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The Threat of Secondary Chemical Contamination of Emergency Departments and Personnel: An Uncommon, but Still Occurring Problem

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Abstract

Objective—To analyze hazardous substance release surveillance data for events involving secondary contamination of hospital emergency departments (EDs). Secondary contamination of EDs may occur when a patient, exposed to a hazardous chemical, is not decontaminated before arrival at the ED and when ED staff is not wearing appropriate personal protective equipment. This can result in adverse health outcomes among department personnel, other patients, and visitors. Even events without actual secondary contamination risk can be real in their consequences and require the decontamination of the ED and/or its occupants, evacuation, or temporary ED shut-down.

Methods—Events involving secondary contamination were identified using the Hazardous Substances Emergency Events Surveillance system and the National Toxic Substances Incidence Program during 2007–2013.

Results—Five incidents involving involved the threat of secondary contamination (0.02% of all events reported to the surveillance systems [n=33,001]) were detected and are described. Four incidents involved suspected secondary contamination in which the facility was evacuated or shut down.

Conclusions—These results suggest that while rare, incidents involving secondary contamination continue to present a hazard for emergency departments. Suggested best practices to avoid secondary contamination have been described. Hospitals should be made aware of the risks associated with secondary contamination and the need to proactively train and equip staff to perform decontamination.

Keywords

hazardous materials events; chemically contaminated victims; secondary contamination

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Introduction

Hospital emergency departments (EDs) differ from other sections of the hospital in that patients are brought in from the outside of the hospital and often have life-threatening injuries. Because ED patients frequently require rapid treatment, ED personnel must work quickly even without complete patient information or knowledge about the cause of the illness or injury. Because of this, ED personnel are at risk of injury or illness resulting from secondary contamination. Secondary contamination may occur when a patient is exposed at the scene to a chemical, radiological, or biological agent, which is then inadvertently transferred to attending personnel or equipment in an ED[1;2]. Optimally, a patient with chemical exposure would be fully decontaminated before arrival at an ED. However, this often does not occur[3;4]. One reason for this is that patients may be transported by private vehicles to the ED without being treated by the field emergency medical services (EMS) system[2–9]. On the other hand, even when transported by EMS, chemical casualties are not always decontaminated in the field[5;10;11]. Further, EMS responders may be unaware that a toxic exposure has occurred.

In this report, we describe five single-patient chemical emergencies involving secondary exposure where contamination occurred in the ED, the ED was evacuated, or it had to be temporarily shut down. Data for this report were obtained from the Hazardous Substances Emergency Events Surveillance (HSEES) system and the National Toxic Substance Incidences Program (NTSIP), which replaced HSEES in 2010[12]. Both systems were or are operated by the Agency for Toxic Substances and Disease Registry (ATSDR), US Department of Health and Human Services.

Methods

HSEES was and NSTIP is a state-based surveillance system for acute hazardous substance releases[12]. Participating state health department personnel enter event-specific information into standardized data fields in a common database managed by ATSDR. Searches of HSEES and NTSIP data for hazardous substance releases that resulted in secondary contamination were performed. The search was limited to the period after 2007 because events involving secondary contamination in prior years have already been described[13–15]. Event records that contained the key words ‘ambulance’, ‘hospital’, ‘decon’, ‘responder’, ‘EMS’ or ‘fire’ in the description of the event were extracted. The resulting records were then reviewed and events not involving ED secondary contamination were excluded.

Results

HSEES/NTSIP data include 33,001 separate events for the years 2007–2013. Of those, 5 incidents (0.02%) involving ED secondary contamination were detected. Descriptions of those incidents follow.

Incident 1: Sulfuric acid

In 2009, a Texas rail yard worker succumbed to various symptoms subsequent to inhalation exposure to sulfuric (and possibly phosphoric) acid. Working inside a railroad tank car used

to transport sulfuric acid, he had been removing rust with a phosphoric acid-based product. The worker had used personal protective equipment (PPE) that included a self-contained breathing apparatus (SCBA) while inside the tank car. Upon exiting and doffing the SCBA, he realized he had left personal equipment inside the tank. The worker then re-entered without the SCBA. He immediately lost consciousness and was removed from the tank approximately 2–4 minutes later. The worker exhibited respiratory irritation and developed nausea and vomiting. EMS transported the worker to the regional medical center. It was not reported whether EMS alerted the medical center that a contaminated patient would be arriving.

Upon arrival in the ED, the worker was incoherent, had bloody emesis, and emitted a strong odor of sulfuric acid. After ED personnel removed his clothing and performed decontamination procedures, two ED nurses (who later reported detecting strong sulfuric acid odors) began to vomit. One of these nurses also experienced unspecified heart problems. Six other ED personnel also developed nausea and vomiting, eye irritation, unspecified respiratory symptoms, headache, dizziness or other central nervous symptoms. Three other ED personnel with potential exposure due to proximity to the worker did not develop symptoms. Data reported to ATSDR indicate Level “B” PPE (which includes SCBA or an air-hose supplied respirator) was worn by affected ED personnel. It was not reported whether ED personnel donned PPE prior to arrival of the patient. The exposure-related symptoms experienced by ED personnel suggests respirators were not worn properly or not worn during the entire time the patient was being treated or contaminated clothing was handled.

All affected ED personnel were decontaminated on site and then released. It was not reported whether the ED was closed as a result of this event. After being decontaminated, the rail yard worker was admitted to the hospital for additional care.

Incident 2: Methamphetamine production chemicals

In 2011, a mobile methamphetamine laboratory exploded in a busy parking lot of a Tennessee hospital resulting in one victim, destroying the victim’s car. The explosion occurred in close proximity to the hospital, and responding firefighters transported the only victim to the hospital’s ED without performing field decontamination. It was not reported whether the first responders had time to alert the ED in advance of patient arrival or if they had time to don appropriate PPE. While not ED personnel were injured in this event, the ED had to be shut down in order to be decontaminated. ED staff and the responding firefighters were also decontaminated. The victim of the explosion later died from severe burns.

Incident 3: Methamphetamine production chemicals

In 2011, a methamphetamine laboratory fire damaged six apartments in Tennessee. One victim of the fire was transported to a nearby ED via a privately-owned vehicle. At the ED, the victim claimed to have been burned in a gasoline explosion. Police arrived at the ED to investigate, linked the victim to the apartment explosion, and suggested to ED staff that the victim likely had been exposed to methamphetamine production chemicals. The victim was decontaminated with water and transported to the area burn unit. Part of the emergency room

was temporarily shut down for decontamination. The local fire department assisted with the decontamination process. Although none of 35 staff reported illness, 15 were decontaminated as a precaution. The hospital returned to normal operation about 45 minutes later.

Incident 4: Malathion

In 2013, a New York woman intentionally ingested malathion, an organophosphate insecticide, in her home. EMS responded, but it was not reported whether field decontamination of the patient was conducted or whether EMS alerted the local ED about the nature of the patient's contamination. EMS then transported the patient to the ED, where she gave off a strong chemical odor. ED staff and patients, approximately 75 persons, were subsequently evacuated and a hazardous materials (Hazmat) team was called in oversee the situation.

Incident 5: Malathion

In 2013, a Tennessee man ingested malathion and was taken to a nearby ED where he later died. ED staff was unaware of what the man had ingested and quarantined his body within the ED. As a precaution, a portion of the ED was locked down for several hours. A local Hazmat team decontaminated more than a dozen ED staff. In this case, the four-hour decontamination did not interfere with operations. No other patients were affected.

Discussion

Events involving secondary contamination of emergency departments have been previously reported using surveillance data from the Hazardous Substances Emergency Events Surveillance (HSEES) system[13]. HSEES was an active, multi-state health department surveillance system for morbidity and mortality from acute releases of hazardous substances and was replaced by the National Toxic Substance Incidents Surveillance Program (NTSIP) in 2010[12]. Events involving secondary contamination are rare with only 5 events, 0.02% of all events captured by HSEES/NTSIP between 2007 and 2013, detected. By comparison, 22 events involving ED secondary contamination were detected in the HSEES/NTSIP systems during the period 1995–2006[13–15]. Despite being rare, events involving secondary contamination have the potential to harm healthcare personnel and/or result in the temporary disruption or closure of an ED. With demand for services outpacing present ED capacity in the US[16], even a temporary ED closure may have significant impacts on community health. Further, secondary contamination of an ED may be more likely during a catastrophic event such as a natural disaster or a terroristic act involving a release of hazardous chemical, biological or radiological agent, events during which a community can ill afford an ED closure[17–19].

Several best practices for ED response to patients contaminated with chemicals have been advanced. The first practice is to establish hospital-based decontamination protocols and train response teams such that decontamination can commence within minutes of a patient's arrival at the ED. That response team should be cognizant that ED staff is only likely to become aware of a contamination incident after affected victims arrive at the hospital [20] and

should be prepared to initiate a basic decontamination without full knowledge of identity of the contaminant. Cibulsky et al. note that there is no consensus in the literature regarding a best method to assess a patient's decontamination needs[21]. However, Cibulsky et al. provide the following guidance for assessing the need to decontaminate a patient:

- Signs and symptoms of exposure displayed by patients;
- Visible evidence of contamination on the patient's skin or clothing;
- Proximity of the patient to the location of the release;
- Contamination detected on the patient using appropriate detection technology;
- The chemical identity (if known) or physical state, characteristics, and behavior (if unknown);
- Request by the patient for decontamination, even if contamination is unlikely.[21]

While it is preferable to decontaminate patients before they are transported from the scene, this does not always occur and every ED must be prepared to carry out this task. Basic chemical decontamination, dating back to at least World War II, involves removing the patient's clothing and rinsing him/her with water [22]. Improving on this generic decontamination method, another best practice is to train ED personnel how to quickly access information on decontamination procedures for patients exposed to common chemicals using readily available tools, such as the Wireless Information System for Emergency Responders (WISER; http://wiser.nlm.nih.gov/). Permanent hospital decontamination facilities are regarded as preferable to temporary ones because they can be activated more quickly and generally provide more protection during adverse weather[23]. A decontamination area that is well-ventilated and with a ventilation system independent from the hospital is best able to prevent cross-contamination[23]. When this is not possible, decontamination may have to be performed outside of the ED to prevent the contamination of it and the patients within[24]. In such a case, a source of warm water and protection from the elements should be assured. While ED personnel are less likely to experience the same exposure levels as responders at the site of a chemical release [25], the training the decontamination team in the selection and use of appropriate PPE would be beneficial. Finally, to develop and maintain competency, the decontamination team should undergo regular refresher training and drills[26]. The Occupational Safety and Health Administration (OSHA) has documented mandatory requirements and best practices for ED management of casualties exposed to hazardous substances[23]. Hospitals may also consider developing response practices in the context of Local Emergency Planning Committees (LEPCs)[27] and Healthcare Coalitions[28]. These collaborative groups may be able to provide hospitals with likely incident scenarios, especially in communities with fixed facilities, such as industrial plants or transportation hubs. Conducting incident surveillance, as done with HSEES and NTSIP, allows for evidence-based planning.

It is unclear how many of the above best practices were implemented in the cases presented here. In incident #1, although it is unknown whether the ED was alerted that the patient was contaminated with sulfuric acid vapor, ED staff apparently deployed with appropriate PPE. Ideally, the patient would have had his clothing removed and stored in chemically-resistant

vapor proof sealed containers for later disposal. The ED staff performing the decontamination would have optimally donned PPE prior to contact with the patient, decontaminated the patient, passed the patient into the ED, undergone decontamination themselves, then doffed their PPE. Incident #3 illustrates how ED staff may be forced to operate with incomplete (or misleading) information, when patients are not transported to the ED via EMS. The incidents involving malathion highlight, once again, that victims may be admitted to an ED without apparent need for decontamination, but still have potential to contaminate the ED via their vomit[29].

Conclusions

It is encouraging that few events involving ED secondary contamination were detected by the HSEES/NTSIP system. However, the cases presented here demonstrate secondary contamination continues to be a risk to emergency departments. This is particularly the case when, as so often happens, patients arrive, unannounced by private car or other non-ambulance vehicles. Making hospitals aware of the risks associated with secondary contamination and the benefits of proactively training and equipping staff to perform decontamination may reduce the risk of secondary contamination. For situations in which ED secondary contamination occurs despite the implementation of relevant protocols, investigations into these types of occurrences could be conducted to prevent future incidents.

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