

Chlorine Gas Exposure at a Metal Recycling Facility — California, 2010

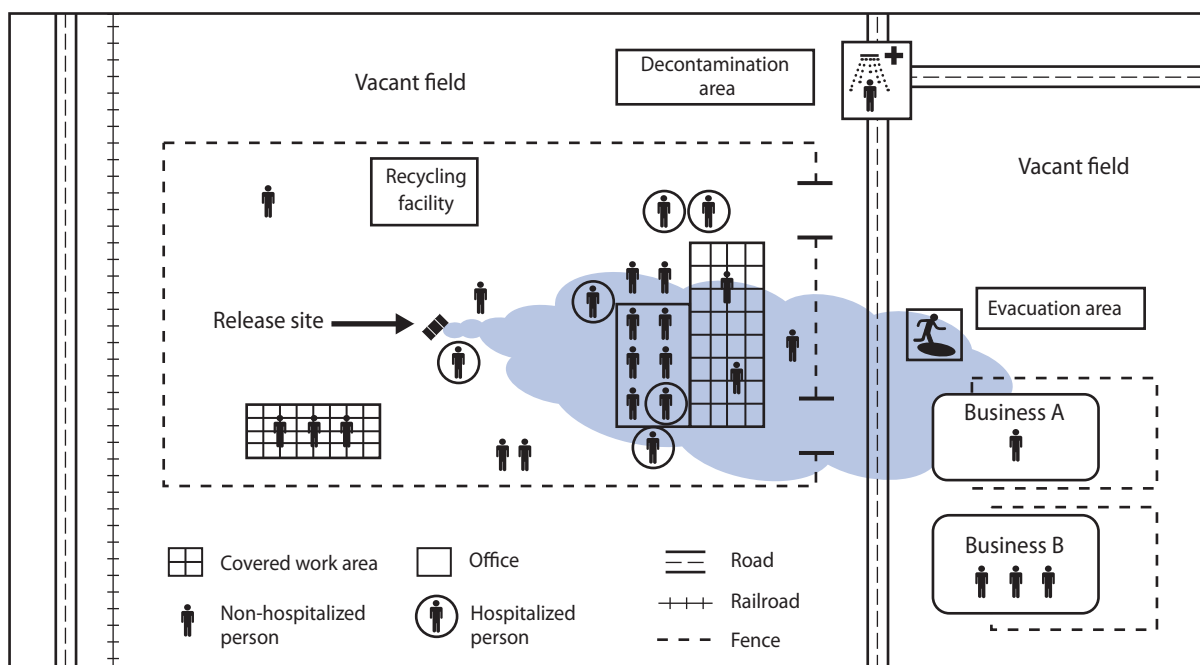
On June 8, 2010, chlorine gas was released from a ruptured, 1-ton, low-pressure tank being recycled at a California metal recycling facility. A total of 23 persons, including employees, customers, and workers at nearby businesses, were treated for the effects of the fumes at seven area hospitals. Chlorine is a corrosive, greenish-yellow gas that is heavier than air and can cause severe respiratory damage; it is used widely in water purification, sewage treatment, and disinfectant washes for foods. Following the incident, the Agency for Toxic Substances and Disease Registry (ATSDR) and CDC collaborated with the California Department of Public Health (CDPH) on an Assessment of Chemical Exposures (ACE) to determine 1) the circumstances surrounding those exposed during the chlorine gas release, 2) health effects associated with exposures, and 3) recommendations for preventing recurrences. This report describes the chlorine gas release in California and summarizes the results of the ACE investigation. Of 29 persons potentially exposed to chlorine gas, 27 were interviewed to collect information regarding their exposures. In addition, information regarding acute health effects and symptoms was abstracted from medical records. At the time of the chlorine gas release, 15 persons were outdoors, and 13 were exposed for >30 minutes before they were decontaminated. Twenty-three persons reported experiencing one or more upper or

lower respiratory tract symptoms within 24 hours of exposure; six persons were hospitalized for 1–11 days. Based on these findings, CDPH issued a statewide alert to all recycling facilities on how to handle containers with potential hazardous waste.

The chlorine gas release occurred at 2:44 p.m. at a metal recycling facility located in an industrial area. A worker used an excavator to cut into a 1-ton, low-pressure tank that was unlabeled, reportedly empty, and sold to the facility as scrap metal. When punctured, the tank produced an explosive release of a greenish-yellow cloud of gas. The release occurred outdoors in an open work area and affected 29 persons who were at or near the recycling facility (Figure). Of the 16 workers at the recycling facility, the majority were outdoors at the time of the release. Most followed a planned evacuation route, exiting the facility through the main gate and meeting in an open field across the street in an evacuation area that was downwind from the tank (Figure).

When emergency medical services and fire department personnel arrived at the scene, they set up a decontamination area 200 yards north of the facility, where the majority of exposed persons were decontaminated by rinsing with water. Twenty-two of those exposed were then transported by ambulance (one person self-transported) to seven local hospitals where some were decontaminated again by removing clothing and washing

FIGURE. Schematic of chlorine gas release at a metal recycling facility, which resulted in 23 persons seeking hospital treatment and six being hospitalized — California, 2010



with soap and water. At 5:58 p.m., local hazardous materials team members identified the gas as chlorine and measured a concentration of 328 ppm near the tank.

ATSDR and CDC arrived in California on June 14 to assist CDPH with the ACE investigation. The ACE program, which is part of the National Toxic Substance Incidents Program, provides assistance to state and local health departments for rapid assessments after large-scale toxic substance releases. Of the 29 persons identified as potentially exposed during the release, 16 were workers at the facility, and 13 were either customers or in businesses located across the street and downwind from the tank. Twenty-seven persons were interviewed (in English and Spanish), and information was collected regarding demographics, exposure characteristics, acute health effects, medical history, occupational history, and health services use. Two persons were not available at the time of interviews. Medical charts were obtained and abstracted for the 23 persons treated at area hospitals, six of whom were admitted. One of the six hospitalized persons was not interviewed.

Twenty-seven (93%) of the 29 potentially exposed persons were aged >18 years; average age was 40 years, with a range of 2–77 years. Of the 27 interviewed, 20 (74%) were Hispanic; 21 (78%) were male, and 18 (67%) had at least a high school education. Fifteen (56%) persons were outdoors at the time of the chlorine gas release, and 24 (89%) reported smelling an odor (Table 1). A total of 22 (82%) had been decontaminated (either by rinsing with water, removing clothing, or washing with soap and water), and 13 (48%) said they were exposed to chlorine gas for >30 minutes before being decontaminated. Five (19%) said they were exposed for <30 minutes, and nine (33%) either did not know how long or did not answer the question.

Twenty-three (85%) of the 27 persons interviewed reported experiencing acute health effects within 24 hours of the chlorine gas release (Table 2). The most common symptoms reported were coughing (22 persons, 82%); difficulty breathing/feeling out of breath (22, 82%); headache (21, 78%); and burning of the nose, throat, or lungs (20, 74%).

Among the 27 interviewed, five persons (19%) reported preexisting high blood pressure, four (15%) reported diabetes, and three (11%) reported allergies (11%); eight (30%) reported current smoking. None of the 27 reported any preexisting respiratory conditions (e.g., asthma or chronic obstructive pulmonary disease) that might have placed them at greater risk from the chlorine exposure.

Of the 23 exposed persons who received care at seven area hospitals, 17 (74%) were treated and discharged from the emergency department, and six (26%) were hospitalized. Five (83%) of the six hospitalized patients worked at the recycling facility. Among those who received medical care,

TABLE 1. Circumstances surrounding chlorine gas exposure reported by 27 persons who were interviewed — California, 2010

Circumstance	No.	(%)
Exposure time*		
<30 min	5	(19)
≥30 min	13	(48)
Don't know/Missing	9	(33)
Location		
Indoors	10	(37)
Outdoors	15	(56)
Don't know/Missing	2	(7)
Distance from release site		
≤100 yards	10	(37)
>100 yards	15	(56)
Don't know/Missing	2	(7)
Smelled odor		
Yes	24	(89)
No	2	(7)
Don't know/Missing	1	(4)
Odor type		
Strong	23	(85)
Mild	—	—
Don't know/Missing	4	(15)
In gas cloud		
Yes	15	(56)
No	9	(33)
Don't know/Missing	3	11
Evacuated area		
Yes	25	(93)
No	1	(4)
Don't know/Missing	1	(4)
Sheltered in place		
Yes	1	(4)
No	25	(93)
Don't know/Missing	1	(4)
Decontaminated		
Yes	22	(82)
No	5	(19)

*Exposure time = (time decontaminated) – (time of chlorine gas release).

TABLE 2. Health effects experienced by 27 persons within 24 hours of chlorine gas exposure — California, 2010

Health effect	No.	(%)
Illness within 24 hrs		
Yes	23	(85)
No	4	(15)
Symptoms within 24 hrs*		
Coughing	22	(82)
Difficulty breathing/feeling out of breath	22	(82)
Headache	21	(78)
Burning nose, throat, or lungs	20	(74)
Increased congestion or mucous	19	(70)
Dizziness/lightheadedness	18	(67)
Eye irritation/pain/burning	18	(67)
Runny nose	18	(67)
Wheezing in chest	17	(63)
Chest tightness or pain/angina	16	(59)
Nausea	16	(59)
Skin irritation/pain/burning	8	(30)

* Affected persons were asked about each symptom separately. The number responding "yes" for each symptom is shown.

What is already known on this topic?

Exposure to chlorine, which is used in numerous industrial processes and for water treatment, can cause severe respiratory damage, depending on the concentration.

What is added by this report?

In June 2010 in California, chlorine gas was released from a tank sold as scrap metal; 23 persons were treated for the effects of the fumes, including six who were hospitalized for 1–11 days.

What are the implications for public health practice?

Health officials should urge metal recycling facilities to 1) only accept containers that are cut open, dry, or without a valve or plug; 2) treat closed containers as potential hazardous waste; and 3) develop and practice a hazardous gas release evacuation plan.

four had an oxygen saturation level <95% recorded in the emergency department. Five persons had an arterial blood gas measurement when they first reached a hospital, and their partial pressure of oxygen values ranged from 62 to 78 mmHg (reference range: 80–100 mmHg) (1).

Among those who were discharged from the emergency department, three received oxygen, and nine were prescribed nebulized β_2 -agonists. All six of those hospitalized were prescribed nebulized β_2 -agonists; five received oxygen, three were given steroids (oral or intravenous), and two were treated with antibiotics. Most of the hospitalized patients were released after 1–4 days. However, one recycling facility worker was hospitalized for 11 days and required mechanical ventilation for 2 days.

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Editorial Note

The incident described in this report demonstrates the risk for unintentional release of a hazardous substance at a metal recycling facility. During 2001–2009, ATSDR's Hazardous Substance Emergency Events Surveillance (HSEES) program received reports of 21 incidents in nine participating states involving a tank that contained a hazardous substance.

In 2009, a total of 230 chlorine release events were reported to HSEES, of which 81 resulted in injuries (2). In California, which is not an HSEES participating state, an earlier chlorine gas release occurred in February 2010 at another scrap metal recycling facility. In that incident, a 1-ton tank being moved by a crane was punctured, and chlorine gas released, resulting in hospitalization of five workers for respiratory symptoms (3).

Chlorine, in its various forms, is used in chemical and plastic manufacturing, textile and paper bleaching, and water purification (4). Chlorine is a respiratory irritant and can produce symptoms ranging from mild ocular and upper respiratory irritation to severe inflammation of bronchoalveolar tissues, which can lead to death (5). The symptoms caused by chlorine depend on the concentration to which a person is exposed. In the incident described in this report, the symptoms experienced were consistent with those reported in previous community exposures (6–10). Although the number of exposed persons was smaller in this incident, the proportion hospitalized was higher (21%) than in incidents reported previously in Pennsylvania (8%) (7) and South Carolina (12%) (10). However, unlike those earlier incidents, which occurred near highly populated areas and involved greater amounts of chlorine gas, no fatalities occurred in California.

As a result of the June 2010 incident in California, the CDPH Division of Environmental and Occupational Disease Control, Emergency Planning and Preparedness Team produced a Chemical Release Alert, which was mailed to approximately 1,200 recycling facilities in the state. The alert urged facilities to 1) only accept containers that are cut open, dry, or without a valve or plug; 2) treat all closed containers as potential hazardous waste; and 3) develop and practice an evacuation plan, including training workers to stay upwind when evacuating after a hazardous gas release (3).

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References

1. Fischbach FT, Dunning MB. A manual of laboratory and diagnostic tests. Philadelphia, PA: Lippincott Williams & Wilkins, 2009:973.

2. Agency for Toxic Substance and Disease Registry. Hazardous Substance Emergency Events Surveillance. Atlanta, GA: US Department of Health and Human Services, Agency for Toxic Substances and Disease Registry; 2008–2009. Available at http://www.atsdr.cdc.gov/hs/hsees/public_use_file.html. Accessed July 19, 2011.
3. Emergency Planning and Preparedness Team, Division of Environmental and Occupational Disease Control, California Department of Public Health. Chemical release alert: chlorine gas release at two scrap recycling facilities. Sacramento, California: California Department of Public Health; 2010. Available at <http://www.cdph.ca.gov/programs/ohb/documents/chlorinereleasealert.pdf> or at [Spanish] <http://www.cdph.ca.gov/programs/ohb/documents/chlorinereleasealertspan.pdf>. Accessed July 15, 2011.
4. Winder C. The toxicology of chlorine. *Environ Res* 2001;85:105–14.
5. Agency for Toxic Substances and Disease Registry. Toxicological profile for chlorine. Atlanta, GA: US Department of Health and Human Services, Agency for Toxic Substances and Disease Registry; 2004.
6. Guloglu C, Kara IH, Erten PG. Acute accidental exposure to chlorine gas in the Southeast of Turkey: a study of 106 cases. *Environ Res* 2002; 88:89–93.
7. Hedges JR, Morrissey WL. Acute chlorine gas exposure. *JACEP* 1979;8: 59–63.
8. Jones RN, Hughes JM, Glindmeyer H, Weill H. Lung function after acute chlorine exposure. *Am Rev Respir Dis* 1986;134:1190–5.
9. Mohan A, Kumar SN, Rao MH, Bollineni S, Manohar IC. Acute accidental exposure to chlorine gas: clinical presentation, pulmonary functions and outcomes. *Indian J Chest Dis Allied Sci* 2010;52: 149–52.
10. Wenck MA, Van Sickle D, Drociuk D, et al. Rapid assessment of exposure to chlorine released from a train derailment and resulting health impact. *Public Health Rep* 2007;122:784–92.