



CDC Home

Search

Health Topics A-Z



Surveillance Summaries

July 22, 1994 / 43(SS-2);1-6

Surveillance for Emergency Events Involving Hazardous Substances -- United States, 1990-1992

H. Irene Hall, Ph.D. V. Ramana Dhara, M.D. Patricia A. Price-Green, M.S.P.H.

Wendy E. Kaye, Ph.D.

Division of Health Studies Agency for Toxic Substances and Disease Registry

Abstract

Problem/Condition: A review of existing reporting systems indicated that not enough information was being collected to determine the public health consequences of emergency events involving hazardous substances.

Reporting Period Covered: January 1990 through December 1992.

Description of System: State health departments in selected states collect and each quarter transmit information about the events, substances released, and the public health consequences of hazardous substance releases (i.e., morbidity, mortality, and evacuations) to the Agency for Toxic Substances and Disease Registry (ATSDR). Five state health departments (Colorado, Iowa, Michigan, New Hampshire, and Wisconsin) began data collection on January 1, 1990. On January 1, 1992, the reporting state health departments included those from Colorado, Iowa, New Hampshire, New York, North Carolina, Oregon, Rhode Island, Washington, and Wisconsin.

Results and Interpretation: During 1990-1992, 3,125 events were reported from participating states to ATSDR's Hazardous Substances Emergency Events Surveillance (HSEES) system. Of these events, 2,391 (77%) were fixed-facility events (i.e., occurred at stationary facilities), and 723 (23%) were transportation related. In 88% of events, a single chemical was released. The most frequently released hazardous substances were volatile organic compounds (18% of the total 4,034 substances released), herbicides (15%), acids (14%), and ammonias (11%). In 467 events (15% of all events), 1,446 persons were injured; 11 persons died as a result of these injuries. Respiratory irritation (37%) and eye irritation (23%) were the most frequently reported health effects. A total of 457 (15%) events resulted in evacuations; of these, 400 (88%) were ordered by an official (e.g., a police officer or firefighter). The median number of persons evacuated was 25 (range: from 12 to greater than 9,999 persons). Evacuations lasted an average of 9.4 hours (median: 3 hours; range: 1-240 hours).

Actions Taken: Information from HSEES is being used for preparedness planning, such as the relocation of hazardous materials (HazMat) teams to areas with higher incidence and the training of first responders and employees. The information is also used to conduct follow-up epidemiologic studies and to determine risk factors associated with events resulting in injury.

INTRODUCTION

Since World War II, the number of chemicals that have been developed, produced, and used in the United States has increased rapidly. More than 65,000 substances are available on the market, and approximately 600 new substances are produced each year (1). However, the potential health effects of many of the substances in common use are unknown. Furthermore, comprehensive information regarding the public health consequences of hazardous substance releases (i.e., the morbidity, mortality, and evacuations of the general public, first responders, and employees *) was not available.

In 1988, the Agency for Toxic Substances and Disease Registry (ATSDR) initiated a study of the information about hazardous substance releases available in three national databases: the National Response Center Database, the Hazardous Materials Information System (HMIS), and the Acute Hazardous Events Database (2). These databases were found to have limitations for assessing the public health consequences of hazardous substance releases (2-4). Not all events were included in these databases (e.g., HMIS does not include events involving intrastate carriers and fixed {stationary} facilities), and many events were not reported. Moreover, the accuracy of the collected information could not be confirmed. Other types of data not included in these systems were information concerning the persons injured by hazardous substance releases, the types of injuries received, and evacuations.

Because of these limitations in data collection, in October 1989 ATSDR implemented an active, state-based Hazardous Substances Emergency Events Surveillance (HSEES) system in selected states to enable assessment of the public health consequences associated with hazardous substance releases. This report describes the public health consequences of events reported to the HSEES system from January 1990 through December 1992.

METHODS

Five state health departments (Colorado, Iowa, Michigan, New Hampshire, and Wisconsin) began data collection on January 1, 1990. On January 1, 1992, the reporting state health departments included those from Colorado, Iowa, New Hampshire, New York, North Carolina, Oregon, Rhode Island, Washington, and Wisconsin. Information regarding the event, chemicals released, affected persons, injuries, ** and evacuations was recorded on standardized data collection forms designed by ATSDR. Personnel from state health departments used different sources (e.g., records or verbal reports by personnel of state environmental protection agencies, police and fire departments, and hospitals) to obtain information for the data collection form. The data were computerized, using a data entry system provided by ATSDR, and were reported quarterly to ATSDR.

Hazardous substance emergency events were defined as uncontrolled or illegal releases or threatened releases of chemicals or their hazardous by-products. The reportable chemicals included the 200 substances identified by ATSDR as the most hazardous substances found at Superfund sites (5), all other insecticides and herbicides in addition to those found at Superfund sites, chlorine, hydrochloric acid, sodium hydroxide, nitric acid, phosphoric acid, acrylic acid, and hydrofluoric acid. Events were reported if the amount of substance released needed to be removed, cleaned up, or neutralized

according to federal, state, or local law. In addition, events were reported if they resulted in a potential for a release of a designated hazardous substance and if this potential led to an action (e.g., an evacuation) to protect the health of employees, first responders, or the general public.

RESULTS

A total of 3,125 events were reported from participating states to the HSEES system during 1990-1992. Of these events, 2,391 (77%) were fixed-facility events, and 723 (23%) were transportation related. Type of event was unknown for 11 of the reported events. Location of event was known for 3,092 events. Most (1,890 {61%}) events occurred in areas with industrial or commercial land use; 547 (18%), in areas classified as rural; and 329 (11%), in residential areas.

The frequency distribution by day of week for Monday through Friday did not vary substantially. However, the daily average number of 538 emergency events on a Monday through Friday was more than twice the daily average number on a Saturday or Sunday (i.e., 219 events). Time of day that the emergency event occurred was known for 2,957 events. Of these, 2,230 (75%) events occurred from 6 a.m. to 6 p.m.; 467 (16%), from 6 p.m. to 12 a.m.; and 260 (9%), from 12 a.m. to 6 a.m.

The hazardous substances released during the events were grouped into 11 categories ([Table 1](#)). The most frequently released hazardous substances were volatile organic compounds (18% of the total 4,034 substances released), herbicides (15%), acids (14%), and ammonias (11%). The substances released during the two types of events were similar; however, a greater number of transportation-related incidents involved the release of herbicides.

For the four categories of substances that were released most frequently, 13%-27% of the releases resulted in injury. The substances released most often, however, were not necessarily those most likely to result in injury. For example, although insecticides were released in only 5% of all events, 80 (37%) of the 217 events with releases of insecticides resulted in injuries.

A single substance was released in 2,747 (88%) of all events, and two substances were released in 199 (6%). The distribution of the number of substances released during events that resulted in injury ([Table 2](#)) was comparable to the distribution of the number of substances released during all events.

In 467 events (15% of all events), 1,446 persons were injured. In 252 (54%) events resulting in injury, only one person was injured. In an additional 88 (19%) events resulting in injury, two persons were injured. Information about age was available for 883 (61%) injured persons (mean age: 33 years; range: 1-79 years). Seventy-six percent of injured persons were male. Overall, 968 (67%) injured persons were employees, 200 (14%) were first responders, and 276 (19%) were from the general public. In transportation-related events, 46 (34%) injured persons were first responders.

For both fixed-facility and transportation-related events, respiratory irritation and eye irritation were the most frequently reported health effects ([Table 3](#)). In transportation-related events, injured persons also commonly had traumatic injuries (i.e., 28 {13%} of transportation-related injuries were traumatic).

Eleven deaths were reported, two of which occurred during one event. Nine deaths occurred at fixed facilities, and two during transportation-related events. Eight persons who died were employees, one was a first responder, and two were from the general public. Demographic information was known for 10 persons who died; all were male (mean age: 43.5 years). Eight persons who died had not worn personal protective equipment, and nine had not worn eye protection. The conditions associated with

these deaths were trauma, chemical burns, thermal burns, heat stress, cardiac arrest, and asphyxiation.

Most (869 {60% }) of the injured persons were treated at a hospital but did not require inpatient admission. Others were admitted to a hospital for treatment (220 {15% } injured persons), treated at the scene of the event (167 {12% }), or transported to a hospital for observation but required no treatment (88 {6% }). Sixty-seven (5%) injured persons were treated for their injuries by private physicians within 24 hours of the event.

Of the 1,353 injured persons for whom information concerning use of protective equipment was available, 984 (73%) were not using any type of personal protective equipment at the scene of the event. Of the injured employees, 676 (75%) were not using personal protective equipment. Hard hats and steel-toed shoes were worn by 136 (15%). Of the injured first responders, 40 (22%) used no personal protective equipment, 77 (43%) used firefighter protective gear, 34 (19%) used Level B protection, and 22 (12%) used Level A protection. ***

Approximately 457 (15%) of events resulted in evacuations, of which 400 (88%) were ordered by an official (e.g., a police officer or firefighter). In 40 (1%) events, persons in the affected areas were instructed to stay indoors. The median number of persons evacuated was 25 (range: from 12 to greater than 9,999), and evacuations lasted an average of 9.4 hours (median: 3 hours; range: 1-240 hours). For 116 (29%) of the evacuations ordered by an official, the evacuation zone was defined as a circle or radius around the site of the event. For 33 (8%) evacuations, no criteria were used for defining the evacuation zone. For 52 (13%), the evacuation zone was downwind from the location of the hazardous substance release; for 192 (49%), the affected building or part of the building was evacuated. Evacuation criteria were not known for seven events.

DISCUSSION

The information from the events reported to the HSEES system during 1990- 1992 indicates that public health consequences (i.e., the morbidity, mortality, and evacuations) may be associated with approximately 15% of hazardous substance releases. These estimates, combined with other information, such as the number and types of substances most likely to be released (e.g., volatile organic compounds, acids, ammonias, and herbicides) and the substances most likely to be associated with injuries (e.g., insecticides), may be used to help develop prevention strategies. For example, knowledge regarding the characteristics of hazardous substance releases and the associated public health consequences may allow formulation of guidelines for primary prevention (i.e., prevention of hazardous substance releases) and secondary prevention (prevention of morbidity and mortality as a result of hazardous substance releases).

The information provided by the HSEES system is used to train first responders, to plan for emergency preparedness, and to conduct follow-up epidemiologic studies. Trends in the spatial distribution of events are used for relocating HazMat (first responder) teams to areas with higher frequency of events. Effective statewide interventions to prevent public health consequences from hazardous substance releases should reduce the number of injuries associated with such events.

Limitations of the HSEES system during the 1990-1992 reporting period included the nonrandom selection of participating states and the narrow definition of an emergency event. To improve the representativeness of these data for the United States, the system has been expanded to additional states and the number of reportable substances has been increased. The definition of an emergency event was expanded January 1, 1993, to include all hazardous substances except petroleum products. This new definition will increase the likelihood of detecting public health consequences from releases

Chlorine	157	(4)	43	(6)	(27)
Cyanides	21	(1)	9	(1)	(43)
Unclassified	698	(17)	108	(14)	(15)
Total	4,034	(100)	777	(100)	

* Refers to injuries and all other adverse health effects.
 + During 1990-1991, participating states included Colorado, Iowa, Michigan, New Hampshire, and Wisconsin. During 1992, participating states included Colorado, Iowa, New Hampshire, New York, North Carolina, Oregon, Rhode Island, Washington, and Wisconsin.
 & Percentage of all substances released.
 @ Percentage of all substances released during events that resulted in personal injury.
 ** Within the substance category, the percentage of substances released during events that resulted in personal injury.

[Return to top.](#)

Table_2

Note: To print large tables and graphs users may have to change their printer settings to landscape and use a small font size.

TABLE 2. Distribution of number of chemicals released per hazardous substances emergency event with injured * persons -- selected states, + Hazardous Substances Emergency Events Surveillance, 1990-1992

No. of chemicals released	Type of event								
	Fixed-facility		Transportation-related			All events &			
	Events	Total no. of chemicals	Events	Total no. of chemicals	Events	Total no. of chemicals	Events	Total no. of chemicals	
	No.	(%)	No.	(%)	No.	(%)	No.	(%)	
1	338	(85.1)	338	53	(76.8)	53	391	(83.9)	391
2	27	(6.8)	54	11	(15.9)	22	38	(8.2)	76
3	12	(3.0)	36	3	(4.3)	9	15	(3.2)	45
4	5	(1.3)	20	1	(1.4)	4	6	(1.3)	24
5	4	(1.0)	20	1	(1.4)	5	5	(1.1)	25
>=6	11	(2.8)	216	--	--	--	11	(2.4)	216
Total	397	(100.0)	684	69	(100.0)	93	466	(100.0)	777

* Refers to injuries and all other adverse health effects.
 + During 1990-1991, participating states included Colorado, Iowa, Michigan, New Hampshire, and Wisconsin. During 1992, participating states included Colorado, Iowa, New Hampshire, New York, North Carolina, Oregon, Rhode Island, Washington, and Wisconsin.
 & Location of one event was not known. A total of 467 events resulted in personal injury.

[Return to top.](#)

Table_3

Note: To print large tables and graphs users may have to change their printer settings to landscape and use a small font size.

TABLE 3. Types of injuries * sustained during emergency events involving hazardous substances -- selected states, + Hazardous Substances Emergency Events Surveillance, 1990-1992

Type of injury	No. of injuries	Percentage
Respiratory irritation	933	37.3

Eye irritation	571	22.8
Nausea	222	8.9
Chemical burns	153	6.1
Dizziness or other central nervous system symptoms	126	5.0
Skin irritation	96	3.8
Physical trauma	82	3.3
Headache	80	3.2
Heat stress	49	2.0
Thermal burns	26	1.0
Vomiting	8	0.3
Other	155	6.2
Total	2,501	100.0

* Refers to injuries and all other adverse health effects.

+ During 1990-1991, participating states included Colorado, Iowa, Michigan, New Hampshire, and Wisconsin. During 1992, participating states included Colorado, Iowa, New Hampshire, New York, North Carolina, Oregon, Rhode Island, Washington, and Wisconsin.

[Return to top.](#)

Disclaimer All *MMWR* HTML versions of articles are electronic conversions from ASCII text into HTML. This conversion may have resulted in character translation or format errors in the HTML version. Users should not rely on this HTML document, but are referred to the electronic PDF version and/or the original *MMWR* paper copy for the official text, figures, and tables. An original paper copy of this issue can be obtained from the Superintendent of Documents, U.S. Government Printing Office (GPO), Washington, DC 20402-9371; telephone: (202) 512-1800. Contact GPO for current prices.

**Questions or messages regarding errors in formatting should be addressed to mmwrq@cdc.gov.

Page converted: 09/19/98

[Print Help](#)

[MMWR Home](#) | [MMWR Search](#) | [Help](#) | [Contact Us](#)

[CDC Home](#) | [Search](#) | [Health Topics A-Z](#)

This page last reviewed 5/2/01

[Centers for Disease Control and Prevention](#)
Morbidity and Mortality Weekly Report