HHE 2018-0067
Evaluation of Potential Occupational Exposures to Opioid Drugs During an Emergency Medical Services Response

Interim Report
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Introduction

The Health Hazard Evaluation program received a request for an evaluation regarding concerns about possible exposure to opioids (including fentanyl or its analogues) after a fire fighter-EMS responder developed symptoms during an EMS response to a drug overdose in January 2018. We visited the fire department on January 31–February 1, 2018. After the visit, in February 2018, we sent interim letters to the fire department and employee representatives summarizing our activities and preliminary findings.

At the time of the evaluation, the fire department had approximately 65 full-time career fire fighters, who were cross-trained to provide EMS at the emergency medical technician level or above, and 6–7 office-based employees. The fire department had two fire stations. In addition to three engine and ladder/tower companies, the fire department staffed two ambulances. One ambulance was continuously staffed by fire fighter-EMS responders. The second ambulance was staffed by fire fighter-EMS responders during daytime hours and a volunteer rescue squad at night. Fire fighters also provided EMS from fire apparatus as needed, for example, when ambulances were responding to other calls. Fire fighters worked in 24-hour shifts on days 1, 3, and 5 of a 9-day cycle and were off on days 2, 4, and 6–9 of the cycle.

The fire department responds to approximately 6,500 fire and EMS calls each year. Recently, the fire department has received an increased volume of calls related to drug overdoses or in which suspected opioid drugs were visible on-scene. This trend is consistent with the increased number of drug overdose fatalities related to fentanyl, fentanyl analogues, and heroin in the Commonwealth of Virginia. No incidents of fire fighter-EMS responders developing symptoms after exposure to opioids had been reported prior to the January 2018 incident. However, a first responder in a neighboring jurisdiction reportedly developed symptoms after potential exposure to an opioid in the past year.

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Methods

The objectives of our evaluation were to:

1. Assess how fire fighter-EMS responders might have been exposed to opioids during the January 2018 incident, and
2. Make recommendations on how to prevent exposures to opioids among fire fighter-EMS responders.

We conducted voluntary, confidential interviews with all three fire fighter-EMS responders ("Responders A, B, and C") who provided direct care to the overdose victim ("victim") and one of the first police officers present during the incident. In total, six fire fighters and five police officers were at the scene. During the interviews, we discussed the January 2018 incident, work history and practices, training, and personal protective equipment (PPE) use. In addition, we spoke with the emergency department physician and members of the nursing staff who treated the victim and symptomatic fire fighter-EMS responder ("Responder A") at the hospital during the incident. We also spoke with the city's safety and risk management coordinator. We reviewed the medical records related to the January 2018 incident for the overdose victim and Responder A. We also reviewed the fire department's prehospital care report for the overdose victim.

To better understand the incident, we reviewed video footage of the January 2018 incident from the body camera of a police officer present during the incident and toured the emergency department where the victim and Responder A underwent medical evaluation and treatment. We also reviewed the police department's incident/investigation report

Results

Description of the Emergency Response

The following summary of the incident is based on the interviews, video footage, and police incident/investigation report that we reviewed. On January 28, 2018, the police and fire departments were dispatched for a 911 call concerning an unconscious victim in a hotel room. EMS responders reported that this category of calls, especially in young persons, often involve drug overdoses. Hotel staff reportedly heard a call for help and saw the victim on the floor of a hotel room. Hotel staff informed the police that they were told that the victim had overdosed. Police officers arrived on the scene first and began cardiopulmonary resuscitation. The 911 call was upgraded to "cardiopulmonary resuscitation in progress." Police officers rearranged the furniture in the room to give the fire department team more space to attend to the victim. When three fire fighter-EMS responders arrived, they assumed responsibility for resuscitation activities.

During a preliminary search of the hotel room, a police officer found signs of recent drug use, including "pulled cotton from a cigarette filter" next to the bed and a "spoon with burn marks underneath" and a lighter in the hotel bathroom. The police department submitted the spoon for forensic testing by the state laboratory. In a subsequent search, the police found a used syringe and "a plastic bag with visible residue," which were also submitted to the state laboratory for forensic testing. The police received reports that items were removed from the room before first responders arrived. None of the first responders reported seeing any powder suspected to be opioids on or near the victim. Forensic test results for items from the hotel room are pending.

During the EMS response in the hotel room, Responder A was primarily managing the victim's airway, including providing bag-valve-mask ventilation and intubating the victim. Responder A reported getting down on knees and elbows on the hotel room floor to achieve the positioning necessary for intubation and placing gloved fingers in the victim's mouth during intubation. In addition, Responder A moved the victim's extremities to assess for muscle rigidity and checked for a carotid pulse. Responder A wore a long-sleeved uniform during the response.

In the hotel room, Responders B and C performed manual chest compressions until they connected the victim to a mechanical chest compression device. The victim's hands were secured to the front of the device. In addition, Responders B and C established interosseous access (access to the circulatory system via a bone marrow cavity), monitored the victim's condition, and administered epinephrine and multiple doses of intranasal and intraosseous naloxone.

The victim was then transported to an emergency department via ambulance. En route, Responder A managed the victim's airway, while another fire fighter-EMS responder administered additional naloxone, obtained an electrocardiogram, and established intravenous access.

Description of Events in the Emergency Department

None of the hospital staff reported seeing any powder suspected to be opioids on or near the victim. After care of the victim was transferred to hospital staff, the fire fighter-EMS responders gave report to the emergency department physician. Responder A removed their gloves shortly before emergency department staff handed Responder A the mechanical chest compression device. Responder A then began to experience warmth, lightheadedness, and palpitations. Responder A reported being soaked with perspiration when moved to an emergency department bed and experiencing numbness and tingling of the cheek and tongue.

In our interview, Responder A reported feeling well prior to and during the entire work shift prior to being in the hospital emergency room. Responder A reported a recent upper respiratory infection (a "cold"). When asked, Responder A did not recall touching their face during the incident, for example, to wipe their nose or eyes.

Responder A developed symptoms in the large emergency department trauma area and was treated in the same area. The emergency department physician requested that all other fire and police department personnel who participated in this EMS response be observed in an adjacent trauma area. After approximately 45 minutes of observation, none of the 10 other first responders had developed symptoms, and all of them were released from the emergency department. The ambulance was wiped down with disposable wipes. Long-sleeved uniforms worn during the incident were placed in plastic bags and transported to the fire station, where they were laundered using standard detergent.

Medical Record Review

According to the medical records reviewed, Responder A began to experience symptoms within 12 minutes of the victim being triaged by the emergency department. Findings from the initial medical assessment of Responder A included mild respiratory distress and pale, diaphoretic skin. No miosis (small pupils) was documented. Vitals signs over a period of approximately 2 hours included a normal temperature, normal to elevated heart rate, normal to elevated blood pressure, and decreased respiratory rate (8 respirations per minute) on one occasion. Other documented respiratory rates were normal or elevated.

Blood and urine samples were collected for testing. Urine collected approximately 1 hour after the start of symptoms tested negative in a standard 7-panel urine drug screen. The 7-panel urine drug screen consisted of cannabinoids, phencyclidine, cocaine, opiates, amphetamines, benzodiazepines, and barbiturates. Responder A received intravenous fluids and three doses (2 milligrams) of naloxone over a period of approximately 1.5 hours. The first dose was given immediately upon triage and gaining intravenous access. The second dose was given 15 minutes after the first dose, and the third dose was given 92 minutes after the first dose. After the second dose of naloxone, the chart noted “overall patient [Responder A] status improved, patient [Responder A] feeling better.” The third dose was given in response to Responder A reporting feeling dizzy again, having numbness in the face, and feeling an increase in heart rate. The respiratory rate of 8 breaths per minute noted above was noted just prior to the third dose of naloxone. Reassessment 40 minutes after the third dose noted a respiratory rate of 26 respirations per minute. Approximately 50 minutes after the third dose, the chart noted “overall patient [Responder A] status improved, patient [Responder A] feeling better.” Responder A was discharged from the emergency department approximately 4.5 hours after symptoms began. The emergency department physician’s clinical impression was “near syncope and accidental overdose.”

The victim’s emergency department admission diagnosis was “suspected opiate overdose and acute cardiopulmonary arrest.” A urine drug screen collected in the emergency department tested as “presumptive positive” for cannabinoids and opiates with the cut-off for opiates noted to be 100 nanograms per milliliter. No ethanol was detected in blood samples collected in the emergency department. Clinical impression upon admittance to the intensive care unit was “cardiac arrest, respiratory arrest, and overdose.” The final diagnosis in the medical records for

the victim, who subsequently died, listed multiple diagnoses including "anoxic injury and narcotic overdose."

Discussion

From 2014 to 2015, there has been a 72% increase in the rate of overdose deaths involving synthetic opioids (which includes fentanyl and its analogues) in the United States [Centers for Disease Control and Prevention 2016]. This has raised concerns about the potential for exposure to opioids among emergency responders, who might come into contact with opioids in the course of their work. Inhalation, mucus membrane contact, ingestion, and percutaneous exposure (e.g., needlestick) are important potential routes of exposure. Brief skin contact with fentanyl or its analogues is not expected to lead to toxic effects if visible contamination is promptly removed [Moss et al. 2017; NIOSH 2017].

Many factors suggested the victim experienced an opioid overdose in the hotel room, including reports that the victim had overdosed and signs of recent suspected opioid use found in the hotel room. The victim's urine drug screening testing was presumptively positive for cannabinoids and opiates, although these tests cannot pinpoint whether the substances were used during the overdose that occurred shortly before urine collection. The pending forensic testing results could provide more information about the substances involved in the victim's overdose to which emergency responders were potentially exposed.

Although the victim likely overdosed on opioids, the potential routes of exposure to Responder A remain unclear. The emergency responders and hospital staff we interviewed reported no powder suspected to be opioids on or near the victim. Responder A was the employee closest to the victim's head and torso both in the hotel room and during transport to the hospital. On the basis of the interviews and body camera video footage, the fire fighter-EMS responders (including Responder A) wore gloves during the incident, which is consistent with National Institute for Occupational Safety and Health (NIOSH) guidance [NIOSH 2017]. The firefighter-EMS responders also wore long-sleeved uniforms, which offer an additional level of dermal protection [NIOSH 2017].

Although Responder A was positioned close to the victim's head, it is unlikely that exposure to opioids occurred through the victim's exhaled breath. During cardiovascular surgery in operating room suites, NIOSH researchers did not find any fentanyl in the air during assessments of possible second-hand exposure to fentanyl when patients received fentanyl intravenously [Law et al. 2010a,b]. However, these findings might not be directly applicable because the assessments did not involve fentanyl in a powder form that might have been "snorted" or "sniffed" through the nasal passages.

We cannot rule out several possible exposure scenarios. First, a small amount of opioids might have been on the hotel room floor carpet or within the victim's respiratory tract and close to

Responder A's breathing zone when the victim was being intubated. Second, there was the possibility of cross-contamination of Responder A's gloves with small amounts of opioids and subsequent hand-to-face contact or aerosolization upon glove removal. Third, a small amount of opioids could have been transferred from the victim's hand to the mechanical chest compression device that was then transferred to Responder A's hands in the emergency department. In these possible scenarios, mucosal membrane contact via inadvertent hand-to-face contact and/or inhalation are possible routes of exposure.

Overall, the clinical manifestations of Responder A are not classic for overt acute opioid poisoning. Well-established signs and symptoms for acute opioid poisoning include lethargy or other indications of central nervous system depression, shallow or slow breathing, miosis (small or "pinpoint" pupils), slow heart rate, and low body temperature [Boyer 2012; Ropper et al. 2014]. Other symptoms of a lesser degree of opioid exposure may include euphoria, nausea, and lightheadedness [Lynch et al. 2018]. Over approximately 2 hours of monitoring, there was one documented transient decrease in respiratory rate. Responder A reported feeling better after receiving naloxone during the course of emergency department treatment. The emergency department assessment included evaluation for some other medical causes that might explain the health effects experienced by Responder A. However, there was no evidence that volume depletion, hypoglycemia, arrhythmia, or seizure might have contributed to the health effects observed.

Responder A's negative urine drug screen result does not rule out the possibility of opioid exposure [Nagpal et al. 2017]. First, commonly used urine drug screening panels are designed to screen for a variety of opiates (a subset of opioids). Screening assays do not detect all opioids equally well. Fentanyl is sufficiently different in chemical structure from the opiate morphine that tests that specifically look for fentanyl are necessary to detect it [Keary et al. 2012; Milone 2012]. The timing of urine collection relative to the time of exposure can also affect the urine testing results. Most studies focus on how long a drug can be detected after exposure, not how long after exposure can a drug first be detected. One study suggests that fentanyl can be detected in the urine by 0.5 hours after an intravenous dose during anesthesia [Makowski et al. 1995], but this time might be longer for work-related exposures through different routes or at low concentrations.

Another consideration is that illicit drugs might contain adulterants or contaminants that might lead to symptoms [Behrman 2008; Cole et al. 2011]. This possibility is difficult to assess because the exact composition of such drugs likely vary by batch and all the components are not well characterized.

Fire fighter-EMS responders and hospital staff brought up questions about decontamination procedures during our discussions. The practice of removing potentially contaminated clothing and carefully placing them in bags until laundering during this incident and having laundry capabilities at the worksite to avoid take-home contamination are consistent with recommended work practices to avoid cross-contamination. Responders who come into contact with materials

which might be fentanyl should immediately wash the affected skin with soap and water. Alcohol-based gels (e.g., hand sanitizers) should be avoided because alcohol can increase absorption of fentanyl through the skin [Interagency Board 2017; Lehmann et al. 1992; Moss et al. 2017; NIOSH 2017]. Bleach, which is often used for decontamination in other settings, should not be used [Interagency Board 2017].

Conclusions

During an EMS response incident in January 2018, Responder A developed health effects after treating a victim with suspected opioid overdose. The etiology of symptoms and potential source of exposure for Responder A could not be definitively identified. First responders wore PPE that followed current NIOSH interim guidance [NIOSH 2017] in situations where opioids are suspected to be present, but not visible. Further evaluations and research are needed to improve understanding of the routes of exposure and potential health effects among first responders potentially exposed to opioid drugs (including opioids such as fentanyl and fentanyl analogues) in the course of their work.

Training to improve understanding of (a) the routes of exposure to opioids likely to cause symptoms; and (b) measures to protect against exposure to opioids can likely help prevent exposures and prevent health effects among fire department employees and other first responders.

Recommendations

NIOSH has issued interim guidance on how to protect emergency responders from exposures to fentanyl and its analogues [NIOSH 2017]. We believe that the current NIOSH guidance is applicable to this evaluation, even though whether fentanyl or its analogues were involved in this incident cannot be confirmed with the available evidence.

On the basis of our current findings, we recommend the actions listed below. We encourage the fire department to use a labor-management health and safety committee or working group to discuss our recommendations and develop an action plan. Those involved in the work can best set priorities and assess the feasibility of our recommendations for the specific situation at the fire department.

1. Provide training to employees on how to prevent occupational exposure to fentanyl and its analogues, including standard safe operating procedures, training, PPE, and decontamination. These topics are addressed in the NIOSH webpage Topic Page "Fentanyl: Preventing Occupational Exposure to Emergency Responders" (https://www.cdc.gov/niosh/topics/fentanyl/risk.html). In addition to established work

practices, responders should follow the following recommendations when fentanyl or its analogues are known or suspected to be present:

a. Do not eat, drink, smoke, or use the bathroom while working in an area with known or suspected fentanyl.
b. Do not touch the eyes, mouth, and nose after touching any surface potentially contaminated with fentanyl.
c. Avoid performing tasks or operations that may aerosolize fentanyl due to increased exposure risks.
d. Wash hands with soap and water immediately after a potential exposure and after leaving a scene where fentanyl is known or suspected to be present to avoid potential exposure and to avoid cross contamination. Do not use hand sanitizers or bleach solutions to clean contaminated skin.

2. Work with 911 emergency dispatch coordinators to identify any possible improvements in gathering information about potential overdoses and whether powders suspected to be opioids are on-scene, and relaying this information to first responders during dispatch communications. Having this information before arriving at the scene can help first responders anticipate the potential level of exposure and prepare accordingly before conducting their own on-scene risk assessment.

3. Continue current procedures and work practices in work situations where the exposure level to fentanyl or its analogues is anticipated to be "minimal" as defined in the NIOSH webpage noted above.
    a. A "minimal" exposure level is as defined a situation where no fentanyl products are visible.
    b. Fire fighter-EMS responders were wearing gloves during the January 2018 incident, which was consistent with current NIOSH recommendations when no fentanyl products are visible.

4. Develop new or modify existing policies or procedures for work situations in which the anticipated exposure level to fentanyl or its analogues is determined to be "moderate" or greater.
    a. A "moderate" exposure level is defined as a situation where small amounts of fentanyl products are visible.
    b. Conduct a risk assessment to identify potential hazards related to fentanyl and its analogues during fire department activities and determine what is appropriate PPE for moderate or high exposures. NIOSH recommendations for these exposure levels are detailed on the NIOSH webpage noted above.

5. Coordinate with local hospitals to ensure that soap and water are available after EMS responses where fentanyl products are known or are suspected to be present for washing skin and decontaminating surfaces and equipment before disinfectants are used.

6. Coordinate with law enforcement agency partners to follow up on the forensic testing results of evidence collected from the hotel room for this specific incident. Document the identity of substances identified in the occupational health or personnel records of fire fighter-EMS responders. Develop mechanisms for coordinated information sharing about the identity of substances for any future potential occupational exposures to opioids among fire fighter-EMS responders.

7. Encourage employees to report possible unintentional work-related opioid exposures and any resulting health effects to their supervisors. This information, along with information on the identity of the substances from forensic testing, can be periodically reviewed to identify any trends affecting the risk of work-related exposure to opioids and any associated health effects. Use this information to help determine whether changes in current procedures may be needed.

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