

Report from the Field

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Using an Electronic Self-Administered Survey Among First Responders to Evaluate the Potential Human Health Effects of Hazardous Substances Released as a Result of a Train Derailment Incident—East Palestine, Ohio, USA, February—March 2023

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Abstract

To understand the potential human health effects of exposure to hazardous substances among first responders from the East Palestine train derailment, an electronic self-administered Assessment of Chemical Exposures (ACE) survey was created and available to first responders between February–March 2023. Among the 339 completed responder surveys analyzed, most reported working at least 1 day during the incident between February 3–8, 2023. Most (79%) reported inhaling, touching, or swallowing potentially harmful substances and did not report using a face mask or respirator while working (75%). Nearly half reported at least 1 new or worsening physical symptom after incident response. These findings support several recommendations to mitigate exposure to hazardous substances among first responders during future incidents, including using a hierarchy of controls framework to reduce exposure to hazards, timely communication of possible hazardous substances involved in the event, and using the Emergency Responder Health Monitoring Surveillance (ERHMS) framework.

On February 3, 2023, a 149-rail-car train in East Palestine, Ohio, USA derailed, and 50 rail cars ignited, 11 of which contained hazardous substances.¹ This event raised concerns about hazardous substances released into neighboring communities including Beaver County, Pennsylvania. Immediately, first responders worked to control the fires and ensure community safety. Responders worked on or near the derailment site, where rail car contents of concern included: vinyl chloride, ethylene glycol, butyl acrylate, isobutylene, and ethylhexyl acrylate.^{2,3} On February 3, evacuation orders were issued for residents within a 1-mile radius of the train derailment.⁴ On February 5, vinyl chloride contents of 5 rail cars

Table 1. Demographics, occupational role, mask use, and self-reported exposures and health symptoms of individuals who participated in the Responder Assessment of Chemical Exposures Survey (*N*=339) — East Palestine, Ohio, February 2023–March 2023

	Number (%) of survey participants
Demographics	
Age, Median (IQR)	39 (30–50)
State of residency	
Ohio	198 (58)
Pennsylvania	111 (33)
Other state	13 (4)
No response	17 (5)
Race and ethnicity^a	
White, non-Hispanic	324 (96)
White, Hispanic	4 (1)
Black or African American or Asian or Multiracial, non-Hispanic	8 (3)
Sex^b	
Male	297 (88)
Female	40 (11)
What was your role during the response to the train derailment incident? (check all that apply)^{c,d}	
Firefighter	206 (61)
Volunteer	162 (79)
Career	25 (12)
Both career and volunteer	18 (9)
Police officer	46 (14)
Government worker	42 (12)
Contractor	38 (11)
Hazmat	27 (8)
Emergency medical services responder	23 (7)
Other	19 (6)
Military	17 (5)
Total number of days worked within 1-mile of the incident site from Feb 3–8, 2023^e	
1	72 (25)
2	138 (47)
3	30 (10)
4	22 (7)
5	14 (5)
6	17 (6)
While responding to the incident, how often did you use the following?: Mask or respirator^f	
Always	8 (2)
Sometimes	65 (20)
Never	244 (75)
Unsure	10 (3)
Number of responders who reported at least 1 type of direct contact^{c,g}	
Inhaling	265 (99)
Touching	72 (27)
Swallowing	28 (10)

(Continued)

Table 1. (Continued)

	Number (%) of survey participants
Number of responders reporting contact with at least 1 of the following substances: smoke, vapor/gas, dust, liquid, debris or other^{c,h}	269 (79)
Smoke	225 (84)
Vapor/gas	165 (61)
Dust	121 (45)
Liquid	48 (18)
Debris	47 (17)
Other	0 (0)
Do you know what chemical/substances you may have been exposed to?	
Yes	61 (23)
No	120 (45)
Prefer not to answer	0 (0)
Unsure	85 (32)
Number of responders reporting at least 1 physical symptom^{c,i}	162 (48)
Symptom type	
Ears, nose or throat	133 (82)
Heart and lungs	52 (32)
Eyes	37 (23)
Skin	19 (12)
Central nervous system	7 (4)
Gastrointestinal tract	7 (4)

^aRace and ethnicity variables were collapsed. Percentages are out of those who self-reported their race and ethnicity ($n=336$). Individuals who identified as Black or African American non-Hispanic, Asian non-Hispanic or Multiracial non-Hispanic were collapsed into 1 category due to small cell sizes.

^bRemaining answer options included prefer not to answer, or other.

^cAnswers are not mutually exclusive. Responders could select more than 1 answer option.

^dDenominators for firefighter type are of the total number of individuals reporting being a firefighter.

^eDenominator are those who reported working at least 1 day from February 3-8 ($n=293$).

^fDenominator includes individuals who answered the question ($n=327$).

^gDenominator includes responders reporting at least 1 direct contact (touching, inhaling, or swallowing) to potentially harmful chemicals/substances. Remaining responses included those who did not report any type of contact, prefer not to answer or unsure.

^hRemaining responses include none of the above.

ⁱFor symptoms, responders were asked: "Since the incident, have you experienced a new onset or worsening of symptoms in any of the following (check all that apply): eyes, ears, nose, throat, central nervous system, heart and lungs, gastrointestinal tract, skin, behavioral/mental health, I have not experienced any of these symptoms or unsure." The total excludes those who reported only a behavioral/mental health symptom, those who did not experience any symptoms, or those who reported unsure.

became unstable. In response, the evacuation area was extended and a controlled vent and burn^a event was conducted (full timeline of events pertaining to the incident were described at the June 22, 2023, National Transportation Safety Board East Palestine, OH Rail Public Hearing¹), causing a chemical plume over the area.

On February 17, the Ohio Department of Health and the Pennsylvania Department of Health requested assistance from the US Centers for Disease Control and Prevention (CDC) and the Agency for Toxic Substances and Disease Registry (ATSDR) to implement an Assessment of Chemical Exposure (ACE) survey for first responders to systematically collect data to inform further public health action.⁶ An electronic self-administered responder ACE survey was developed in RED-Cap^{7,8} with considerable input from partners including Ohio

and Pennsylvania health partners, first responder survey pilot participants, and subject matter experts at CDC, ATSDR, and the National Institute for Occupational Safety and Health. The survey began March 5 and ended March 31, 2023. Eligible responders were those who responded to the East Palestine train derailment and were ≥ 18 years old. Responders residing in any state were eligible to participate. The survey collected information on demographics, occupation, self-reported health outcomes, personal protective equipment (PPE) use, decontamination procedures, prior training, and other topics. The survey also collected responders' contact information and consent to be contacted in the future. This activity was reviewed by CDC, deemed not research, and was conducted consistent with applicable federal law and CDC policy.^b

^aA vent and burn "involves the use of explosive charges to cut holes in the damaged tank car to relieve internal vapor pressure and subsequently drain the liquid product from the car for destruction."⁵

^bSee e.g., 45 C.F.R. part 46.102(l)(2), 21 C.F.R. part 56; 42 U.S.C. §241(d); 5 U.S.C. §552a; 44 U.S.C. §3501 et seq.

Results

Three hundred thirty-nine completed surveys were included in the analysis. Over half of responders reported their role as firefighter (61%), of whom 79% were volunteer. Most reported being non-Hispanic White (96%) and male (88%). The median age was 39 (IQR: 30-50) years. Most responders (86%) reported working on response activities within a 1-mile radius of the derailment site for at least 1 day between February 3-8, the period during which fires were active at the site. Most responders (79%) reported inhaling, touching, or swallowing potentially harmful substances. Of those who reported contact with at least 1 substance, smoke (84%) was the most frequently reported exposure, while 77% reported being exposed to an unknown/uncertain chemical. Most responders (75%) selected "Never" using a face mask or respirator during the incident. Approximately 48% reported at least 1 new or worsening physical symptom since responding to the incident. Of responders who reported at least 1 physical symptom, the most reported symptoms were related to the ears, nose, or throat (82%), heart and lungs (32%), eyes (23%), and skin (12%) (Table 1).

Conclusion

Survey results show responders reported low rates of respiratory protection use combined with high rates of inhalation exposure to unknown substances. Additional findings will be described in more detail in a separate manuscript. A similar train derailment incident involving vinyl chloride occurred in Paulsboro, New Jersey in November 2012 and an ACE investigation was conducted among emergency responders—the investigation found almost a quarter (23%) of emergency responders did not wear PPE during the response activities, as only 21 of 92 emergency responders self-reported donning self-contained breathing apparatus during the response.⁹

The survey design has several limitations. First, the survey aimed to maximize the detail responders may be able to recall but remains subject to recall bias given post-event administration. Secondly, information on specific timing and frequency of PPE use or contact with substances was not captured in this survey, preventing more exact estimates of exposures. Finally, given the cross-sectional nature of the survey, we were unable to examine causal relationships between variables over time.

A hierarchy of controls framework focusing on elimination of hazards, substitution for less hazardous substances, engineering controls, administrative controls, and PPE usage prioritizes other actions over relying on an individual's behavioral protective practices.¹⁰ This framework should be used to reduce the likelihood and severity of health effects among responders. It is worth noting, however, that for some events, employing the use of a hierarchy of controls framework may not be feasible. For example, during an emergency response, first responders may not be able to eliminate or substitute a hazard and may only be able to rely on their training and PPE to minimize potential exposure to hazards. Further, volunteer fire departments are often under-resourced and have specific challenges (e.g., inadequate equipment), which may impact their ability to respond effectively to disasters and other emergencies.¹¹

Increasing awareness and timely communications between rail operators and first response agencies about the hazardous contents

of rail cars can improve response efforts. In addition, increasing responders' timely access to information on substances in their environment might increase their ability to employ engineering controls and other appropriate protective measures. An existing approach that details pre-, during, and post- deployment activities that can be used in emergency events to protect worker safety and health is the Emergency Responder Health Monitoring Surveillance (ERHMS) framework. It includes recommendations and tools to protect emergency responders, including volunteers, during all phases of a response, as well as protocols for rapid identification and sharing of chemical information.¹² Local and state health agencies and responder groups can continue to support the health of responders to this incident by encouraging routine annual preventive care visits with primary healthcare providers, and training in hazardous substances response and appropriate use of PPE.

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