HHS Public Access

Author manuscript

J Environ Health. Author manuscript; available in PMC 2024 March 01.

Published in final edited form as:

J Environ Health. 2023 March ; 85(7): 8–15.

Assessment of Chemical Exposures Investigation After Fire at an Industrial Chemical Facility in Winnebago County, Illinois

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Abstract

After a chemical fire, an investigation assessed health effects by using syndromic surveillance to monitor emergency department (ED) visits, a general health survey to assess the general public, and a first responders health survey to assess first responders. A total of four separate multivariable

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Disclaimer: The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of CDC or ATSDR.

logistic regression models were developed to examine associations between reported exposure to smoke, dust, debris, or odor with any reported symptom in the general public. Syndromic surveillance identified areas with increased ED visits. Among general health survey respondents, 45.1% (911 out of 2,020) reported at least one symptom. Respondents reporting exposure to smoke, dust, debris, or odor had 4.5 (95% confidence interval (CI) [3.7, 5.5]), 4.6 (95% CI [3.6, 5.8]), 2.0 (95% CI [1.7, 2.5]), or 5.8 (95% CI [4.7, 7.3]) times the odds of reporting any symptom compared with respondents not reporting exposure to smoke, dust, debris, or odor, respectively. First responders commonly reported contact with material and being within 1 mi of the fire ≥5 hr; 10 out of 31 of first responders reported at least one symptom. There was high symptom burden reported after the fire. Results from our investigation might assist the directing of public health resources to effectively address immediate community needs and prepare for future incidents.

Introduction

On the morning of June 14, 2021, a fire ignited and spread rapidly through an industrial chemical facility owned by the largest industrial grease manufacturer in the U.S. and located on the Beloit Corporation Superfund site (U.S. Environmental Protection Agency [U.S. EPA], 2022a) in Winnebago County, Illinois (2020 population: 285,350; U.S. Census Bureau, n.d.). The fire created a dark plume of smoke visible by satellite imagery; required specialized firefighting services; and released smoke, dust, and debris for 4 days. Local authorities issued a 1-mi evacuation order and a 3-mi masking advisory during this time to assist mitigation of potential negative health outcomes in the nearby communities.

The available air sampling data from the U.S. Environmental Protection Agency demonstrated several 2.5 micron ($PM_{2.5}$) and 10 micron (PM_{10}) measurements above the World Health Organization public health screening levels (World Health Organization and Environmental Health Team, 2006); the Illinois Department of Public Health and the Agency for Toxic Substances and Disease Registry (ATSDR) determined that no measurements above the public health screening levels were found for other analytes monitored, including volatile organic compounds, carbon monoxide, oxygen, and hydrogen sulfide (Illinois Environmental Protection Agency, 2022; U.S. EPA, n.d.). Because additional chemical exposures, such as exposures to heavy metals, were unknown, public health authorities considered how to determine the health effects of the chemicals released from the fire in nearby communities and among first responders, who could have had different exposure experiences than the general population.

After a chemical exposure incident, ATSDR evaluates the need to conduct an Assessment of Chemical Exposures (ACE) investigation, which is an epidemiological assessment that can provide information to assess the health effects of the incident on individuals and communities, direct the public health response, focus outreach to prevent similar incidents, assess the need for modification of emergency response procedures, and identify groups of people who might need long-term follow-up (Agency for Toxic Substances and Disease Registry [ATSDR], 2016; Duncan, 2014). On June 25, 2021, the Illinois Department of Public Health invited ATSDR to conduct an ACE investigation (Surasi et al., 2021).

This report presents findings from the ACE investigation of a chemical fire in Winnebago County, Illinois. The investigation included several public health tools to examine the magnitude, geography, and nature of the health effects of the fire in nearby communities and assessed exposures and health outcomes among first responders.

Methods

This ACE investigation used syndromic surveillance to monitor emergency department (ED) visits, a general health survey to assess the general public, and a first responders health survey to assess first responders.

Syndromic Surveillance

State health departments have access to the Electronic Surveillance System for the Early Notification of Community-based Epidemics (ESSENCE), a syndromic surveillance program that monitors counts of reasons for ED visits (i.e., chief complaints) (Burkom et al., 2021; Centers for Disease Control and Prevention, 2022). The ESSENCE program incorporates statistical methods to detect anomalies in data and provides alerts and warnings that can guide efforts to determine if the trends require further attention or intervention. ESSENCE was used to monitor trends in ED visits during the month after the incident, map ZIP Code areas with the largest numbers of ED visits, and specify which chief complaints (e.g., respiratory, mental health) increased in these areas. As the facility was near the Wisconsin border, the Wisconsin Department of Health Services also queried ESSENCE using the same criteria for ED visits related to the fire during June 14–July 1, 2021.

General Health Survey

Using a general health survey to assess the general public, the investigation team examined the association of residents' reported contact with material (i.e., smoke, dust, debris) or report of smelling an odor with any reported new or worsening symptom within the 2 weeks prior to survey completion. The investigation team designed an electronic survey that was adapted from survey forms available from ATSDR's ACE toolkit (ATSDR, 2014; Duncan & Orr, 2016) and Epi Contact Assessment Symptom Exposure (Epi CASE) toolkit (ATSDR, 2020) to evaluate the human health effects of the fire in the nearby population. The survey asked about demographic characteristics, residential distance from the facility, contact with material, smelling an odor, healthcare use, and new or worsening symptoms within the 2 weeks prior to survey completion.

Demographic characteristics included age, gender, race, and ethnicity. Age was calculated from date of birth and categorized as 0–19, 20–44, 45–64, and ≥65. Respondents selected one option for gender: female, male, transgender, or other. Respondents self-reported race from a list of options (White, Black or African American, Asian, American Indian or Alaska Native, Native Hawaiian or Pacific Islander, Other) and were considered "Multiracial" if they selected more than one race. Respondents indicated whether they were Hispanic or Latino. The distribution of age, gender or sex, race, and ethnicity was compared between survey respondents and the entire population of the 11 ZIP Codes of interest using estimates from the American Community Survey 5-Year Data 2019 (U.S. Census Bureau, 2021).

Residential addresses of survey respondents were geocoded at the census tract level. Their residential distance from the facility was calculated using Esri's ArcGIS Pro desktop application, and respondents were categorized as living <1, 1 to <3, 3 to <5, 5 to <10, 10 to <15, or ≥15 mi from the facility. Geospatial analyses used data from the Social Vulnerability Index (SVI), in which a higher quartile indicates higher social vulnerability (i.e., a community's susceptibility to negative effects from disasters) than a lower quartile (ATSDR, 2022).

The survey asked about contact with material and respondents chose all that applied: smoke, dust, debris, other, none, or unsure. Respondents also indicated if they smelled an odor. The survey then asked about the highest level of healthcare received because of the incident: formal healthcare services (i.e., hospitalization; visit to an ED, urgent care center, or outpatient clinic; or telehealth consult), self-treatment, or "no healthcare needed."

The survey asked, "Over the past 2 weeks since the event have you experienced worsening of a pre-existing or a new onset of any of the following symptoms?" and allowed respondents to select all that applied from a list of symptoms organized by category: ears, nose, and throat (ENT); neurological; ophthalmic; cardiopulmonary; psychiatric; and skin. Respondents reporting a new or worsening symptom within the 2 weeks prior to survey completion were categorized as symptomatic and all others as asymptomatic. Among symptomatic respondents, it was determined which symptoms were reported, how many symptoms were reported, and how many symptom categories were involved.

The survey was administered by leveraging the Qualtrics XM Platform client engagement system, which is an existing system that was used for COVID-19 vaccination registration. The survey was publicly available July 1–15, 2021, and residents could access it through a link shared via news outlets, social media, and the local health department website. Additionally, on July 5, the Qualtrics system was used to send the survey link to 40,217 email addresses of registered residents from 11 ZIP Codes of interest (5 identified through surveillance data and 6 nearby ones) and it was noted whether a respondent accessed the survey through the email link. On July 12, the survey link was emailed to registered residents of a neighboring Wisconsin county.

Survey data were analyzed in R software (version 4.1.0) and a response was excluded if it was a duplicate entry, the residential addresses did not geocode, it was missing symptom data, or it was from a first responder. Duplicate entries were determined by identifying duplicate unique identifiers created by the Qualtrics system; the earliest entry was included and subsequent entries with the same unique identifier were excluded. Additionally, geospatial analysis was conducted to visualize the distribution of respondents reporting any symptom. Frequencies were calculated for reported demographic characteristics, residential distance from the facility, healthcare use, contact with material, smelling an odor, and symptoms for residents from the general public responding to the general health survey. Multivariable logistic regression was applied to assess the association of contact with material or smelling an odor with the outcome of symptom status (symptomatic versus asymptomatic) among residents from the general public. Four separate models were developed with symptom status as the dependent variable and contact with smoke, contact

with dust, contact with debris, or smelling an odor as the main exposure variable—and were adjusted for age, gender, race, ethnicity, and residential distance from the facility.

First Responders Health Survey

Although the general health survey was available to the general public, a separate health survey was later developed specifically for first responders that had nearly identical questions. Because it was suspected that first responders did not want to be identified on the general health survey because of fear of professional consequences, the first responders survey did not require them to enter identifying information to complete it. Local police and fire chiefs shared the survey link through internal professional communication channels.

First responders who completed the first responders health survey and respondents who completed the general health survey (e.g., before the first responders health survey was available) and self-identified as first responders were grouped together. Frequencies were calculated for reported demographic characteristics, use of personal protective equipment (PPE), contact with material, smelling an odor, symptoms, and healthcare use for first responders. No inferential statistical tests for first responders were performed because of small sample size.

This activity was reviewed by the Centers for Disease Control and Prevention (CDC) and was conducted consistent with applicable federal law and CDC policy.

Results

Syndromic Surveillance

ESSENCE syndromic surveillance data identified 15% more ED visits than baseline on the day of the incident in the county, and the number declined within the week. Mapping the area around the facility, the team identified 6 ZIP Code areas downwind of the facility with the largest number of ED visits. Among residents in those 6 ZIP Code areas, ESSENCE data showed alerts and warnings for specific chief complaints compared with the previous 90-day baseline. Chief complaints for respiratory symptoms increased on June 14, and chief complaints for asthma increased on June 17. Chief complaints for disaster-related mental health increased on June 15, and chief complaints related to self-harm increased on multiple days. Continued trends in ESSENCE 1 month after the incident were not identified.

The Wisconsin Department of Health Services' ESSENCE query resulted in 17 unique results for individuals visiting the ED from June 15–24; further, 6 of the results had a direct reference to the chemical fire for the chief complaint. None of the individuals was admitted for a higher level of care.

General Health Survey

From an initial 2,053 responses, 2 duplicate entries, 17 responses with residential addresses that did not geocode, 4 responses that were missing symptom data, and 10 responses from first responders were excluded, resulting in an analytic sample of 2,020. Overall, 911 (45.1%) of respondents reported experiencing at least one new or worsening symptom within the 2 weeks prior to survey completion. Characteristics of respondents by symptom

status and respondents overall, along with demographic characteristics of the general population from 11 ZIP Codes, are shown in Table 1. Figure 1 presents a map of the distribution of symptomatic respondents using a magnitude-per-unit-area visualization. Only 91 responses were completed between July 1–5; on July 6 and 7, an additional 860 and 630 responses were completed, respectively. Among symptomatic respondents, 80.6% (734 out of 911) accessed the survey through the email link, and among asymptomatic respondents, 96.1% (1,066 out of 1,109) used the email link to access the survey. Analysis indicated fewer survey responses and fewer reports of using formal healthcare services in census tracts with the highest SVI quartile compared with census tracts with lower SVI quartiles in a nearby city.

A total of 1,225 (60.6%) respondents reported contact with any material, with 965 (78.8%), 498 (40.7%), 690 (56.3%), and 47 (3.8%) of them reporting contact with smoke, dust, debris, and other material, respectively. A total of 1,047 (51.8%) respondents reported smelling an odor. Table 2 presents adjusted odds ratios for four separate models with reported symptom status as the outcome variable and different exposure variables (i.e., contact with smoke, contact with dust, contact with debris, or smelling an odor), adjusting for age, gender, race, ethnicity, and residential distance from the facility.

Among the 911 symptomatic respondents, 635 (69.7%) reported any ENT symptom, 477 (52.4%) reported any neurological symptom, 380 (41.7%) reported any ophthalmic symptom, 302 (33.2%) reported any cardiopulmonary symptom, 237 (26.0%) reported any psychiatric symptom, and 99 (10.9%) reported any skin symptom. Among symptomatic respondents, the median number of symptoms was 4 (interquartile range: 2–6) and the median number of symptom categories involved was 2 (interquartile range: 1–3). Symptoms reported by ≥100 respondents are listed in Table 3. Among symptomatic respondents, 106 (11.6%) used formal healthcare services and 347 (38.1%) self-treated. Four respondents who used formal healthcare services were hospitalized and the reported indications for admission were asthma ($n = 2$), epistaxis ($n = 1$), and one unknown indication.

First Responders Health Survey

Representing 14 different organizations, 31 first responders completed the surveys (10 from the general health survey and 21 from the first responders health survey). One first responder self-identified as female and the rest self-identified as male. Further, 28 first responders self-identified as White, 1 self-identified as Black or African American, 1 self-identified as Other for race, and 1 first responder was missing race data. Furthermore, 2 first responders self-identified as Hispanic or Latino, 1 was missing ethnicity data, and the remaining self-identified as non-Hispanic or Latino.

Moreover, 19 first responders reported wearing standard fire protection gear (i.e., fire helmet, turnout pants and jacket, leather gloves, and boots); 3 first responders reported wearing a mask; and 7 first responders reported not wearing a mask, gloves, goggles, hazmat suit coveralls, or standard fire protection gear. Further, 7 first responders reported spending ≤4 hr, 17 reported spending 5–23 hr, and 5 reported spending ≥24 hr within 1 mi of the facility; 2 were missing data on time spent within 1 mi of the facility. Only 2 first responders reported not contacting any material; 26, 19, 19, and 5 reported contact with smoke, dust,

debris, and other material, respectively. And lastly, 26 first responders reported smelling an odor, 4 were unsure whether they smelled an odor, and 1 reported not smelling an odor.

Of the 10 symptomatic first responders, 6 reported ENT symptoms, 4 reported neurologic symptoms, 3 reported ophthalmic symptoms, and 5 reported cardiopulmonary symptoms. Symptoms reported by first respondents are listed in Table 4. Furthermore, 1 first responder sought care in an ED, urgent care, or outpatient clinic; 2 self-treated; and the remaining 28 did not need healthcare.

Discussion

Nearly one half of the general health survey respondents reported a new or worsening symptom within the 2 weeks prior to survey completion. Moreover, reported contact with smoke, dust, or debris or report of smelling an odor was strongly associated with being symptomatic. This association suggests that the increase in reported symptoms could be related to reported exposure to the fire and its resulting material. Reported symptoms are consistent with previous reports of exposure to elevated $PM_{2.5}$ and PM_{10} (An Han et al., 2020; Bazyar et al., 2019). While the long-term health effects of this incident are unknown, other reports have identified adverse health outcomes reported many years after acute exposure to a chemical fire (Degher & Harding, 2004; Granslo et al., 2017; Greven et al., 2009). Given the high level of reported symptom burden in this sample, support for the community's access to appropriate healthcare resources and ongoing monitoring for changes in health, such as via syndromic surveillance, should be prioritized.

Findings from this investigation can also inform leaders to prepare for future emergency responses. Industrial companies can consider discussions to prevent and mitigate incidents with chemical exposures by having safety measures and emergency response resources to limit impact on the surrounding population and environment. Robust participation in Local Emergency Planning Committees can contribute to emergency response planning (U.S. EPA, 2022b). Careful attention to first responders' working conditions and PPE, especially during chemical exposures, is important in protecting the health of this group (Melnikova et al., 2018). More attention to gender, racial, and ethnic minority groups and residents from areas with higher social vulnerability—who might be at higher risk for negative effects from disasters—could contribute to a better understanding of if and how specific groups are disproportionately affected by chemical exposures. Additionally, future investigations and survey methods (e.g., oversampling) could be beneficial in addressing this issue.

Our report findings are subject to limitations of the survey that was rapidly modified from an in-person, interviewer-administrated survey to an electronic, self-administrated survey with limited time for validation. The general health survey might not be representative of the entire exposed cohort because it used a convenience sample. Further, the general health survey was primarily accessed through a direct link emailed to registrants who signed up for COVID-19 vaccine updates and required respondents to provide contact information and demographic information. This sampled population might be more comfortable with electronic communications, interested in public health activities, and agreeable to providing identifying information in surveys than the general public (Tripepi et al., 2010). The

general health survey used an adapted Epi CASE survey—a brief survey designed to capture information soon after a disaster—but it did not capture detailed information on behaviors that might have increased or decreased exposure, factors affecting health status, or the nature of contact with material. Moreover, the general health survey did not collect detailed information, such as duration or intensity, about the characteristics of symptoms. Furthermore, the survey question about use of healthcare did not provide an option for respondents to indicate that they needed healthcare but lacked access, which could potentially mask the needs and experiences of different groups of people. Additionally, the 1-mi evacuation order and 3-mi masking advisory might have affected respondents' exposure, perception of risks, and responses to survey questions.

Conclusion

An epidemiological assessment was performed after a large chemical fire at a facility to identify potentially affected areas and assess the health effects of the fire in nearby communities and among first responders. This investigation was successful in using several public health tools after a fire at an industrial chemical facility in Winnebago County, Illinois. High levels of reported symptom burden were identified among surveyed residents. There were associations between respondents' reported contact with material or report of smelling an odor with any reported new or worsening symptom. Results from this investigation might assist the directing of public health resources to effectively address immediate community needs and prepare for future incidents.

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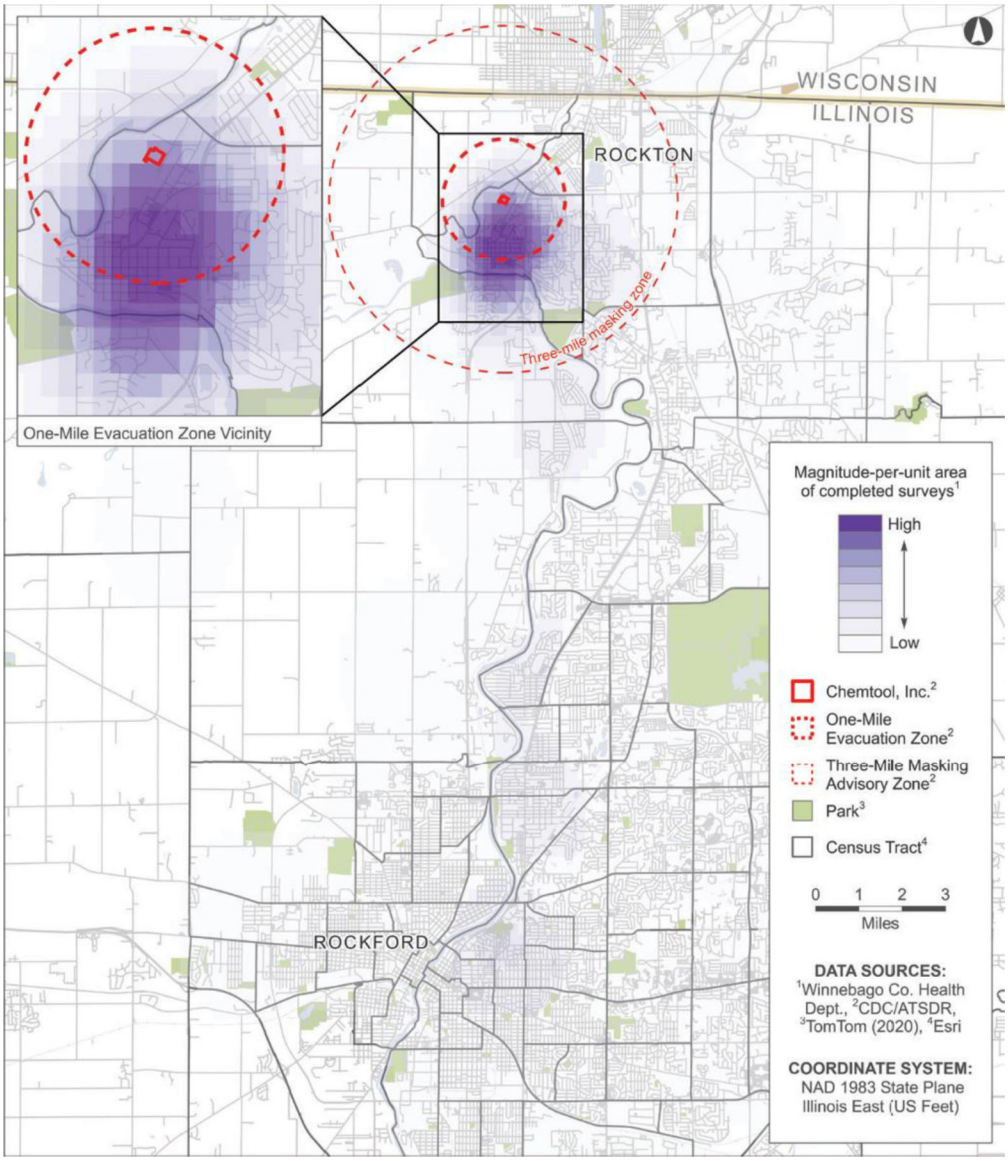

FIGURE 1. Kernel Density Map of General Health Survey Respondents Reporting a New or Worsening Symptom Within the 2 Weeks Prior to Survey Completion, Winnebago County, Illinois, July 2021

Note. Data include survey respondents of the general health survey and exclude first responders.

CDC/ATSDR = Centers for Disease Control and Prevention/Agency for Toxic Substances and Disease Registry.

Table 1

Characteristics of General Health Survey Respondents by Symptom Status and Overall and Characteristics of the General Population From 11 ZIP Codes, Winnebago County, Illinois, July 2021

Characteristic	Asymptomatic Respondents (*n* = 1,109) # (%)	Symptomatic Respondents (*n* = 911) # (%)	Respondents Overall (*N* = 2,020) # (%)	General Population From 11 ZIP Codes (*N* = 240,043) # (%)
Age (years)				
0–19	17 (1.5)	11 (1.2)	28 (1.4)	61,626 (25.7)
20–44	370 (33.4)	363 (39.8)	733 (36.3)	72,678 (30.3)
45–64	492 (44.4)	400 (43.9)	892 (44.2)	64,305 (26.8)
≥65	225 (20.3)	135 (14.8)	360 (17.8)	41,434 (17.3)
Missing	5 (0.5)	2 (0.2)	7 (0.3)	–
Gender or Sex[a]				
Female	664 (59.9)	613 (67.3)	1,277 (63.2)	123,580 (51.5)
Male	431 (38.9)	272 (29.9)	703 (34.8)	116,463 (48.5)
Transgender	1 (0.1)	5 (0.5)	6 (0.3)	–
Other	1 (0.1)	5 (0.5)	6 (0.3)	–
Prefer not to answer	12 (1.1)	16 (1.8)	28 (1.4)	–
Race				
White	967 (87.2)	777 (85.3)	1,744 (86.3)	188,983 (78.7)
Black or African American	25 (2.3)	40 (4.4)	65 (3.2)	30,516 (12.7)
Other	21 (1.9)	21 (2.3)	42 (2.1)	4,396 (1.8)
Asian	31 (2.8)	9 (1.0)	40 (2.0)	7,291 (3.0)
Multiracial	15 (1.4)	12 (1.3)	27 (1.3)	8,075 (3.4)
American Indian or Alaska Native	2 (0.2)	6 (0.7)	8 (0.4)	757 (0.3)
Native Hawaiian or Pacific Islander	0 (0)	0 (0)	0 (0)	25 (<0.1)
Prefer not to answer	48 (4.3)	46 (5.0)	94 (4.7)	–
Hispanic or Latino				
No	1,064 (95.9)	855 (93.9)	1,919 (95.0)	209,996[b] (87.5)
Yes	45 (4.1)	56 (6.1)	101 (5.0)	30,047 (12.5)

Characteristic	Asymptomatic Respondents (*n* = 1,109) # (%)	Symptomatic Respondents (*n* = 911) # (%)	Respondents Overall (*N* = 2,020) # (%)	General Population From 11 ZIP Codes (*N* = 240,043) # (%)
Residential distance from the facility				
<1 mi	26 (2.3)	92 (10.1)	118 (5.8)	–
1–<3 mi	140 (12.6)	175 (19.2)	315 (15.6)	–
3–<5 mi	86 (7.8)	90 (9.9)	176 (8.7)	–
5–<10 mi	233 (21.0)	177 (19.4)	410 (20.3)	–
10–<15 mi	438 (39.5)	280 (30.7)	718 (35.5)	–
≥15 mi	186 (16.8)	97 (10.6)	283 (14.0)	–
Healthcare use				
No healthcare needed	1,096 (98.8)	451 (49.5)	1,547 (76.6)	–
Self-treated	8 (0.7)	347 (38.1)	355 (17.6)	–
Consulted a healthcare professional via phone or video conferencing	3 (0.3)	45 (4.9)	48 (2.4)	–
Visited an emergency department, urgent care, or outpatient clinic	0 (0)	57 (6.3)	57 (2.8)	–
Hospitalized	0 (0)	4 (0.4)	4 (0.2)	–
Missing	2 (0.2)	7 (0.8)	9 (0.4)	–

Note. Data include survey respondents of the general health survey and exclude first responders. General population data were obtained from the American Community Survey 5-Year Data 2019.

[a]Survey respondents self-identified their gender. The American Community Survey 5-Year Data 2019 presents proportions for sex.

[b]The non-Hispanic or Latino proportion of the general population was calculated by subtracting the number of Hispanic or Latino proportion from the total population.

Table 2

Adjusted Odds Ratio Associated With General Health Survey Respondents Reporting a New or Worsening Symptom Within the 2 Weeks Prior to Survey Completion for Four Separate Models With Different Exposure Variables, Winnebago County, Illinois, July 2021

Exposure Group	Adjusted *OR*	95% CI
Contact with smoke versus no contact with smoke	4.5	[3.7, 5.5]
Contact with dust versus no contact with dust	4.6	[3.6, 5.8]
Contact with debris versus no contact with debris	2.0	[1.7, 2.5]
Smelling an odor versus not smelling an odor	5.8	[4.7, 7.3]

Note. Data include survey respondents of the general health survey and exclude first responders. The four separate models are adjusted for age, gender, race, ethnicity, and residential distance from the facility. A total of six respondents with missing age data were removed from all four models. Furthermore, a total of 252 respondents were unsure about smelling an odor and were removed from the model with smelling an odor as the exposure variable. CI = confidence interval.

Table 3

General Health Survey Respondents Reporting a New or Worsening Symptom Within the 2 Weeks Prior to Survey Completion for Commonly Reported Symptoms, Winnebago County, Illinois, July 2021

Symptom	Symptom Category	Respondents Reporting Symptom (*N* = 2,020) # (%)
Headache	Neurological	449 (22.2)
Stuffy nose or sinus congestion	ENT	384 (19.0)
Increased congestion or phlegm (mucus)	ENT	309 (15.3)
Irritation, pain, or burning in eyes	Ophthalmic	280 (13.9)
Burning nose or throat	ENT	267 (13.2)
Runny nose	ENT	250 (12.4)
Anxiety	Psychiatric	208 (10.3)
Coughing	Cardiopulmonary	207 (10.2)
Increased watering or tearing	Ophthalmic	199 (9.9)
Hoarseness	ENT	198 (9.8)
Dizziness or lightheadedness	Neurological	181 (9.0)
Difficulty breathing or feeling out-of-breath	Cardiopulmonary	139 (6.9)
Tension or nervousness	Psychiatric	129 (6.4)
Asthma	Cardiopulmonary	105 (5.2)
Fatigue or tiredness	Psychiatric	104 (5.1)
Difficulty sleeping (e.g., falling asleep, staying asleep)	Psychiatric	100 (5.0)

Note. Data include survey respondents of the general health survey and exclude first responders.

The table includes only symptoms reported by ≥100 respondents.

Respondents were able to report more than one symptom. ENT = ears, nose, and throat.

Table 4

First Responders Reporting a New or Worsening Symptom Within the 2 Weeks Prior to Survey Completion, Winnebago County, Illinois, July 2021

Symptom	Symptom Category	First Responders Reporting (*N* = 31) # (%)
Headache	Neurological	4 (12.9)
Irritation, pain, or burning in eyes	Ophthalmic	3 (9.7)
Coughing	Cardiopulmonary	3 (9.7)
Hoarseness	ENT	2 (6.5)
Stuffy nose or sinus congestion	ENT	2 (6.5)
Increased congestion or phlegm (mucus)	ENT	2 (6.5)
Asthma	Cardiopulmonary	2 (6.5)
Runny nose	ENT	1 (3.2)
Burning nose or throat	ENT	1 (3.2)
Odor on breath	ENT	1 (3.2)
Sensation in throat	ENT	1 (3.2)
Dizziness or lightheadedness	Neurological	1 (3.2)
Blurred or double vision	Ophthalmic	1 (3.2)
Difficulty breathing or feeling out-of-breath	Cardiopulmonary	1 (3.2)
Wheezing in chest	Cardiopulmonary	1 (3.2)

Note. Data include respondents of the first responders health survey and respondents of the general health survey who self-identified as first responders. Data exclude respondents of the general health survey who did not self-identify as first responders. Respondents were able to report more than one symptom.

ENT = ears, nose, and throat.