

In 1980, Congress created the Agency for Toxic Substances and Disease Registry (ATSDR) to implement health-related sections of laws that protect the public from hazardous wastes and environmental spills of hazardous substances. The Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), commonly known as the "Superfund" Act, designated ATSDR as the lead agency within the Public Health Service to help prevent or reduce further exposure to hazardous substances and the adverse health effects that result from such exposures, and also to expand the knowledge base about such effects.

This publication reports the results and findings of a health study, registry, or other health-related activity supported by ATSDR in accordance with its legislative mandate described above.

Comments regarding this report are welcome. Please address to:

Agency for Toxic Substances and Disease Registry  
Attn: Director, Division of Health Studies (E-31)  
1600 Clifton Road, N.E.  
Atlanta, Georgia 30333

Agency for Toxic Substances and  
Disease Registry . . . . . David Satcher, MD, PhD, Administrator  
Barry L. Johnson, PhD, Assistant Administrator  
John S. Andrews Jr., MD, MPH, Associate Administrator for Science

Division of Health Studies . . . . . Jeffrey A. Lybarger, MD, MS, Director  
Sharon S. Campolucci, MSN, Deputy Director  
Robert F. Spengler, ScD, Assistant Director for Science  
Connie L. Whitehead, Editor

Epidemiology and Surveillance Branch,  
Hazardous Substances Emergency  
Events Surveillance Staff . . . . . Wendy E. Kaye, PhD, Chief  
Sean Buckley, MPH  
Gilbert S. Haugh, MS  
Patricia Price-Green, MSPH  
Casetta R. Simmons  
Richard D. Wendt

**U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES  
PUBLIC HEALTH SERVICE  
AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY  
ATLANTA, GEORGIA**

**HAZARDOUS SUBSTANCES EMERGENCY EVENTS  
SURVEILLANCE (HSEES)**

**ANNUAL REPORT**

**1996**

**DIVISION OF HEALTH STUDIES  
EPIDEMIOLOGY AND SURVEILLANCE BRANCH**

## **DISCLAIMER**

Mention of the name of any company or product does not constitute endorsement by the Agency for Toxic Substances and Disease Registry, Public Health Service or the U.S. Department of Health and Human Services.

## CONTENTS

	<u>Page</u>
DISCLAIMER . . . . .	ii
LIST OF TABLES . . . . .	v
LIST OF FIGURES . . . . .	vii
LIST OF APPENDICES . . . . .	ix
EXECUTIVE SUMMARY . . . . .	1
INTRODUCTION . . . . .	3
METHODS . . . . .	4
RESULTS . . . . .	5
SUBSTANCE NAME STANDARDIZATION PROJECT . . . . .	23
USE OF HSEES DATA . . . . .	24
SUMMARY OF RESULTS, 1990 – 1996 . . . . .	24
REFERENCE . . . . .	29
APPENDICES . . . . .	31



## LIST OF TABLES

	<u>Page</u>
Table 1.—Number of events meeting the surveillance definition, reported by state and type of event, Hazardous Substances Emergency Events Surveillance, January 1 – December 31, 1996 . . . . .	6
Table 2.—Distribution of the number of substances released, by type of event, Hazardous Substances Emergency Events Surveillance, January 1 – December 31, 1996 . . . . .	9
Table 3.—Distribution of the number of substances released, by substance category and type of event, Hazardous Substances Emergency Events Surveillance, January 1 – December 31, 1996 . . . . .	10
Table 4.—Distribution of the number of victims by type of event, Hazardous Substances Emergency Events Surveillance, January 1 – December 31, 1996 . . . . .	12
Table 5.—Number of substances released in all events and events with victims, by substance category, Hazardous Substances Emergency Events Surveillance, January 1 – December 31, 1996 . . . . .	14
Table 6.—Distribution of type of injury by type of event, Hazardous Substances Emergency Events Surveillance, January 1 – December 31, 1996 . . . . .	18

Table 7.—Cumulative data for all states, Hazardous  
Substances Emergency Events Surveillance,  
1990 – 1996 . . . . . 26

## LIST OF FIGURES

	<u>Page</u>
Figure 1.—Distribution of victims by population group and type of event, Hazardous Substances Emergency Events Surveillance, January 1– December 31, 1996 . . . .	16
Figure 2.—Distribution of responder victims by population group and type of event, Hazardous Substances Emergency Events Surveillance, January 1 – December 31, 1996 . . . . .	17
Figure 3.—Distribution of type of injury for all events, Hazardous Substances Emergency Events Surveillance, January 1 – December 31, 1996 . . . . .	20
Figure 4.—Distribution of victims, Hazardous Substances Emergency Events Surveillance, 1990 – 1996 . . . . .	27
Figure 5.—Cumulative data for all states, Hazardous Substances Emergency Events Surveillance, 1990 – 1996 . . . . .	28



## LIST OF APPENDICES

	<u>Page</u>
Appendix A—The 100 Most Frequently Released Substances, Hazardous Substances Emergency Events Surveillance, January 1 – December 31, 1996 . . . . .	33
Appendix B—HSEES-Related Publications . . . . .	41



## EXECUTIVE SUMMARY

Since 1990, the Agency for Toxic Substances and Disease Registry (ATSDR) has maintained an active, state-based Hazardous Substances Emergency Events Surveillance (HSEES) system to describe the public health consequences associated with the release of hazardous substances. Five state health departments participated in the pilot phase of the surveillance system and began data collection on January 1, 1990. Since 1995, the number of participating state health departments has remained at 14. This report summarizes the characteristics of events reported to the surveillance system from January 1, 1996, through December 31, 1996.

Information on acute hazardous substances emergency events was collected on data collection forms designed by ATSDR. The types of data collected included general information on the event, substance(s) released, victims, injuries, and evacuations. Estimates have been made of the number of people at risk of exposure by a particular event.

Several data sources were used to obtain the maximum amount of information about these events. These sources included, but were not limited to, records or oral reports of state environmental protection agencies, police and fire departments, and hospitals. The data obtained were computerized using an ATSDR-provided data entry system and were sent to ATSDR quarterly.

The 14 states reported a total of 5,502 events for 1996; 79% of the events occurred at fixed facilities and 21% were transportation related. In 96% of the events, only a single substance was released. The most commonly reported categories

of substances were “ Volatile organic compounds”; “ Acids”; “ Ammonia”; “ Pesticides”; “ Other inorganic substances”; and the category designated “ Other,” which included mixtures of substances, as well as substances that were not mixtures but could not be placed in one of the other nine categories. During this reporting period, 390 events (approximately 7% of all events) resulted in a total of 1,620 victims. The most frequently reported injuries sustained by victims were respiratory irritation, eye irritation, nausea or vomiting, and headache. There were a total of 33 deaths in all events, and 543 events required evacuations.

The findings regarding the distribution of the types of events, the numbers of events with victims and evacuations, and the injuries reported have, overall, been consistent over the years.

# **HAZARDOUS SUBSTANCES EMERGENCY EVENTS SURVEILLANCE (HSEES)**

## **INTRODUCTION**

Since 1990, the Agency for Toxic Substances and Disease Registry (ATSDR) has maintained an active, state-based Hazardous Substances Emergency Events Surveillance (HSEES) system to describe the public health consequences associated with the release of hazardous substances. The decision to initiate a surveillance system of this type was based on a 1988 study on the reporting of hazardous substances releases to three national databases: the National Response Center Data Base, the Hazardous Materials Information System (HMIS), and the Acute Hazardous Events Data Base (1). Review of the national databases indicated that they were limited because many events were missed through incomplete reporting (for example, HMIS does not include intrastate carrier or fixed-facility events). Other missing information included demographic information about victims, the types of injuries received, and the number of people evacuated. As a result of this review, ATSDR implemented the HSEES system to describe the public health consequences associated with the release of hazardous substances. The surveillance system has four goals:

- To describe the distribution and characteristics of hazardous substances emergencies.
- To describe the morbidity and mortality experienced by employees, responders, and the general public as a result of hazardous substances releases.
- To identify risk factors associated with the morbidity and mortality.

- To identify strategies that might reduce future morbidity and mortality resulting from the release of hazardous substances.

This report summarizes the characteristics of hazardous substances releases and the associated public health consequences reported to the surveillance system from January 1, 1996, through December 31, 1996.

## **METHODS**

In 1996, 14 state health departments collected data for HSEES. Information was collected on standardized data collection forms. The types of information collected on data collection forms included information on the event, substance(s) released, victims, injuries, and evacuations.

Various data sources were used to obtain information about these events. These sources included, but were not limited to, records and oral reports of state environmental protection agencies, police and fire departments, and hospitals. Census data were used to estimate populations residing in the vicinity of the events. All of the data were computerized using an ATSDR-provided data entry system and were sent to ATSDR quarterly.

Hazardous substances emergency events were defined as uncontrolled or illegal releases or threatened releases of hazardous substances or the hazardous by-products of substances. Not included were events involving petroleum products exclusively. Events were included when the amount of substance that was released, or that might have been released, needed (or would have needed) to be removed, cleaned up, or neutralized according to federal, state, or local law; or when there was only a threatened release of a substance, but this threat led to an action

(for example, evacuation) that could have affected the health of employees, responders, or the general public. Victims were defined as those people who suffered at least one injury or died as a consequence of the event. In counting injuries, victims could have been counted more than once if they had more than one injury. Events were defined as transportation related when they occurred during surface, air, or water transport of hazardous substances. Fixed-facility events were defined as events occurring at industrial sites, schools, farms, or any other type of facility. For the analyses, the substances released were categorized into 10 groups.

## **RESULTS**

A total of 5,502 events were reported in 1996 to the HSEES system by the 14 participating state health departments. Seventy-nine percent of the events occurred at fixed facilities and 21% were transportation related (Table 1). About 2% of all events were threatened releases.

Thirty-two percent of fixed-facility events were reported as involving a process vessel. Approximately 13% involved storage above ground, 13% involved a fixed-facility type reported as "other," and about 10% involved material handling. The remaining fixed-facility events primarily involved a combination of areas of involvement. In transportation events, approximately 81% occurred during ground transport and 13% involved transport by rail. The remaining transportation events primarily involved water, air, or pipeline transport.

Factors contributing to fixed-facility events were also reported. In the 4,343 fixed-facility events, approximately 62% involved equipment failure as a factor contributing to the occurrence of the event. Sixteen percent of fixed-facility events

were reported as involving operator error.

Table 1.—Number of events meeting the surveillance definition, reported by state and type of event, Hazardous Substances Emergency Events Surveillance, January 1–December 31, 1996.

STATE REPORTING EVENT	TYPE OF EVENT				TOTAL NUMBER OF EVENTS
	FIXED FACILITY		TRANSPORTATION		
	NUMBER OF EVENTS	(%)	NUMBER OF EVENTS	(%)	
Alabama	166	(81.8)	37	(18.2)	203
Colorado	101	(31.2)	223	(68.8)	324
Iowa	203	(68.1)	95	(31.9)	298
Minnesota	224	(74.4)	77	(25.6)	301
Mississippi	70	(59.8)	47	(40.2)	117
Missouri	109	(68.1)	51	(31.9)	160
New Hampshire	30	(78.9)	8	(21.1)	38
New York	379	(89.2)	46	(10.8)	425
North Carolina	128	(74.0)	45	(26.0)	173
Oregon	135	(64.0)	76	(36.0)	211
Rhode Island	30	(83.3)	6	(16.7)	36
Texas	2,265	(91.0)	223	(9.0)	2,488
Washington	291	(73.5)	105	(26.5)	396
Wisconsin	212	(63.9)	120	(36.1)	332
Total	4,343	(78.9)	1,159	(21.1)	5,502

Ninety-six percent of the events involved the release of only one substance. Two substances were released in approximately 3% of the events (Table 2).

Most releases were either liquid spills (55%) or air emissions (39%). The remaining releases were the result of fires (3%) or other types of releases (3%).

Events occurred primarily from 6 AM through 11:59 AM (38%) and from 12 noon through 5:59 PM (32%). Approximately 18% of events occurred at some time during the weekend.

Of the 10 categories into which HSEES substances were grouped, “Volatile organic compounds” (VOCs) (19%), “Other inorganic substances” (25%), “Ammonia” (9%), “Acids” (7%), and “Other” substances (28%) were most commonly released in fixed-facility events (Table 3). The category “Other” consisted of mixtures of substances from different categories, as well as substances that were not mixtures but could not be placed in one of the other nine substance categories. The category “Other inorganic substances” comprised all inorganic substances except for acids, bases, ammonia, and chlorine. In transportation-related events, the categories “Pesticides” (15%), “Other inorganic substances” (12%), “Volatile organic compounds” (12%), “Acids” (12%), and “Other” substances (33%) were most frequently reported.

Table 4 shows the distribution of the number of victims by the type of event. A total of 1,620 victims were involved in 390 events (approximately 7% of all events). Approximately 46% of the events with victims involved only one victim; about 68% of the events involved one or two victims. Fixed-facility events accounted for the majority (82%) of victims.

The substance categories with the most events did not

necessarily have the most victims (Table 5). For instance, 1,016 events involved VOCs, but only 40 (4%) of these events involved victims. Although chlorine accounted for only 114 (2%) events, nearly 30% of chlorine events resulted in victims, indicating its greater potential for harm.

The population groups most often injured were employees (51%) and the general public (30%) (Figure 1) and, overall, a higher proportion of responders and the general public were injured in transportation events than in fixed-facility events.

Figure 2 shows the distribution of responder victims in fixed-facility and transportation events. In fixed-facility events, victims most frequently injured were volunteer firefighters (31%), responders of unknown affiliation (22%), and professional firefighters (17%). In transportation events, victims were primarily police officers (63%) and responders of unknown affiliation (27%).

The types of injuries sustained by victims are shown in Table 6 and in Figure 3. The victims sustained a total of 2,769 injuries. Some victims experienced more than one injury. The most commonly reported injuries in fixed-facility events were respiratory irritation (40%), eye irritation (16%), nausea or vomiting (13%), and headache (10%). In transportation-related events, respiratory irritation (28%), trauma (20%), nausea or vomiting (14%), and dizziness or other central nervous system (CNS) symptoms (10%) were most frequently reported. Trauma was more often reported in transportation-related events than in fixed-facility events. The trauma might have been caused by the sequence of events (for example, a motor vehicle accident) leading to the release of a hazardous substance and not necessarily by exposure to the hazardous substance itself.

The most frequently reported injuries by population group

were also evaluated. Among students, employees, and the

Table 2.—Distribution of the number of substances released, by type of event, Hazardous Substances Emergency Events Surveillance, January 1 – December 31, 1996.

NUMBER OF SUBSTANCES RELEASED	TYPE OF EVENT					ALL EVENTS			
	FIXED FACILITY		TRANSPORTATION						
	NUMBER OF EVENTS	(%)	NUMBER OF SUBSTANCES	NUMBER OF EVENTS	(%)	NUMBER OF SUBSTANCES	NUMBER OF EVENTS	(%)	NUMBER OF SUBSTANCES
1	4,206	(96.8)	4,206	1,078	(93.0)	1,078	5,284	(96.0)	5,284
2	90	(2.1)	180	55	(4.7)	110	145	(2.7)	290
3	30	(0.7)	90	16	(1.4)	48	46	(0.8)	138
4	5	(0.1)	20	7	(0.6)	28	12	(0.2)	48
5	5	(0.1)	25	1	(0.1)	5	6	(0.1)	30
6 or more	7	(0.2)	82	2	(0.2)	15	9	(0.2)	97
Total	4,343	(100.0)	4,603	1,159	(100.0)	1,284	5,502	(100.0)	5,887

Table 3.—Distribution of the number of substances released, by substance category and type of event, Hazardous Substances Emergency Events Surveillance, January 1 – December 31, 1996.

SUBSTANCE CATEGORY	TYPE OF EVENT				ALL EVENTS	
	FIXED FACILITY		TRANSPORTATION			
	NUMBER OF SUBSTANCES	(%)	NUMBER OF SUBSTANCES	(%)	NUMBER OF SUBSTANCES	(%)
Acids	324	(7.0)	156	(12.1)	480	(8.2)
Ammonia	393	(8.5)	51	(4.0)	444	(7.5)
Bases	147	(3.2)	94	(7.3)	241	(4.1)
Chlorine	109	(2.4)	5	(0.4)	114	(1.9)
Other inorganic substances	1,137	(24.7)	154	(12.0)	1,291	(21.9)

Table 3.—Continued.

SUBSTANCE CATEGORY	TYPE OF EVENT				ALL EVENTS	
	FIXED FACILITY		TRANSPORTATION			
	NUMBER OF SUBSTANCES	(%)	NUMBER OF SUBSTANCES	(%)	NUMBER OF SUBSTANCES	(%)
Paints and dyes	62	(1.4)	52	(4.0)	114	(1.9)
Pesticides	171	(3.7)	194	(15.1)	365	(6.2)
Polychlorinated biphenyls	112	(2.4)	6	(0.5)	118	(2.0)
Volatile organic compounds	861	(18.7)	155	(12.1)	1,016	(17.3)
Other	1,287	(28.0)	417	(32.5)	1,704	(29.0)
Total	4,603	(100.0)	1,284	(100.0)	5,887	(100.0)

Table 4.—Distribution of the number of victims by type of event, Hazardous Substances Emergency Events Surveillance, January 1 – December 31, 1996.

NUMBER OF VICTIMS	TYPE OF EVENT				ALL EVENTS				
	FIXED FACILITY		TRANSPORTATION						
	NUMBER OF EVENTS	NUMBER OF VICTIMS (%)	NUMBER OF EVENTS	NUMBER OF VICTIMS (%)	NUMBER OF VICTIMS	NUMBER OF VICTIMS (%)			
1	108	(39.3)	108	73	(63.5)	73	181	(46.4)	181
2	63	(22.9)	126	22	(19.1)	44	85	(21.8)	170
3	28	(10.2)	84	3	(2.6)	9	31	(8.0)	93

Table 4.—Continued.

NUMBER OF VICTIMS	TYPE OF EVENT					ALL EVENTS			
	FIXED FACILITY		TRANSPORTATION						
	NUMBER OF EVENTS	(%)	NUMBER OF VICTIMS	NUMBER OF EVENTS	(%)	NUMBER OF VICTIMS	NUMBER OF EVENTS	(%)	NUMBER OF VICTIMS
4	20	(7.3)	80	1	(0.9)	4	21	(5.4)	84
5	8	(2.9)	40	3	(2.6)	15	11	(2.8)	55
6 or more	48	(17.4)	886	13	(11.3)	151	61	(15.6)	1,037
Total	275	(100.0)	1,324	115	(100.0)	296	390	(100.0)	1,620

Table 5.—Number of substances released in all events and events with victims, by substance category, Hazardous Substances Emergency Events Surveillance, January 1 – December 31, 1996.

SUBSTANCE CATEGORY	TOTAL NUMBER OF RELEASES	(%)	NUMBER OF RELEASES WITH VICTIMS	(%)	PERCENT OF RELEASES WITH VICTIMS*
Acids	480	(8.2)	65	(13.5)	13.5
Ammonia	444	(7.5)	47	(9.8)	10.6
Bases	241	(4.1)	20	(4.2)	8.3
Chlorine	114	(1.9)	34	(7.1)	29.8
Other inorganic substances	1,291	(22.0)	90	(18.8)	7.0

Table 5.—Continued.

SUBSTANCE CATEGORY	TOTAL NUMBER OF RELEASES	(%)	NUMBER OF RELEASES WITH VICTIMS	(%)	PERCENT OF RELEASES WITH VICTIMS*
Paints and dyes	114	(1.9)	6	(1.2)	5.3
Pesticides	365	(6.2)	48	(10.0)	13.2
Polychlorinated biphenyls	118	(2.0)	1	(0.2)	0.8
Volatile organic compounds	1,016	(17.3)	40	(8.3)	3.9
Other	1,704	(28.9)	129	(26.9)	7.6

\*Percent of releases that resulted in personal injury within the substance category calculated by: Percent of releases with victims =  $100 \times (\text{Number of releases with victims}) / (\text{Total number of releases})$

Figure 1.—Distribution of victims by population group\* and type of event, Hazardous Substances Emergency Events Surveillance, January 1 – December 31, 1996.

\* There were 3 victims whose population group was recorded as unknown.

Figure 2.—Distribution of responder victims by population group and type of event, Hazardous Substances Emergency Events Surveillance, January 1 – December 31, 1996.

There were 162 responder victims reported to the HSEES system in 1996.  
FF= Firefighter; EMT= Emergency Medical Technician; unk= unknown.

Table 6.—Distribution of type of injury by type of event, Hazardous Substances Emergency Events Surveillance, January 1 – December 31, 1996.

TYPE OF INJURY	TYPE OF EVENT				ALL EVENTS	
	FIXED FACILITY		TRANSPORTATION			
	NUMBER OF INJURIES	(%)	NUMBER OF INJURIES	(%)	NUMBER OF INJURIES	(%)
Chemical burns	43	(1.8)	17	(3.9)	60	(2.2)
Dizziness or other CNS*	209	(9.0)	43	(9.8)	252	(9.1)
Eye irritation	373	(16.0)	38	(8.7)	411	(14.8)
Headache	242	(10.4)	17	(3.9)	259	(9.4)
Heat stress	6	(0.3)	4	(0.9)	10	(0.4)
Nausea or vomiting	298	(12.8)	61	(13.9)	359	(12.9)
Respiratory irritation	933	(40.0)	124	(28.3)	1,057	(38.2)

Table 6.—Continued.

TYPE OF INJURY	TYPE OF EVENT					
	FIXED FACILITY		TRANSPORTATION		ALL EVENTS	
	NUMBER OF INJURIES	(%)	NUMBER OF INJURIES	(%)		NUMBER OF INJURIES
Skin irritation	129	(5.5)	23	(5.3)	152	(5.5)
Thermal burns	14	(0.6)	5	(1.1)	19	(0.7)
Trauma	28	(1.2)	86	(19.6)	114	(4.1)
Other	56	(2.4)	20	(4.6)	76	(2.7)
Total	2,331	(100.0)	438	(100.0)	2,769	(100.0)

The number of injuries is greater than the number of victims, because a victim could have had more than one injury.

\* Central nervous system symptoms or signs.

Figure 3.—Distribution of type of injury for all events, Hazardous Substances Emergency Events Surveillance, January 1 – December 31, 1996.

There were a total of 2,769 injuries reported. The number of injuries is greater than the number of victims, because a victim can have more than one injury.

\*Central nervous system symptoms or signs.

general public, the most commonly reported injuries were respiratory irritation, eye irritation, and nausea or vomiting. Among responders, respiratory irritation, nausea or vomiting, and dizziness or other central nervous system injuries were most often reported.

The sex was known for 90% of victims; 65% were male and 35% were female. Among the population subgroups, more of the responders (89%) and employees (66%) were male. The mean age of the victims was about 32 years, with a range from 1 to 86 years. Most victims (66%) were reported to have been transported to and treated at a hospital, but not admitted. Fourteen percent were treated at the scene with first aid; 8% were admitted to a hospital; 4% were transported to hospital for observation; 4% of victims experienced injuries within 24 hours that were reported by an official (for example, personnel with the fire departments, police, or poison control center); 2% were seen by a private physician within 24 hours; and 2% died.

Among victims, 65% of employees and 45% of responders did not wear any personal protective equipment. Those employees who did wear personal protective equipment most frequently wore a form of eye protection (29%) or level "D" protection (13%). The personal protective equipment most frequently worn by first responders was firefighter turnout gear (38%), level "A" protection (3%), and gloves (3%).

A total of 33 persons died as the result of events; 8 died in 1 event, 3 in 1 event, 2 in each of 3 events; and 1 in each of 16 separate events. Seventeen of the thirty-three deaths occurred in fixed-facility events and 16 occurred in transportation-related events. Of those who died, all were male; 31 were employees, and 2 were members of the general public. There were no deaths among responders. Twenty-six sustained traumatic injuries, of which 14 occurred as a result of transportation events and 12 as

a result of fixed-facility events. Respiratory irritation, chemical or thermal burns, and a cardiac arrest were the reported injuries sustained by other victims who died.

Among the employees who sustained fatal injuries, 14 wore no personal protective equipment; 2 persons wore a hard hat and steel-toed shoes; 3 wore only gloves; 1 wore level B protection; 9 persons wore level D protection; and 2 wore a combination of eye protection, a hard hat, and steel-toed shoes.

It was very unusual to have 8 persons die in one event. These people were employees who wore level D protection equipment and sustained traumatic injuries in a fixed-facility event. The two members of the general public who died received fatal traumatic injuries in separate events—one at a fixed-facility and the other in a transportation-related event.

The types of contingency or preparedness plans varied among events, with approximately 39% involving the use of a company's operating procedures. Thirty-five percent of events were reported as following an incident-specific ad hoc plan, and 19% involved the use of a HazMat or response team's standard operating procedures.

Evacuations were ordered in 543 events. Sixty-five percent of the evacuations were of a building or the affected part of a building. Fourteen percent were based on a defined circular area around an event, 18% were based on actual or anticipated downwind dispersion, and 3% were reported as having been ordered without criteria. The median number of people evacuated was 25, with a range of from 0 to 2,200 persons. In 43 events, in-place sheltering was ordered, and instructions regarding precautions to take during in-place sheltering were provided in 30 of these events.

## **SUBSTANCE NAME STANDARDIZATION PROJECT**

In 1996, ATSDR began the process of standardizing the names of substances in the HSEES database. This process, which has continued into the 1997 data collection year, was initiated so ATSDR could more effectively perform analyses on specific substances reported to the database. Although the HSEES computerized data entry system includes a pick-list of substances, often there was a need for state coordinators to manually enter a substance name in a 37-character free text substance identification field. This often resulted in a great amount of time being consumed when analyzing substances reported to the database.

More than 6,000 names of substances reported to the HSEES system or on the HSEES pick-list since 1990 were reviewed for spelling accuracy and appropriateness of the substance name. A mapping system was then created to relate the reported substance name to a standard substance name which in turn would be associated with the appropriate HSEES substance category. Standard substance names adopted by the American Conference of Governmental Industrial Hygienists (ACGIH) and the Department of Transportation (DOT) were used to generate standard HSEES names.

The components of substances reported to the HSEES as mixtures were arranged in alphabetical order using the HSEES standard names. In addition, common synonyms for substances were added to the HSEES pick-list. Selection of a substance synonym from the HSEES pick-list also results in mapping to an HSEES standard name. This was done to enable HSEES staff to determine more about specific substances reported to the HSEES system. Substance name standardization is an ongoing project that will require periodic review of substance names not selected from the HSEES pick-list. Each manually entered substance

name will be reviewed to determine its mapping destination. The newly established mapping system was used to generate a list of the 100 most frequently reported substances to the HSEES system for 1996 (Appendix A).

## **USE OF HSEES DATA**

ATSDR continues to respond to requests for HSEES information from local, state, and federal agencies and organizations. In addition, ATSDR continues to receive requests from researchers from various countries and territories for the HSEES protocol and data collection form to help develop similar surveillance systems in their countries. The HSEES data has also been used to produce several publications (Appendix B). The substance name standardization project will allow greater opportunity to perform analyses on specific substances reported to the database.

## **SUMMARY OF RESULTS, 1990 – 1996**

The number of events, substances released, events with victims, and deaths for the years 1990 through 1996 are shown in Table 7. In the 7 years of data collection, most events have involved a single substance and have occurred at fixed facilities. Respiratory irritation has consistently been reported as the most common injury experienced by victims. In 1996, a total of 33 fatalities were reported to the system. This number represents the largest number of deaths reported to the system during a data collection year. The overall percentage of events involving victims, however, has declined from 19% in 1990 to 7% in 1996. The decrease in the number of events involving victims may be indicative of increased or strengthened procedures to protect health and safety. However, the large number of deaths

associated with events suggests the need to evaluate not only the danger posed by exposure to hazardous substances, but also the circumstances surrounding the occurrence of events.

Figure 4 shows the distribution of victims for the years 1990 through 1996. Employees continue to be the most commonly reported victims of emergency events. Cumulative data on the number of events, substances, victims, and events involving victims are displayed in Figure 5. Overall, the results of HSEES data collection have remained constant, and this pattern of stability should allow for the identification of risk factors related to the occurrence of emergency events and the associated morbidity and mortality. Findings from HSEES data collection efforts can provide a wealth of information for developing training and health education programs for first responders, as well as for manufacturers and transporters of hazardous materials.

Table 7.—Cumulative data for all states, Hazardous Substances Emergency Events Surveillance, 1990 – 1996.

YEAR	NUMBER OF STATES REPORTING	TYPE OF EVENT			NUMBER OF SUBSTANCES RELEASED	NUMBER OF DEATHS	NUMBER OF VICTIMS	NUMBER OF EVENTS WITH VICTIMS (%)*
		FIXED FACILITY NUMBER OF EVENTS	TRANSPORTATION NUMBER OF EVENTS	TOTAL NUMBER OF EVENTS				
1990	5	441	147	588	918	5	476	110 (19)
1991	5	461	200	661	911	2	370	94 (14)
1992	9	1,500	376	1,876	2,221	4	600	263 (14)
1993†	11	3,303	642	3,945	4,485	16	2,269	486 (12)
1994†	12	3,333	911	4,244	5,153	20	2,178	414 (10)
1995†	14	4,310	1,041	5,351	6,166	14	1,689	402 (8)
1996†	14	4,343	1,159	5,502	5,887	33	1,620	390 (7)
TOTAL		17,691	4,476	22,167	25,741	94	9,202	2,159 (10)

\* Percent of events with victims.

† Reportable event definition expanded to include ALL hazardous substances except petroleum and petroleum by-products.

Figure 4.—Distribution of victims, Hazardous Substances Emergency Events Surveillance, 1990 – 1996.

Before 1996, students were counted among the employee population.

Figure 5.—Cumulative data for all states, Hazardous Substances Emergency Events Surveillance, 1990 – 1996.

## REFERENCE

1. Binder S. Death, injuries, and evacuations from acute hazardous materials releases. *Am J Public Health* 1989;79:1042-4.



## **APPENDICES**



Appendix A—The 100 Most Frequently Released Substances,  
Hazardous Substances Emergency Events Surveillance,  
January 1 – December 31, 1996



Number	Standardized Substance Name	Frequency
1.	Ammonia	424
2.	Sulfur Dioxide	358
3.	Sulfuric Acid	169
4.	Sodium Hydroxide	162
5.	Hydrochloric Acid	138
6.	Polychlorinated Biphenyls	117
7.	Chlorine	112
8.	Benzene	104
9.	Ethylene Glycol	101
10.	Indeterminate	92
11.	Mix: H <sub>2</sub> S/SO <sub>2</sub>	92
12.	Paint or Coating NOS	91
13.	Butadiene	68
14.	Hydrogen Sulfide	63
15.	Ethylene	61
16.	Mercury	57
17.	Carbon Monoxide	54
18.	Nitrogen Fertilizer	53

Number	Standardized Substance Name	Frequency
19.	Freon 22	46
20.	Xylene	39
21.	Toluene	37
22.	Sodium Hypochlorite	37
23.	Potassium Hydroxide	34
24.	Mix: NO/NO <sub>2</sub>	34
25.	Nitric Acid	33
26.	Hydrocarbon NOS	32
27.	Formaldehyde	32
28.	Methanol	32
29.	Freon 31	31
30.	Ethylene Oxide	29
31.	Phosphoric Acid	29
32.	Methyl Mercaptan	28
33.	Isopropanol	26
34.	Ethanol	25
35.	Perchloroethylene	24
36.	Acetic Acid	23
37.	Mix: Benzene/Butadiene	23

Number	Standardized Substance Name	Frequency
38.	Methylene Chloride	23
39.	Styrene	22
40.	Pendamethalin	22
41.	VOC NOS	22
42.	Freon NOS	21
43.	Nitrogen Dioxide	21
44.	Ammonium Nitrate	20
45.	Vinyl Chloride	20
46.	Malathion	20
47.	Mix: NO/SO <sub>2</sub>	19
48.	Propylene	19
49.	Diesel Fuel	19
50.	Mix: CO/Formaldehyde/NO/NO <sub>2</sub> /VOC NOS	19
51.	Acetone	19
52.	Nitrous Oxide	18
53.	Corrosive NOS	18
54.	Hydrogen Peroxide	17
55.	Chlorpyrifos	17

56. Diethanolamine 17

---

Number	Standardized Substance Name	Frequency
57.	Ammonium Hydroxide	16
58.	Resin NOS	16
59.	Base NOS	16
60.	Hydrofluoric Acid	15
61.	Propylene Oxide	15
62.	Solvent NOS	15
63.	Calcium Hypochlorite	15
64.	NPK Fertilizer	14
65.	Pesticide NOS	14
66.	Trifluralin	14
67.	Benzoic Acid	14
68.	Sulfur	13
69.	Creosote	13
70.	Ethanolamine	12
71.	Nitric Oxide (NO)	12
72.	Carbon Tetrachloride	12
73.	Adhesive NOS	11
74.	Epoxy NOS	11

---

75. Urea-Ammonium Nitrate Fertilizer Solution 11

---

Number	Standardized Substance Name	Frequency
76.	Carbon Dioxide	11
77.	Triethylene Glycol NOS	11
78.	Flammable Liquid NOS	10
79.	Ethylene Dichloride	10
80.	Hydrogen	10
81.	Methyl Ethyl Ketone	10
82.	Mix: NO/NO <sub>2</sub> /SO <sub>2</sub>	10
83.	Oxygen	10
84.	Fertilizer NOS	10
85.	Trichloroethylene	10
86.	Mix: H <sub>2</sub> S/Methyl Mercaptan/Sulfur/VOC NOS	10
87.	Oil NOS	10
88.	Mix: CO/CO <sub>2</sub> /H <sub>2</sub>	10
89.	Methyl Chloride	10
90.	Glyphosate Isopropylammonium	10
91.	Toluene-2,4-Diisocyanate	9
92.	Amine NOS	9

---

93.	Phenol	9
94.	Urea	9

---

---

Number	Standardized Substance Name	Frequency
95.	Mix: Propane/Propylene	9
96.	Propylene Glycol	9
97.	Mix: SO <sub>2</sub> /SO <sub>3</sub>	9
98.	Acid NOS	9
99.	Chlorine Dioxide	9
100.	Ink NOS	8
Total		3,783

---

## Appendix B—HSEES-Related Publications



Agency for Toxic Substances and Disease Registry. ATSDR update: Hazardous Substances Emergency Events Surveillance (HSEES) system: 1993 data. Health and Environment Digest 1995;8(10):83-4.

Agency for Toxic Substances and Disease Registry. Hazardous Substances Emergency Events Surveillance System: information for local emergency planning committees and first responders. Atlanta: US Department of Health and Human Services, Public Health Service, 1995.

Agency for Toxic Substances and Disease Registry. Hazardous Substances Emergency Events Surveillance system 1995 annual report. Atlanta: US Department of Health and Human Services, Public Health Service, 1996.

Agency for Toxic Substances and Disease Registry. Hazardous Substances Emergency Events Surveillance system 1994 annual report. Atlanta: US Department of Health and Human Services, Public Health Service, 1995.

Hall HI, Dhara VR, Kaye WE, Price-Green PA. Public health consequences of hazardous substance releases. Toxicol Ind Health 1996;12(2):289-93.

Hall HI, Dhara VR, Kaye WE, Price-Green PA. Surveillance of hazardous substance releases and related health effects. Arch Environ Health 49(1);1994:45-8.

Hall HI, Dhara VR, Price-Green PA, Kaye WE. Surveillance for emergency events involving hazardous substances—United States, 1990-1992. MMWR 1994;43(No. SS-2):1-6.

Hall HI, Haugh GS, Price-Green PA, Dhara VR, Kaye WE. Risk factors for hazardous substance releases that result in injuries and evacuations: data from 9 states. *Am J Public Health* 1996;86(6):855-7.

Hall HI, Price-Green PA, Dhara VR, Kaye WE. Health effects related to releases of hazardous substances on the Superfund priority list. *Chemosphere* 1995;31(1):2455-61.