,3-propanetricarboxylate) is an analogue of the synthetic μ-opioid agonist fentanyl. Fentanyl (N-phenyl-N-[1-(2-phenylethyl)-4- piperidinyl]propanamide) is a water-soluble solid that exists in a crystal or crystalline powder form. The effects of fentanyl and carfentanil are similar to those produced by other illicit opioids. They include euphoria, relaxation, analgesia, myosis, drowsiness, sedation, bradycardia, hypotension, hypothermia, loss of consciousness, and respiratory depression. The drug is endowed with a high abuse liability and dependence potential. Importantly, due to their extraordinarily high affinity to opioid receptors, even very small doses are pharmacologically active. The most serious acute health risk from using carfentanil is rapid and severe respiratory depression, which could lead to apnea, respiratory arrest, and death in overdose. The pharmacodynamic effects of inhaled aerosolized carfentanil were examined in mice. Loss of consciousness and Straub tail were observed within 1 min of exposure, along with decreases in blood pressure, minute volume, heart rate, and core body temperature lasting for up to 24 h post-treatment. In rats, carfentanil given subcutaneously produced significant hypothermia that lasted for four hours (3 μg/kg) and eight hours (10 μg/kg). Due to low molecular weight and high lipophilicity, carfentanil can be inhaled or even absorbed through the skin.

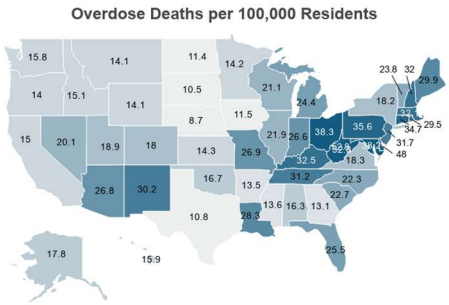
Issues

Fentanyl and carfentanil can resemble powdered cocaine or heroin and are toxic in microscopic quantities that are not visible. First responders and other emergency response personnel may be unaware of the present danger at an event or scene. Improperly handling fentanyl or carfentanil may lead to deadly consequences. Moreover, police, fire, and EMS personnel are not generally equipped with extensive personal protective equipment (PPE), which typically accompanies hazardous material team operatives required to deal with hazards such as opioids safely.

Most of the fentanyl trafficked by the Sinaloa and CJNG Cartels is being mass-produced at secret factories in Mexico with chemicals sourced largely from China. In 2021, the DEA issued a Public Safety Alert on the widespread drug trafficking of fentanyl in the form of fentanyl-laced, fake prescription pills. These pills are made to look identical to real prescription medications—including OxyContin®, Percocet®, and Xanax®—but only contain filler and fentanyl and are often deadly. Pills bought on social media are not safe.

The exponential growth of overdose deaths has involved three overlapping opioid waves: prescription opioids, heroin, and synthetic opioids, including fentanyl and its analogs. Since 2016, the majority of overdose deaths have been linked to synthetic opioids. The surge in availability of fentanyl and its analogs in the US was driven by market forces, including the increased ease of production, increased demand for cheaper opioids, and the ease of online sales of these chemicals.

The spread of fentanyl and carfentanil has become an epidemic across the nation. Virtually no community remains untouched by the potential. The following demonstrates the far-reaching impacts of the opioid crisis:



Technology Development

Noviryn's founder was the original licensee of the Sandia Decon Formulation developed by the US Department of Energy (DOE). The proprietary formulation results from advancements in molecular chemistry, resulting in a highly effective yet safe-to-use system. Originally designed as a broad-spectrum chemical and biological warfare agent decontaminant, Noviryn's senior scientists reformulated the technology to conform to the regulatory requirements established by the USFDA while maintaining its high degree of rapid efficacy. The Company developed a proprietary formula suitable for use as a skin cleanser/decontaminant, utilizing the tenets of the underlying technology. In the development phase, Noviryn examined the pharmacological data of fentanyl and carfentanil, as illustrated in Table 1.

Table 1. Pharmacological and toxicological dosages for fentanyl and carfentanil

Dosage of fentanyl via bolus injection for a minor surgical procedure	0.5 µg/kg of body weight
Label claim of fentanyl dosage in a transdermal patch	0.4 mg/cm^2, 400 µg/cm^2
LD_{50} in Monkeys for fentanyl	0.03 mg/kg of body weight
LD_{50} in rats and mice for carfentanil	3.39 and 18.75 mg/kg

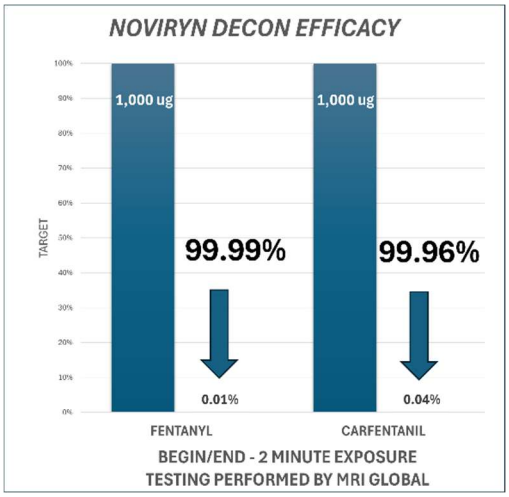
The amount of Fentanyl needed to promote a toxic response was estimated by using the minimum amount needed to promote pain interruption for a minor surgical procedure. This amount is 0.5 micrograms per kg of body weight when administered by an IV bolus. Assuming an average body weight of 80 kgs, the resulting minimum needed to promote a toxic (therapeutic) response is

$$\mathbf{0.5\ \mu g\ per\ kg\ \times 80\ kg\ = 40\ \mu g}$$

This was then reduced by a factor of 10 to promote a margin of safety arriving at a threshold toxic limit of 4 micrograms. For the sake of design, this limit was accepted for inhalation and skin contact. Those two dosage routes are not as direct as IV and are less likely to promote exposure toxicity. The tactical realities of encountering fentanyl or carfentanil led to an effort to address the most likely route of exposure: contact with the human hand. We estimated that the human hand has a palm-side surface area of approximately 200 square centimeters. Applying the tolerable limit described above, a fentanyl-contaminated surface would need to be treated to reduce the amount to less than 0.02 µg/cm^2. Visually seeing 4 µg spread out over 200 cm^2 is impossible. It would be challenging, if not impossible, to see 1,000x that amount, 4 mg, spread out over the same area, particularly if the surface is articulated or mottled.

The amount of decontamination agent needed is an essential factor in the deployment decision. The underlying chemistry is based on the presence of activated oxygen species, surfactant micelles, proprietary buffering systems, and the pH conditions designed into the product. Fentanyl and carfentanil are susceptible to hydrolysis, oxidation, and nucleophilic attack. All three of those mechanisms are present in Noviryn's formulation. The decontamination reactions occur in the aqueous phase of the solution, and the hydrophobic micelle phase is dispersed in solution. It is reasonable to project that one mole of peroxide will react with one mole of fentanyl. To build a margin for safety, we established a stoichiometric relationship of 100 moles of peroxide needed to treat one mole of fentanyl hydrochloride. The minimum fentanyl toxic dosage levels were set at 40 micrograms (µg) (or 0.04 milligrams), and therefore 0.2 µg/cm^2. Initial screening confirmed that fentanyl was destroyed > 99.9% on a surface at a dosage of 11 µg/cm^2 and is effective (> 99.9% clearance) at a minimum of 1 mL for every 100 µg of Fentanyl in 7 minutes.

To realistically estimate potential exposure and logistical operational considerations, target lethal contamination doses of 1,000 µg fentanyl and carfentanil were selected for testing after an accelerated time frame of two minutes of contact. 10 mL of Noviryn Fentanyl Defender, representing a logistically optimal and portable amount of solution, was used as the challenge level. The independent laboratory testing conducted by MRI Global in December 2024 resulted in the rapid destruction of both fentanyl and carfentanil, as illustrated in the following graph:



This means that less than <1 µg of fentanyl and carfentanil remained after a 2-minute treatment of Noviryn's Fentanyl Defender. This is well below the estimated toxic dose limits and demonstrates the capability of mitigating the harmful effects of opioids, including reducing the risk of cross-contamination.

First responders increasingly encounter fentanyl-related compounds in environments where traditional hazardous material protocols and personal protective equipment (PPE) are impractical. With overdose deaths surging due to synthetic opioids, the need for an effective, easy-to-use decontaminant has never been greater. Noviryn's Fentanyl Defender bridges this critical gap by providing immediate, reliable protection.

Key Features

Noviryn's Fentanyl Defender has the following key features:

- High-Efficacy Decontaminant: Rapidly neutralizes fentanyl and carfentanil on contaminated surfaces, reducing residual amounts to well below toxic thresholds.
- Portable and Practical Design: The decontamination kit includes a lightweight, pocket-sized burst pak containing the solution and an absorbent pad for safe cleanup and disposal.
- Validated Performance: Independent testing by MRI Global and the US Army Combat Capabilities Development Command confirmed the superior effectiveness of Noviryn's formulation compared to conventional solutions alone, such as water or soap.
- Versatile and Safe: The solution is effective against a broad spectrum of hazardous materials, ensuring protection in diverse emergency scenarios. It is also safe on skin.

Use Parameters

Frontline first responders and emergency personnel are often not supplied with the appropriate hazardous material PP&E and are unprotected against accidental exposure. Current protocols call for immediate cleansing with water or the drug to be removed mechanically in case of unintentional skin contamination. Alcohol-based hand sanitizers are contraindicated as they may support transdermal absorption. Further, water is generally not readily available. Cross-contamination and accidental inhalation risks are high if decontamination procedures are not initiated.

Moreover, testing conducted by the US Army Combat Capabilities Department Command – Chemical Biological Center confirmed that decontaminants such as 5% Sodium Hydroxide (soap), DI water, and RSDL showed no neutralization capability against fentanyl and carfentanil.

Noviryn's Fentanyl Defender economical decontamination kit consists of a highly compact, lightweight, and portable 2" x 3" amber zip lock that can be easily carried in a pocket. The decontamination solution (10 mL) is supplied in a specially designed 3-part burst pak that keeps the components separated until use. The kit also contains a specialized, highly absorbent pad that can remove all the applied solution and contaminants from the skin, providing functional removal. The pad is versatile, designed to absorb a wide range of hazardous materials, including acids, bases, corrosive chemicals, and unknown liquids, providing first responders with better safety. As the pad takes on the properties of the absorbed liquids, the amber zip lock serves as a convenient disposal container for the saturated absorbent. This configuration also lends itself to being a component of an enhanced kit that would include doses of Narcan, which would be a desirable field decon response kit for first responders.

Professional Endorsement:

"Given the inherent, immense dangers associated with inadvertent exposure to Fentanyl and Carfentanil faced by first responders, and my personal experience in witnessing these dangers in practice, I anticipate that Fentanyl Defender

represents a bona fide solution for effective cleansing and removal of contamination in the field when hazmat resources are unavailable. It truly is a breakthrough application that can greatly facilitate protecting our nation's first responders"

Dr Todd Leonard MD CCHP-CP

Call to Action:

Protecting our nation's emergency personnel is paramount. Noviryn's Fentanyl Defender represents a transformative approach to mitigating the risks associated with fentanyl and carfentanil exposure. By implementing this solution nationwide through government initiatives, we can safeguard first responders, enhance public safety, and restore community confidence.

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