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Special Contribution

Scene Safety and Force Protection in the Era of Ultra-Potent Opioids

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Abstract

Ultra-potent opioids (fentanyl, carfentanil) are now widely available and fueling an epidemic of overdose. First responders are increasingly exposed to these potent narcotics necessitating guidance for scene safety and force protection from medical directors. Reports in lay media have sensationalized accounts of exposure and harm that may lead providers to fear providing care to patients suspected of opioid overdose. The likelihood of prehospital providers suffering ill effects from opioid exposure during routine emergency medical services (EMS) operations is extremely low. We propose recommendation to assist medical directors in providing guidance and education to their providers minimizing the risk of provider exposure while allowing the delivery of prompt and appropriate care to patients with suspected overdose.
Key words: overdose; scene safety; carfentanil; PPE

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Introduction

Overdose deaths from opioids have reached epidemic proportions in the United States. According to the Centers of Disease Control and Prevention (CDC), there were 52,404 drug overdose deaths in 2015 with 33,091 from opioids.[1] More than 500,000 Americans died from unintentional drug overdose since 1999 making overdose the leading cause of accidental injury death in the United States.[2] This trend was initially driven by prescription opioid misuse, but has since been supplanted by inexpensive and potent heroin and illicit synthetic opioids.[1] While prescription opioid deaths have remained relatively stable since 2011, deaths related to heroin and illicit synthetic opioids (including fentanyl, carfentanil, and its derivatives) rose by 20.6% and 72.2%, respectively, with 2015 representing the first year in which illicit opioid overdose deaths surpassed prescription opioid deaths.[2] Representative of many communities in the United States, Pennsylvania's Allegheny County, reported fentanyl related deaths surpassing heroin deaths for the first time in 2016[3] (Figure 1). The 2016 DEA Emerging Threat Report identified 15 synthetic opioid and fentanyl analogues including carfentanil and U-47700. Of those 15, nine were reported for the first time in 2016.[4] These findings demonstrate the rapid evolution of available opioids and the surge of potent fentanyl analogues with an associated increase in mortality (Figure 2).

Medical and law enforcement first responders have anecdotally reported observations related to the increasing variety and potency of synthetic opioids which they have encountered. First, it has been widely, though anecdotally, reported that higher doses of naloxone are required to achieve reversal of higher potency synthetic opioids.[5] Furthermore, although naloxone has continued to be effective in the management of acute opioid toxicity even in these settings, physical contact between victims and first responders is anticipated due to the need for basic life support while awaiting the effects of naloxone.[6,7] Popular media reports describe law enforcement exposures to synthetic opioids and potential toxicity requiring treatment. A minimal amount of peer-reviewed data exists to inform definitive guidelines for first responder safety. We propose recommendations for first responder force protection based upon pharmacologic understanding of fentanyl as well as recently growing clinical experience with the breadth of synthetic drugs.

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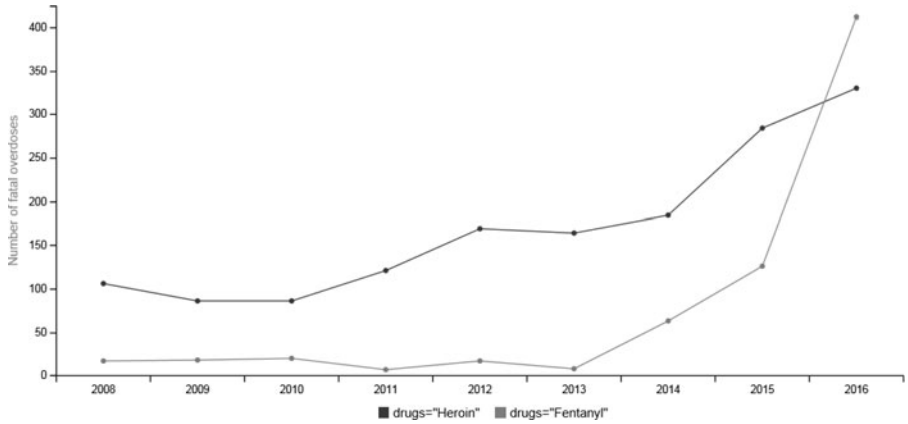

FIGURE 1. Opioid related deaths in Allegheny County, Pennsylvania 2008–2016 Adapted from Karl Williams, MD, 2017. Opioid Related Deaths in Allegheny County https://www.overdosefreepa.pitt.edu/know-the-facts/view-overdose-death-data/ downloaded on June 25, 2017 (Used by permission).

FENTANYL PHARMACOLOGY

Fentanyl and its analogues are primarily injected or ingested through contact with mucous membranes (snorting). Transdermal delivery of fentanyl has been described and developed for decades, however, crystallized or powdered fentanyl has markedly diminished absorption and systemic availability.[8] Fentanyl has demonstrated relatively favorable skin permeation characteristics, but requires pharmaceutical delivery mechanisms to achieve meaningful systemic levels.[9] In order to promote diffusion across epidermal skin layers in patch formulation, fentanyl is typically produced in an alcohol-based solution and gelled with hydroxyethyl cellulose.[10] Small studies of occupational exposure in pharmaceutical production workers loading, filtering, drying, and packaging large amounts of powdered fentanyl have shown dermal absorption of clinically insignificant levels of fentanyl following prolonged exposure.[11,12] The primary sites of skin exposure to fentanyl were the hands and distal forearms.[12] Factors such as temperature and skin integrity contribute to absorption, as well.[13] Oral and nasal mucosal absorption of liquid and solid form fentanyl is well established with a variety of existing pharmaceutical products including effervescents, sprays, lollipops, and lozenges.[14,15] Specific absorption and pharmacokinetic data are limited for carfentanil and other emerging synthetic opioids; however, a study of sufentanil indicated similar absorption characteristics.[16]

Industrial production and pharmacokinetics of fentanyl would indicate that there is a theoretical risk of skin absorption; however, rapid absorption of crystallized or powdered fentanyl or fentanyl derivative outside of solution is unlikely. Extended contact, particularly in the presence of diaphoresis, elevated temperature, or defect in the skin may potentially increase the likelihood of absorption.[16] The use of ethanol based hand sanitizers in the field may cause increased transdermal absorption of powdered fentanyl on the skin, and cannot be recommended for use under these circumstances. Copious amounts of water and a mild detergent are suggested to eliminate suspected fentanyl contamination or to remove bodily fluid contamination. Mucous membrane exposure due to airborne dust, while more likely to result in drug absorption, is uncommon.[12]

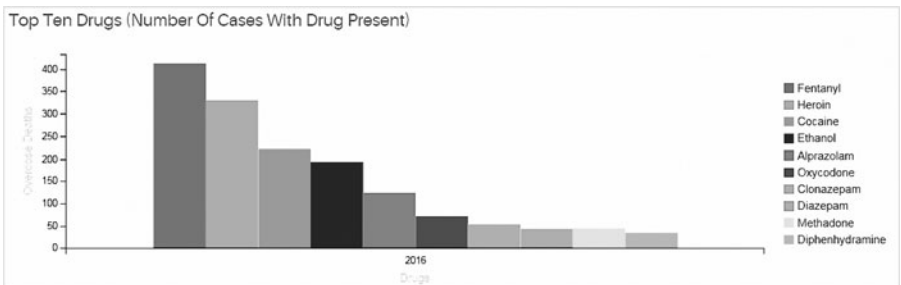

FIGURE 2. Etiology of overdose deaths in Allegheny County, Pennsylvania. Adapted from Karl Williams, MD, 2017. Etiology of Overdose Deaths in Allegheny County, PA https://www.overdosefreepa.pitt.edu/know-the-facts/view-overdose-death-data/ downloaded on June 25, 2017 (Used with permission).

Prehospital Exposure

Occupational data during fentanyl pharmaceutical production is not necessarily indicative or predictive of prehospital risk. Much smaller quantities of drug are present in the prehospital environment. Handling of drugs is inadvertent, brief, and relatively uncommon. At the same time, the formulation of illicit powder is extremely variable with individual drug constituents unknown to the responder. Increasingly potent fentanyl derivatives are now widely available and the specific pharmacological and pharmacokinetic properties of the various drugs are less well known that those of pharmaceutical fentanyl. These factors plus the wide range of situations in which providers may find themselves makes universally applicable guidelines difficult to develop.

Occupational exposure by first responders and law enforcement fall primarily into two categories: 1) healthcare response to a presumed overdose or other emergency medical condition and 2) confiscation of drug evidence as part of operational law enforcement activities. The latter scenario typically is less time dependent allowing for environmental investigation and hazardous materials protocols to be applied. Regardless of the type of occupational exposure, maintaining a standard protective posture based upon a hierarchy of controls is of fundamental importance.[17]

This paper will primarily focus on the first group in which providers are responding to a presumed medical emergency and the administrative and personal protective stance needed to manage the scene when elimination or isolation of the hazard is not possible. In either case, safety of the responders is of paramount importance.

Scene Assessment

As with any emergency response, a careful scene safety assessment is necessary with particular attention to identification of visible powder or other drug related paraphernalia. Whenever possible, powdered or packaged drug should not be handled or disrupted by responders. At no time should providers attempt to identify the substance by tasting or touching the material. Environments in which unidentified powder is visible should be exited as soon as it is reasonably safe. However, visible powder without evidence of disruption or airborne dust should not preclude identification, removal, and standard treatment of a victim. Cases in which powder has clearly been disrupted and dust particles are identified are rare but should prompt careful evaluation of the scene and danger to personnel. Principles of time, distance, and shielding (in this case barrier devices associated with universal precautions including gloves, long sleeves, and pants, and a particulate [N95] mask) should be utilized to minimize exposure. When multiple victims are identified, particularly when there are no unaffected individuals at the scene, alternative scenarios such as carbon monoxide exposure, hydrogen sulfide, or other toxic gases should be considered. Great caution should be taken as well as consideration of higher levels of PPE including full skin and mucosal coverage. Individual scenarios will vary and on-scene responders will need to determine the level of perceived threat. These rare situations should not prevent normal response to routine emergency calls. Universal precautions (gloves, masks, eye protection when indicated) should be followed and would be expected to prevent toxic exposure to illicit drugs in nearly all circumstances. While published data regarding first responder safety with the advent of highly potent opioid derivatives do not exist, the widespread national availability of these drugs combined with the infrequent of reports of emergency medical responder, drug dealer, and illicit drug lab exposure incidents are encouraging that routine performance of these activities is unlikely to result in toxicity. Much like handling a dirty bomb scenario, first responders should understand the risks of inhalation or ingestion of this material and take adequate steps to prevent this from happening.

Personal Protective Equipment

Pharmacologic properties of fentanyl and occupational exposure data suggest that use of a single pair of nitrile gloves would be expected to prevent inadvertent absorption of fentanyl and its derivatives when there is no evidence of visible powder. Simultaneous donning of multiple pairs of gloves is not necessary. Following the therapeutic encounter, gloves should be immediately removed and disposed of in an appropriate medical waste container to prevent accidental secondary exposure. More extensive coverage may be necessary if free powder is visualized. Normal universal precautions should otherwise be followed.

Management of a patient who is presumed to be suffering toxicity from an opioid including fentanyl derivatives should not routinely require use of a mask. While aerosolized dust may be anticipated following disruption of free powder, medical care of a patient who has injected, snorted, or otherwise ingested any type of opioid would not be expected to result in airborne drug particles. Therefore, we do not recommend routine use of masks of any kind for medical response to a potential overdose.

When a small amount of free powder is identified, caution should be taken to avoid touching or disturbing the powder. In the prehospital setting, it is unlikely that the provider will know the composition of the powder. Universal precautions should be taken and the powder essentially treated as a body substance such that any contact is avoided, no bare skin

contact is permitted, and inadvertent contact should result in immediate cleansing of the area with copious water or saline irrigation to flush away any contaminant. Ethanol-based sanitizers should be avoided as they could potentially enhance skin absorption. Even in the presence of a small amount of visualized powder, a mask is unlikely to be necessary if it remains undisturbed.

There are no data regarding the ideal type of mask to prevent oral and nasal mucosal exposure to heroin and synthetic opioids. Airborne fentanyl or other synthetic analogues, when present, would be expected to be a dust rather than a gas or fume. While carfentanil has been implicated in gas attacks, this was a weaponized preparation, not the street level drug, primarily found as a powder, pressed into pill form, or in liquid solution.[18] Dust from the disruption of powdered drug is likely the primary source of respiratory or mucous membrane exposure. In this case, a simple surgical mask would likely provide a barrier to dust particles; however, in order to provide a more complete seal to a provider's face, an N-95 mask would be expected to prevent nearly all oral and nasal exposure. In environments with significant risk of airborne contact as in a manufacturing facility, following deployment of an explosive (as was reported in Connecticut following use of a stun grenade),[19] or other disruptive forces such as fans, it is reasonable to consider full body and face coverage as is recommended by the National Institute for Occupational Safety and Health (NIOSH).[20] Environmental exposure to airborne powder or aerosolized drug is more likely to be encountered during the course of law enforcement operations rather than primary medical response. However, if such an environment were to be encountered by medical responders, it would be prudent to attempt to remove victims from the scene, if assessed to be safe, and retreat from the area until further investigation and resources, including potentially a Hazardous Material team, can be activated.

Popular media reports of possible law enforcement exposure and toxicity have included removal of dust from clothing. Clothing should act as an appropriate barrier to direct skin contact, however, secondary exposure through hand contact or production of dust is unlikely but possible. If powder or dust is identified on clothing, a disinfectant wet wipe should be used with a gloved hand to remove it. Using a wetted wipe will prevent significant aerosol of dust and disinfectant wet wipes have been shown to remove approximately three times more dust from skin than water-based ones.[12] Following dust removal, clothing should be carefully removed and laundered at the first opportunity. Additionally, after any shift in which potential contact with a drug could have been made, clothing should be removed and washed as soon as possible to prevent a potential, though very unlikely, secondary exposure. Similarly, the provider should change into a clean pair of gloves prior to doffing a mask to avoid inadvertent contamination of mucous membranes. If there is any concern for external contamination the provider should shower as soon as is practicable.

Patient Care Considerations

While larger doses of naloxone have been widely, though anecdotally, reported necessary to reverse toxicity from potent opioids and fentanyl analogues, naloxone is still appropriate and effective therapy.[5] The reported "resistance" to naloxone is likely multifactorial. Rising potency and receptor binding potential of newer analogues can certainly contribute to dose requirements. Other factors may include exposure to non-opioid sedatives; administration of naloxone after anoxic brain injury and other secondary organ dysfunction that has already occurred; larger initial doses and increased frequency of administration with higher dose nasal formulations; and incomplete understanding of appropriate endpoints of treatment being reversal of respiratory depression and not necessarily arousal. Regardless, naloxone administration with dose escalation when no response is observed within 2–3 minutes remains the appropriate pharmacologic intervention and should be employed by first responders and bystanders, when available. First responders and lay rescuers should place emphasis on activation of the EMS system and escalation of care with the intent to expedite transport to definitive medical care. At the same time, the primary risk to opioid overdose victims is respiratory depression with associated hypoxemia and hypercapnia. Therefore, in situations where respiratory depression is observed, assisted ventilation should be initiated at the earliest opportunity with or without naloxone administration. Ventilation should not be delayed while administering naloxone or awaiting a response. Fentanyl and other opioids are not exhaled. Bag valve mask ventilation or barrier-assisted rescue breathing will not result in secondary provider toxicity while managing a patient who has suffered an opioid overdose. However, if there is visible drug on a patient's face, it is appropriate to remove the powder with a gloved hand prior to initiation of ventilation.

Provider Exposure

There has been understandably growing concern about responder safety with the advent of a diverse array of potent opioids available on the streets throughout the country. Anecdotal stories of law enforcement exposure have been reported in popular media. It is important to note that while these reports are troubling, exposure and toxicity have not been verified in peer-reviewed publications. Symptoms described in media accounts are not consistent with anticipated

opioid toxicity, but complete descriptions of medical outcomes are publicly unavailable. We are not aware of any substantiated accounts of medical responder exposures resulting in toxicity and our goal is to maintain the safety of first responders. In addition to preventing exposure, plans should be in place to manage a potential responder exposure. Providers should work in pairs whenever possible to maximize the likelihood that immediate recognition and care for an exposure incident can occur. Symptoms of opioid exposure include euphoria, nausea, lightheadedness, sedation, coma, and respiratory depression. As in caring for patients, the first response to a symptomatic exposure should be the activation of additional healthcare providers and immediate transportation to a healthcare facility for observation, diagnosis, and management of an exposure or other acute health issue. Cardiac monitoring, pulse oximetry, and nasal capnometry should be applied when available. Naloxone administration is recommended for the treatment of sedation with respiratory depression. Most law enforcement officers have been cautioned to no longer perform field testing in accordance with Drug Enforcement Administration (DEA) recommendations. Likewise, medical first responders should not handle drugs or paraphernalia, although documentation of those products can be valuable for providers as well as public health surveillance. Drug related evidence should be left for appropriate forensic collection by law enforcement.

Summary and Recommendations

Environmental exposure to potent opioid products by medical and law enforcement first responders is a growing concern in the United States. Popular reports of law enforcement and first responder exposure have not been confirmed as resulting in opioid toxicity as described symptoms have not generally corresponded to anticipated symptoms. However, the risk requires evaluation and preparation to prevent a potential threat to first responders who work in uncertain and difficult environments. Specific evidence to guide prevention and response is not available, but recommendations based upon recent experience and known pharmacologic and occupational information can be made pending development of more rigorous scientific evaluation. The following recommendations are based upon published pharmacokinetic data, limited occupational safety literature, and clinical experience of the authors in caring for overdose patients, directing EMS agencies, and supervising hazardous materials medical response teams. However, specific investigation of the extent to which first responder and EMS activity may result in exposure, absorption, or potential toxicity has not been published and represents an opportunity for future research. A position statement from the American College of Medical Toxicology and American Association of Clinical Toxicologists that was concurrently and separately written and reviewed has come to similar conclusions.[20]

We Recommend

1. Careful scene safety assessment with particular attention to the presence of drugs, unidentified powders, and drug paraphernalia.
2. Identification of multiple casualties, large amounts of free powder, or visibly aerosolized dust should:
   a. Prompt rapid exit from the scene with retrieval of victims for treatment whenever possible.
   b. Assess for alternative exposures (CO, HS, toxic gases or other toxins).
   c. Consider law enforcement and/or hazardous materials team activation.
3. A single pair of nitrile gloves should be used while caring for any patient including an overdose victim. Handwashing with soap and water at the completion of care should be performed.
4. Follow standard universal precautions, treating unidentified powder or drug like blood.
5. We do not recommend routine use of masks for medical response.
6. Unpackaged drug/powder (as opposed to remnant of use or packaged products) may prompt consideration of N-95 masks, eye protection, and skin coverage (e.g. long sleeves and pants or paper gowns if there is concern for potential aerosol exposure; otherwise these additional PPE are unnecessary).
7. When there is a high likelihood of aerosolized dust, full skin and face coverage as recommended by NIOSH is appropriate.
8. Dust exposure to skin should be managed by rapidly flushing the exposed area with a large volume of water or saline.
9. Dust exposure to clothing should prompt wiping with an alcohol-based wipe and gloved hand followed by immediate laundering of clothing.
10. Clothing worn during a shift in which exposure could have occurred should be laundered at the first opportunity with limited secondary contact.
11. The provider should shower as soon as is practicable following exposure to skin or clothing.
12. Immediate initiation of assisted ventilation for any patient with respiratory depression.
13. Administration of naloxone to potential victims of opioid toxicity following system protocols. **Do not** delay assisted ventilation while administering naloxone or awaiting effect.
14. Visible dust or drug on a victim's face should be wiped away prior to assisted ventilation.
15. Providers should work in pairs whenever possible.

16. Provider exposure is extremely unlikely, but in the event of suspected exposure:
    a. Activate back up resources.
    b. Perform assessment and monitoring of the provider.
        i. Monitor respiration.
        ii. Evaluate pupil size.
    c. Facilitate transportation to the nearest healthcare facility as soon as possible.
    d. Administration of naloxone with any signs of sedation, particularly with respiratory depression.
    e. Prophylactic administration of naloxone is not recommended.
17. Drugs, paraphernalia, unidentified powders, and other substances should not be handled unless the provider is trained to do so safely.

It is critical to maintain the safety of our responders without unnecessarily compromising the care of potential victims. Research to better understand the potential risks and preventive measures may include further pharmacokinetic evaluation of illicit opioids with a focus on absorption, occupational exposure surveillance of healthcare and law enforcement personnel, and specific evaluation of different levels of personal protective equipment in a variety of real world settings.

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