Biennial Report 1999-2000

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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.

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EXECUTIVE SUMMARY

The Hazardous Substances Emergency Events Surveillance (HSEES) system, maintained by the Agency for Toxic Substances and Disease Registry (ATSDR), actively collects information to describe the public health consequences associated with the release of hazardous substances. This report summarizes the characteristics of events reported to the 13 state health departments participating in 1999 and the 15 state health departments participating in 2000. Information on acute hazardous substances emergency events was collected, including the substance(s) released, number of victims, number and types of injuries, and number of evacuations. The data obtained were computerized using an ATSDR-provided Web-based data entry system.

A total of 13,808 events was reported. In 13,215 (95.7%) of the events, only a single substance was released. The most commonly reported categories of substances were inorganic substances (excluding acids, bases, ammonia, and chlorine); volatile organic compounds (VOCs); mixtures involving more than one category; acids; ammonia; and pesticides. During this reporting period, 1,256 events (9.1% of all reported events) resulted in a total of 4,425 victims. The most frequently reported injuries sustained by victims were respiratory irritation, headache, eye irritation, dizziness or other central nervous system (CNS) symptoms, and gastrointestinal problems. A total of 74 persons died as a result of all events, and 622 (4.5%) events required evacuations.

The findings regarding the distribution of the numbers of events with victims and evacuations, and the numbers and types of injuries reported have, overall, been consistent since HSEES inception. The distribution of transportation events has increased over the last couple years, in part, because of the use of new notification sources for transportation events.

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 made on the basis of a study published in 1989 on the reporting of hazardous substances releases to three national databases: the National Response Center Database, the Hazardous Materials Information System (HMIS), and the Acute Hazardous Events Database (1). A review of these databases indicated limitations. Many events were missed because of incomplete reporting (for example, the HMIS did not record events involving intrastate carriers or fixed-facility events). Other important information was not recorded, such as the demographic characteristics of victims, the types of injuries sustained, and the number of persons evacuated. As a result of this review, ATSDR implemented the HSEES system to more fully 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 biennial report summarizes the characteristics of hazardous substances releases and the associated public health consequences of events reported to the surveillance system during 1999-2000.

METHODS

In 1999, 13 state health departments (Alabama, Colorado, Iowa, Minnesota, Mississippi, Missouri, New York, North Carolina, Oregon, Rhode Island, Texas, Washington, and Wisconsin) collected data for HSEES. In 2000, two additional state health departments (New Jersey and Utah) collected data for HSEES. For each event, information was collected about 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, the U.S. Department of Transportation, the National Response Center, and hospitals. Census data were used to estimate the number of residents living in the vicinity of the events. All data were computerized using a Web-based data entry system provided by ATSDR.

Hazardous substances emergency events are defined by HSEES as uncontrolled or illegal releases or threatened releases of hazardous substances. Events involving petroleum and no other hazardous substances are not included. Events are included if (1) 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 (2) there was only a threatened release of a substance, but the threat led to an action (for example, evacuation) that could have affected the health of employees, emergency responders, or the general public. Victims are defined as persons who suffered at least one adverse health effect or died as a consequence of the event. Victims who receive more than one type of injury are counted once in each applicable injury type. Events are defined as

transportation-related if they occurred during surface, air, pipeline, or water transport of hazardous substances. All other events are considered fixed-facility events.

For the data analyses in this report, the substances released were categorized into 11 groups. The category "mixtures" consists of mixtures of substances from different categories, and the category "other inorganic substances" comprises all inorganic substances, except for acids, bases, ammonia, and chlorine. "Other" refers to substances that could not be categorized.

RESULTS

A total of 13,808 hazardous substances emergency events was reported for 1999-2000 to the HSEES system; 182 (1.3%) of these events were threatened releases. In 1999, 74.0% of the events occurred at fixed facilities (Table 1a), and in 2000, 72.9% were at fixed facilities (Table 1b). This distribution is heavily influenced by Texas, which had 37% of all events and had a larger than typical percentage of fixed-facility events. Thus, the distribution of fixed-facility events excluding Texas events indicated 64.4% for 1999 and 66.4% for 2000. These percentages are slightly less than those found in previous years for fixed-facility events.

For each fixed-facility event, one or two choices can be selected for type of area. Of all 11,030 fixed-facility area choices, 2,301 (20.9%) were classified as ancillary processing equipment, 2,199 (19.9%) as a process vessel (a reaction chamber in which chemicals are processed), 1,645 (14.9%) as storage areas above and below ground, and 1,386 (12.6%) as piping (Figure 1). Of the 3,675 transportation-related events, 3,142 (85.4%) occurred during ground transport (for example, truck, van, or tractor), and 277 (7.5%) involved transport by rail (Figure 2). Fewer events involved water, air, pipeline, or unknown transportation modes.

The primary factors contributing to the 10,133 fixed-facility events were also reported (Figure 3). Equipment failure was the primary contributing factor in 4,511 (44.5%) events, followed by 2,140 events involving operator error (21.1%), 942 involving "other" uncategorized factors (9.3%), and 412 involving system process upset (4.1%).

Ninety-six percent of all events involved the release of only one substance. Two substances were released in approximately 2% of the events, and 2% involved the release of more than two substances (Table 2).

There were 15,316 substances either released or threatened to be released during the 13,808 events. Two types of releases could be reported for each chemical (e.g., spill and air). Spills were reported in 8,275 (54.0%) of the releases, followed by 6,393 air releases (41.7%), 1,047 fires (6.8%), 361 threatened releases (2.4%), and 181 explosions (1.2%).

HSEES events were more likely when there was more industrial, commercial, or agricultural activity, e.g., in the 6 hours before noon (35.0%) and the 6 hours after and including noon (29.3%), compared with the 6 hours before midnight (14.2%) and the 6 hours after and including midnight (16.2%) (5.3% did not have a specified time). Additionally, 16%-17% of events occurred on each weekday as compared with 8%-9% on a weekend day. April through September, the peak agricultural season, had 56% of the events, and the other 6 months of the year had 44%.

SUBSTANCES

The 15,316 substances released were grouped into 11 categories. The number of substances released was greater than the number of events because more than one substance could be released per event. The categories of substances most commonly released in fixed-facility events (Table 3) were other inorganic substances (26.9%), volatile organic compounds (VOCs) (21.3%), mixtures (11.7%), acids (7.0%), and ammonia (6.7%). In transportation-related events, VOCs (15.9%), acids (14.3%), other inorganic substances (11.9%), pesticides (7.5%), and bases (7.3%) were most frequently released. The 100 substances most frequently reported for 1999-2000 are listed in Appendix A. Ammonia, sulfur dioxide, and sulfuric acid were the top released substances.

Table 1a-Number of events meeting the surveillance definition, by state and type of event, Hazardous Substances Emergency Events Surveillance, 1999.

State reporting event	Type of event				Total no. of events
	Fixed facility		Transportation		
	No. of events	%	No. of events	%	
Alabama	104	61.5	65	38.5	169
Colorado	148	59.2	102	40.8	250
Iowa	196	68.1	92	31.9	288
Minnesota	287	82.5	61	17.5	348
Mississippi	100	45.3	121	54.8	221

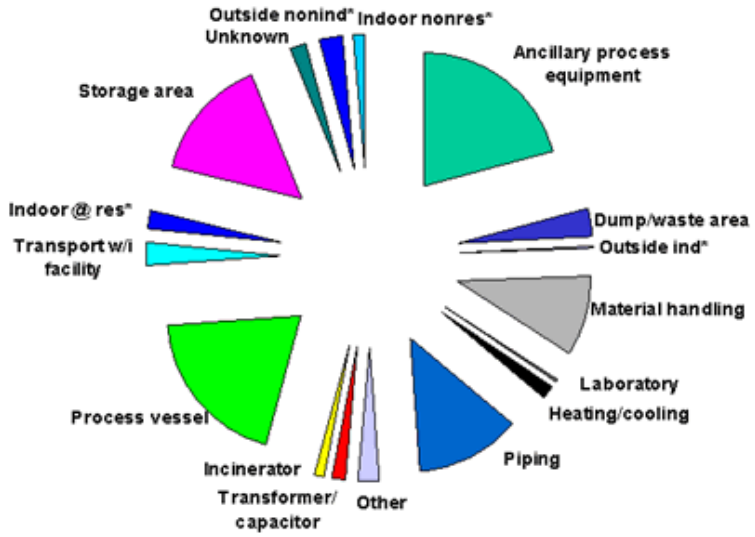
Missouri	166	57.0	125	43.0	291
New York	514	85.8	85	14.2	599
North Carolina	108	34.0	210	66.0	318
Oregon	80	76.2	25	23.8	105
Rhode Island	40	80.0	10	20.0	50
Texas	2,336	86.8	355	13.2	2,691
Washington	317	74.9	106	25.1	423
Wisconsin	238	46.9	269	53.1	507
Total	4,634	74.0	1,626	26.0	6,260

Table 1b-Number of events meeting the surveillance definition, by state and type of event, Hazardous Substances Emergency Events Surveillance, 2000.

State reporting event	Type of event				Total no. of events
	Fixed facility		Transportation		
	No. of events	%	No. of events	%	
Alabama	115	67.6	55	32.4	170
Colorado	99	47.1	111	52.9	210
Iowa	204	70.3	86	29.7	290
Minnesota	346	82.6	73	17.4	419
Mississippi	90	43.5	117	56.5	207
Missouri	199	55.1	162	44.9	361
New Jersey	457	90.1	50	9.9	507
New York	897	84.3	167	15.7	1,064
North Carolina	87	28.9	214	71.1	301
Oregon	178	65.9	92	34.1	270
Rhode Island	32	74.4	11	25.6	43
Texas	2,137	86.0	349	14.0	2,486

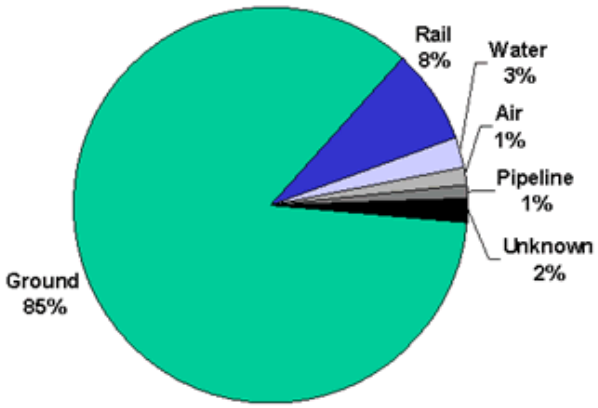
Utah	140	46.2	163	53.8	303
Washington	319	72.7	120	27.3	439
Wisconsin	199	41.6	279	58.4	478
Total	5,499	72.9	2,049	27.1	7,548

Figure 1-Areas of fixed facilities involved in events, Hazardous Substances Emergency Events Surveillance, 1999-2000.



*These areas were not available for the entire time period. Indoor @ res=an area inside a place where someone is residing. Indoor nonres=inside at a place that is not a residence (e.g., farm, industry, commercial business, and school). Outside nonind=outside at a place that is nonindustrial, or nonfarming (e.g., driveways, yards, roofs at residences, and schools). Outside ind=outside at an industry or farming area.

Figure 2-Distribution of transportation-related events, by type of transport, Hazardous Substances Emergency Events Surveillance, 1999-2000.*



*Four events had a combination of transportation types: one event, ground and rail; one event, water and rail; and two events, pipeline and water.

Figure 3-Factors reported as contributing to the occurrence of fixed-facility events, Hazardous Substances Emergency Events Surveillance, 1999-2000.

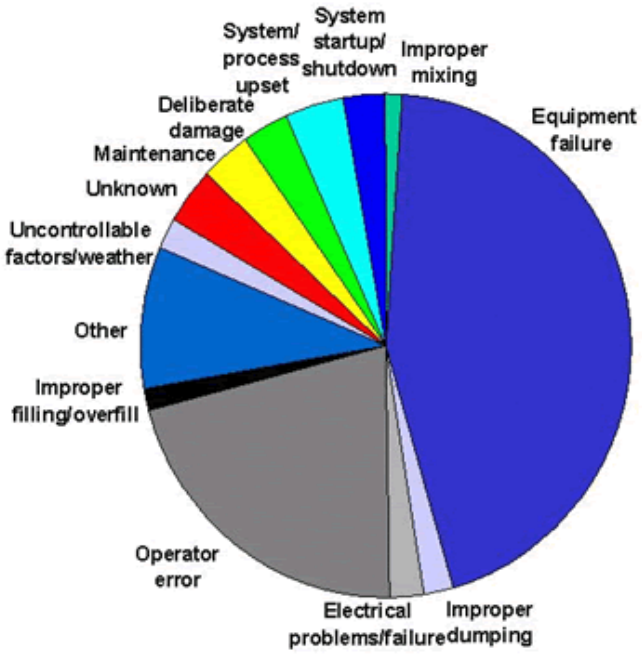


Table 2 -Distribution of the number of substances released, by type of event, Hazardous Substances Emergency Events Surveillance, 1999-2000.

No. of substances released	Type of event						All events		
	Fixed facility			Transportation					
	No. of events	(%)	No. of substances	No. of events	(%)	No. of substances	No. of events	(%)	No. of substances

1	9,715	95.9	9,715	3,500	95.2	3,500	13,215	95.7	13,215
2	216	2.1	432	121	3.3	242	337	2.4	674
3	105	1.0	315	27	0.7	81	132	1.0	396
4	44	0.4	176	11	0.3	44	55	0.4	220
?5	53	0.5	722	16	0.4	89	69	0.5	811
Total	10,133	100.0	11,360	3,675	100.0	3,956	13,808	100.0	15,316

Table 3-Distribution of the number of substances released, by substance category and type of event, Hazardous Substances Emergency Events Surveillance, 1999-2000.

Substance Category	Type of event				All events	
	Fixed facility		Transportation			
	No. of substances	**(%)**	**No. of substances**	**(%)**	**No. of substances**	**(%)**
Acids	800	7.0	567	14.3	1,367	8.9
Ammonia	757	6.7	80	2.0	837	5.5
Bases	268	2.4	288	7.3	556	3.6
Chlorine	182	1.6	7	0.2	189	1.2
Other inorganics*	3,055	26.9	472	11.9	3,527	23.0
Paints and dyes	219	1.9	208	5.3	427	2.8
Pesticides	349	3.1	297	7.5	646	4.2
PCBs	163	1.4	12	0.3	175	1.1
VOCs	2,423	21.3	629	15.9	3,052	19.9
Mixtures†	1,332	11.7	170	4.3	1,502	9.8
Other‡	1,813	16.0	1,225	31.0	3,038	19.8
Total§	11,361	100.0	3,955	100.0	15,316	100.1

PCBs=Polychlorinated biphenyls.
VOCs=Volatile organic compounds.
*All inorganic substances except for acids, bases, ammonia, and chlorine.
†Mixtures of substances from different categories.
‡Not classified.
§Total may not equal 100% due to rounding.

VICTIMS

A total of 4,425 victims were involved in 1,256 events (9.1% of all events) (Table 4). Of the 1,256 events with victims, 744 (59.2)% events involved only one victim, and 919 (73.2)% events involved either one or two victims. Of the 4,425 total victims, 3,787 (85.6%) were injured in fixed-facility events.

The substances released most often were not necessarily the most likely to result in victims (Table 5). For example, other inorganic substances were released 3,527 times; however, only 340 (9.6%) of these events resulted in injury. Conversely, chlorine was released in only 189 events, but 62 (32.8%) of these events resulted in injury, which indicates chlorine's greater potential for immediate harm.

Employees (2,365 or 53.4%) were the population groups most often injured, followed by the general public (919 or 20.7%), students (662 or 15.0%), and responders (460 or 10.4%) (Figure 4). The population group was unknown for 19 victims (0.43%). There were 366 emergency response personnel injured in fixed-facility events. Of those, 144 (39.3%) were police, 86 (23.5%) were professional firefighters, and 83 (22.7%) volunteer firefighters (Figure 5a). There were 94 emergency-responder victims injured in transportation-related events. Of these, 50 (53.1%) were police officers, 22 (23.4%) were professional firefighters, and 12 (12.8%) were emergency medical technicians (EMTs) (Figure 5b).

The types of injuries sustained by victims are shown in Table 6 and Figure 6. Victims sustained a total of 6,970 injuries. Some victims had more than one injury. The most commonly reported injuries in fixed-facility events were respiratory irritation (32%), headache (13%), dizziness or other central nervous system (CNS) symptoms (11%), eye irritation (11%), and gastrointestinal problems (11%). In transportation-related events, trauma (30%), respiratory irritation (21%), headache (9%), and eye irritation (6%) were reported most frequently. Trauma was reported more frequently in transportation-related events (30%) than in fixed-facility events (3%). 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 sex of 79% of the victims was known; of these, 54% were male. The mean age of the 63% of victims with a specified age was 40 years (range: 0-77 years). For the 37% of injured persons for whom specific age was unknown, 70% were adults (first responders or employees), 3% were children (students), and 27% could have been adults or children (general public or unknown victim category). Most (49%) victims were transported to a hospital and treated on an outpatient basis, and 1.6% died (Figure 7). Appendix B details the fixed-facility events in which deaths occurred, and Appendix C details the transportation events in which deaths occurred.

Among victims, 34% of employees, 20% of emergency responders, and 99% of students had not worn any form of personal protective equipment. For injured employees reported as wearing personal protective equipment, a combination of gloves, eye protection, and a hard hat were worn (14%). Fourteen percent wore other type of protective equipment, 4% wore firefighter turnout gear, and 2% wore level "D" protection, as defined by the Occupational Safety and Health Administration (OSHA). Of the known personal protective equipment worn, the most frequently worn by emergency responders was firefighter turnout gear (5%) and OSHA level "A" protection (2%).

Level "A" protection is worn when the highest level of respiratory, skin, and eye protection is needed. It includes supplied-air respirator, approved by the Mine Safety and Health Administration (MSHA), U.S. Department of Labor, and the National Institute for Occupational Safety and Health (NIOSH); pressure-demand, self-contained breathing apparatus; fully encapsulating chemical-resistant suit; coveralls; long cotton underwear; chemical-resistant gloves (inner); boots, chemical-resistant, steel toe and shank; hard hat; disposable gloves and boot covers; cooling unit; and two-way radio communications. Level "D" is worn as a work uniform and is not recommended for sites with respiratory or skin hazards. Level "D" includes coveralls, gloves, boots/shoes (leather or chemical-resistant, steel toe and shank), safety glasses or chemical splash goggles, and hard hat. Level "D" provides no protection against chemical hazards. Firefighter turnout gear is protective clothing normally worn by firefighters during structural fire-fighting operations, and is similar to level "D" protection.

Table 7 lists all of the events in which 50 or more people were injured. There were eight such events during the 2-year period.

EVACUATIONS

Evacuations were ordered in 1,182 events, and the evacuation status of 64 events was unknown. Of known evacuations, 71% were of a building or the affected part of a building, 14% were of a defined circular radius surrounding an event, 6% were of a downwind/downstream area, 5% were reported as having a circular and downwind/downstream area, and 3% had no criteria. The median number of persons evacuated was 20. In 93 events, in-place sheltering was ordered by an official, and instructions regarding precautions to take during in-place sheltering were provided by an official in 18 of these events.

CONTINGENCY PLANS

A contingency plan was followed in 95% of events. The types of contingency or preparedness plans used during an event varied, with 72% involving the use of a company's operating procedures. Twenty-one percent of events were reported as using a (HAZMAT)/Response team's standard operating procedures, and 6% of events were reported as using an incident-specific ad hoc plan.

Table 4-Distribution of the number of victims, by type of event, Hazardous Substances Emergency Events Surveillance, 1999-2000.

No. of victims	Type of event		All events
	Fixed facility	Transportation	

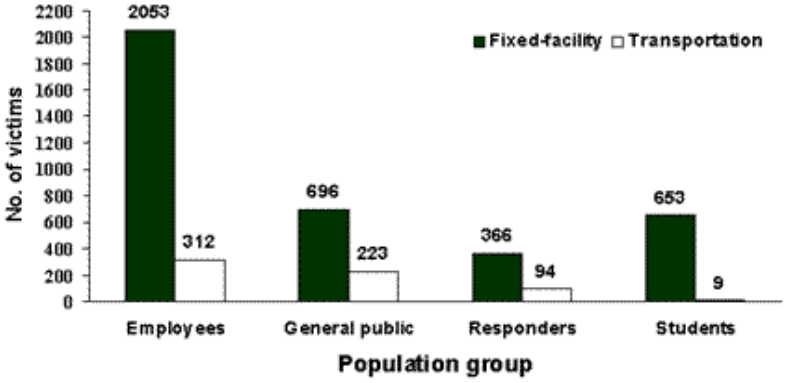
	No. of events	(%)	No. of substances	No. of events	(%)	No. of substances	No. of events	(%)	No. of substances
1	526	55.4	526	218	71.0	218	744	59.2	744
2	136	14.3	272	49	16.0	98	175	14.7	370
3	79	8.3	237	2	3.9	36	91	7.2	273
4	54	5.7	216	5	1.6	20	59	4.7	236
5	33	3.5	165	9	2.9	45	42	3.3	210
?6	121	12.8	2,371	14	4.6	221	135	10.7	2,592
Total	949	100.0	3,787	307	100.0	638	1,256	100.0	4,425

Table 5-Number of substances released in all events and events with victims, by substance category, Hazardous Substances Emergency Events Surveillance, 1999-2000.

Substance Category	Total releases		Releases with victims		
	No.	Percentage of total releases	No.	Percentage of all releases with victims	Percentage of releases in substance category
Acids	1,367	(8.9)	238	(13.3)	17.4
Ammonia	837	(5.5)	169	(9.4)	20.2
Bases	556	(3.6)	63	(3.5)	11.3
Chlorine	189	(1.2)	62	(3.5)	32.8
Other inorganics*	3,527	(23.0)	340	(19.0)	9.6
Paints and dyes	427	(2.8)	27	(1.5)	6.3
Pesticides	646	(4.2)	107	(6.0)	16.6
Polychlorinated biphenyls	175	(1.1)	1	(0.1)	0.6
VOCs	3,052	(19.9)	302	(16.9)	9.9
Mixtures†	1,502	(9.8)	135	(7.5)	9.0
Other‡	3,038	(19.8)	348	(19.4)	11.5
Total	15,316	(100.0)	1,792	(100.0)	(100.0)

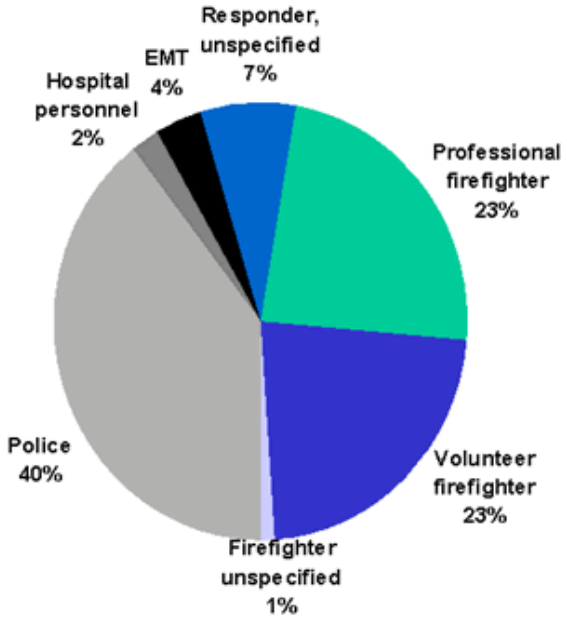
VOCs=Volatile organic compounds.
*All inorganic substances except for acids, bases, ammonia, and chlorine.
†Mixtures of substances from different categories.
‡Not classified.

Figure 4-Distribution of victims, by population group* and type of event, Hazardous Substances Emergency Events Surveillance, 1999-2000.



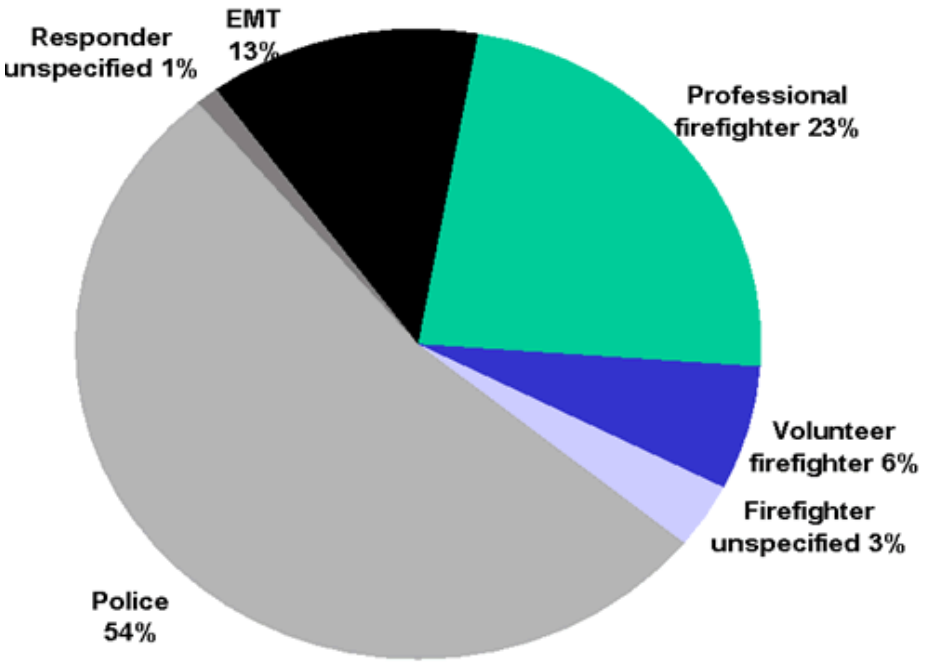
*Population group was unknown for 19 persons injured in fixed-facility events.

Figure 5a-Distribution of responders injured in fixed-facility events,* by population group, Hazardous Substances Emergency Events Surveillance, 1999-2000.



*A total of 366 responders were injured during fixed-facility events.

Figure 5b-Distribution of responder victims for transportation-related events,* by population group, Hazardous Substances Emergency Events Surveillance, 1999-2000.



*A total of 94 responders were injured during transportation-related events.

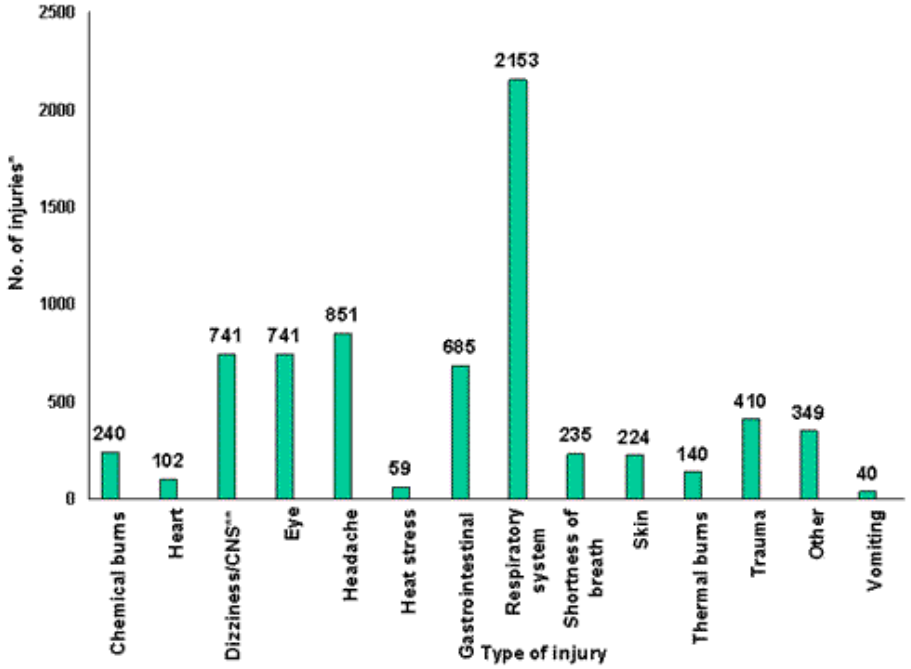
Table 6-Distribution of type of injury, by type of event,* Hazardous Substances Emergency Events Surveillance, 1999-2000.

Type of injury	Type of event				All events	
	Fixed facility		Transportation			
	No. of injuries	**(%)**	**No. of injuries**	**(%)**	**No. of injuries**	**(%)**
Chemical burns	207	3.4	33	4.0	240	3.4
Heart problems	99	1.6	3	0.4	102	1.5
Dizziness/CNS†	699	11.4	42	5.1	741	10.6
Eye irritation	691	11.2	50	6.1	741	10.6
Headache	776	12.6	75	9.2	851	12.2
Heat stress	40	0.6	19	2.3	59	0.8
Gastrointestinal problems	644	10.5	41	5.0	685	9.8
Respiratory system	1,978	32.1	175	21.4	2,153	30.9
Shortness of breath	198	3.2	37	4.5	235	3.4
Skin irritation	187	3.0	37	4.5	224	3.2
Thermal burns	119	1.9	21	2.6	140	2.0

Trauma	168	2.7	242	29.7	410	5.9
Other	328	5.3	21	2.6	349	5.0
Vomiting	20	0.3	20	2.5	40	0.6
Total	6,154	100.0	816	100.0	6,970	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.

Figure 6-Distribution of type of injury for all events, Hazardous Substances Emergency Events Surveillance, 1999-2000.



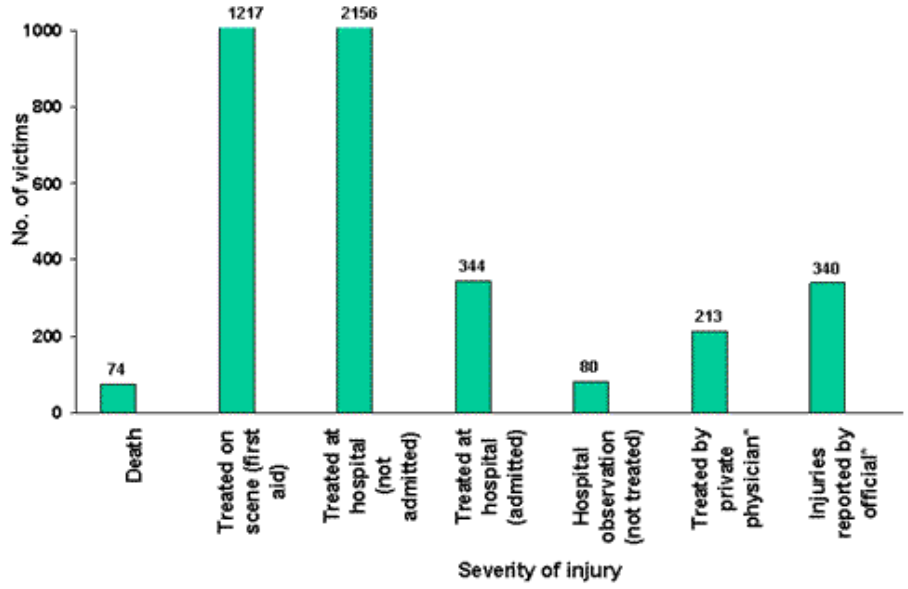
*A total of 6,970 injuries was reported. The number of injuries was greater than the number of victims because some victims had more than one injury.
**Central nervous system symptoms.

Table 7-Profiles of events with =50 victims, Hazardous Substances Emergency Events Surveillance, 1999-2000.

Victim Type	No. of Victims	Treatment(s)	Chemical(s)	Injuries(s)
Employees, Responders	54 4	Treated on scene	Benzene	Respiratory problems, dizziness or other CNS
General public, Students	1 63	Treated at hospital	Carbon monoxide	Gastrointestinal problems, carbon monoxide poisoning, dizziness or other CNS
General public, EMTs, Volunteer firefighters, Professional firefighters	44 8 3 10	Treated at hospital, treated on scene	Ammonia	Respiratory problems,eye irritation, thermal burns, gastrointestinal problems, dizziness or other CNS, headache, heart problems

Employees, General public	86 4	Treated at hospital, treated on scene, death	12 substances	Trauma; respiratory, skin, and eye irritation; thermal burns; gastrointestinal problems; dizziness or other CNS; headache; heart problems; shortness of breath; coughing blood; alkylemia; ringing in ears; posttraumatic syndrome
Students, General public	98 9	Treated on scene, adverse health effects within 24 hours	Pyridine	Respiratory, skin, and eye irritation; headache; gastrointestinal problems; dizziness or other CNS; shortness of breath
Students, General public	118 10	Treated on scene, adverse health effects within 24 hours	Pyridine	Respiratory and eye irritation, Headache, Gastrointestinal problems, Shortness of breath, Dizziness or other CNS
Employees	141	Treated on scene, treated at hospital	Dichlorobenzene	Respiratory problems, Dizziness or other CNS
Students, General public	191 68	Treated on scene, treated at hospital, adverse health effects within 24 hours	Pyridine	Respiratory, skin, and eye irritation, Gastrointestinal problems, Dizziness or other CNS, Headache, Metallic taste, Fatigue, Malaise

Figure 7-Injury outcome, Hazardous Substances Emergency Events Surveillance, 1999-2000.



*Within 24 hours.

MANUFACTURING OF CHEMICALS AND ALLIED PRODUCTS

HSEES industry codes are based on the 1990 Industrial Classification System of the Bureau of the Census, U.S. Department of Commerce. Additional analyses of events involving industries in the category Manufacturing of Chemicals and Allied Products (codes 180-Plastics, synthetics, and resins, 181-Drugs, 182-Soaps and cosmetics, 190-Paints, varnishes, and related products, 191-Agricultural chemicals, and 192-Industrial and miscellaneous chemicals) were conducted to determine the public health consequences of these events.

The Manufacturing of Chemicals and Allied Products category was the second most frequently reported industry category in the surveillance system during 1999-2000. A total of 3,414 hazardous

substances events (25% of all events and 33% of fixed-facility events) was reported to have occurred in this industry. Further classification by industry code found that 64% of these events occurred at manufacturers of industrial and miscellaneous chemicals, 28% in plastics, synthetics, and resins, 4% in agricultural chemicals, 2% in drugs, 2% in cosmetics, and approximately 1% in paints, varnishes, and related products manufacturing. Of the known primary contributing factors, 54% of the events occurred as a result of equipment failure and 11% were due to operator error. The category of substances most frequently released were VOCs (33%), other inorganic substances (22%), and mixtures (19%). Seventy-four percent of the releases were air emissions, 23% were spills, and the remainder involved mostly fire and explosions.

Events involving the Manufacturing of Chemicals and Allied Products category accounted for the most (22%, n=981) injured persons of any industry category in the surveillance system during 1999-2000. Forty-one percent of injured persons were students, 40% employees, 15% were the general public, and the remainder were first responders. Seventy-one percent (n=644) of the victims were treated at the scene, 14% (n=130) were transported and treated in the hospital, and 3% (n=27) were admitted to the hospital. Events in the category Manufacturing of Chemicals and Allied Products resulted in 10 deaths (13% of all deaths), of which nine were employees, and one was a first responder.

Twenty-five percent of events occurred within a quarter mile of a residential area. Evacuations were ordered in 105 (3%) of the events. The number of persons evacuated was available for 90% of events with known evacuation orders. Ordered evacuations resulted in the evacuation of a range of 0 to 4,493 persons, with a median of 20 persons. The length of the evacuation period, available for 84% of the events with known evacuation orders, ranged from 1 to 1,800 hours, with a median of 3 hours.

One particular drug manufacturing facility accounted for three of the events for which evacuations were ordered. Two of these events resulted in the evacuation of more than 4,400 persons on each occasion for periods of 3 to 4 hours. These three events resulted in 494 injured persons, 407 of whom were students at a neighboring high school. These figures illustrate the potential public health threat and financial costs associated with releases of hazardous substances in the manufacturing of chemicals and allied products industry.

USE OF HSEES DATA

During 1999-2000, ATSDR continued to respond to requests for HSEES information from local, state, and federal agencies and organizations. In addition, ATSDR continued to receive requests from researchers for copies of the HSEES protocol, data collection form, data, and publications. HSEES data have been used to produce the publications listed in Appendix D.

The HSEES Internet Web site page is available at http://www.atsdr.cdc.gov/HS/HSEES/. At this site, HSEES annual reports and other information can be downloaded to a user's personal computer. Internet linkages to other relevant Web sites will be available on the HSEES Web site in the future.

Current activities include collaboration with the Federal Emergency Management Agency and other agencies and organizations involved with response to chemical terrorism, emergency response, hazardous substances releases, and public health. Eight years of HSEES data are now available for trend analysis, and several publications are under way. Participating states have developed their own cumulative data reports and prevention plans.

In December 1999, a new Internet-based data-entry system became available for use by participating states. This system has improved data management and synchronization and has resulted in more rapid reporting, which could lead to broader uses of the data.

SUMMARY OF RESULTS, 1993-2000

The number of events, substances released, events with victims, and deaths for the years 1993 through 2000 are shown in Table 8. During this period, most events involved a single substance at fixed facilities. However, the number of transportation events is increasing, partially the result of using the U.S. Department of Transportation's Hazardous Materials Information System as a primary notification source for transportation events. The total number of events and the number of substances released during 1999-2000 continued the upward trend. This is partially explained by the addition of two new states in 2000; however, the number of events in states that have been in the system since 1993 grows every year.

Respiratory symptoms have consistently been most frequently reported. The number of deaths associated with events continues to suggest the need to evaluate not only the danger posed by exposure to hazardous substances, but also the circumstances surrounding the occurrence of events. Employees continue to be the most commonly reported victims of emergency events (Figure 8). Cumulative data on the number of events, substances, victims, and events involving victims are displayed in Figure 9.

HSEES data regarding risk factors related to the occurrence of emergency events and the associated morbidity and mortality have multiple uses. The states and ATSDR use the results of data analysis for prevention activities aimed at several different target groups, including school personnel, industry and labor groups, first responders, hospital personnel, and producers or users of potentially dangerous substances.

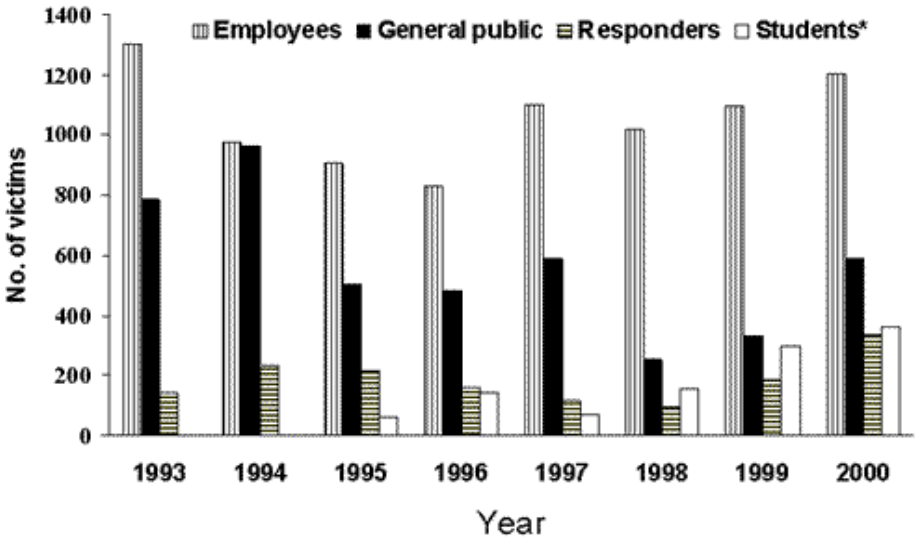
Table 8-Cumulative data for all states, Hazardous Substances Emergency Events Surveillance, 1993-2000.*

Year	No. of states	Type of event			No. of substances released	No. of deaths	No. of victims	Events with victims No. -- (%)†
		Fixed facility	Transportation	Total				

1993	11	3,199	634	3,833	4,361	16	2,230	464	(12)
1994	12	3,321	912	4,233	5,073	21	2,181	414	(10)
1995	14	4,273	1,037	5,310	6,027	14	1,688	402	(8)
1996	14	4,327	1,159	5,486	5,862	33	1,622	390	(7)
1997	13	4,385	1,128	5,513	6,089	28	1,896	372	(7)
1998	13	4,729	1,252	5,981	6,486	36	1,533	405	(7)
1999	13	4,634	1,626	6,260	6,974	30	1,912	504	(8)
2000	15	5,499	2,049	7,548	8,384	44	2,513	752	(10)
Total		34,367	9,797	44,164	49,256	222	15,575	3,703	(8)

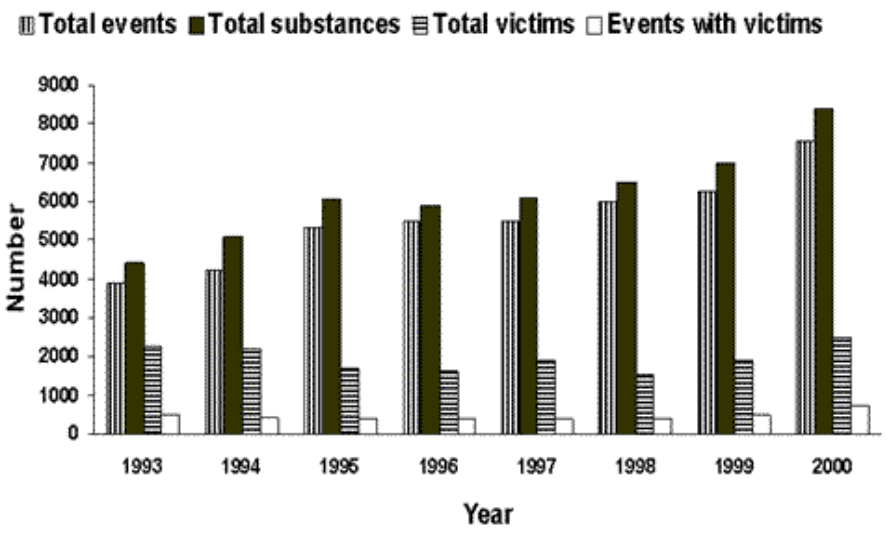
*Numbers in the table may differ from those reported in previous years because of adjustments in HSEES qualification requirements for events. †Percentage of events with victims.

Figure 8-Distribution of victims, Hazardous Substances Emergency Events Surveillance, 1993-2000†



*The student category was not available before 1995.
†The numbers of unknown victims were as follows: 14 for 1993, six for 1994, three for 1996, 14 for 1997, eight for 1998, one for 1999, and 17 for 2000.

Figure 9-Cumulative data for all participating states, Hazardous Substance Emergency Events Surveillance, 1993-2000.



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APPENDICES

Appendix A-The 100 Most Frequently Released Substances, Hazardous Substances Emergency Events Surveillance, 1999-2000

Number	Standardized Substance Name	Frequency
1.	Ammonia	801
2.	Sulfur Dioxide	560
3.	Sulfuric Acid	422
4.	Hydrochloric Acid	330
5.	Paint or Coating NOS*	323
6.	Sodium Hydroxide	302
7.	Mercury	267
8.	Carbon Monoxide	259
9.	Nitric Oxide	253
10.	Ethylene Glycol	244
11.	Chlorodifluoromethane	192

12.	Butadiene	187
13.	Benzene	187
14.	Chlorine	183
15.	Oxides of Nitrogen NOS	179
16.	Polychlorinated Biphenyls	174
17.	Corrosive NOS	153
18.	Nitrogen Dioxide	127
19.	Solvent NOS	124
20.	Phosphoric Acid	123
21.	Hydrogen Sulfide	121
22.	Mix: Hydrogen Sulfide/Sulfur Dioxide	120
23.	Potassium Hydroxide	114
24.	Adhesive NOS	110
25.	Sodium Hypochlorite	110
26.	Mix: Nitric Oxide/Nitrogen Dioxide	105
27.	Acid NOS	96
28.	Resin Solution	92
29.	Ethanol	86
30.	Ethylene	82
31.	Pesticide NOS	82
32.	Xylene	82
33.	Toluene	79
34.	Methanol	77
35.	Flammable Liquid NOS	76
36.	Acetone	75
37.	Methylene Chloride	72

38.	Isopropanol	69
39.	Hydrogen Peroxide	68
40.	Nitric Acid	67
41.	Mix: Benzene/Butadiene	65
42.	Ink NOS	59
43.	Propylene	57
44.	Acetic Acid	56
45.	Ethyl Ether	54
46.	Formaldehyde	50
47.	Freon NOS	50
48.	Diesel Fuel	49
49.	Nitrogen Fertilizer	47
50.	Methyl Ethyl Ketone	46
51.	Tetrachloroethylene	46
52.	Brake or Hydraulic Fluid NOS	44
53.	Hypochlorite NOS	40
54.	Asbestos	39
55.	Resin NOS	38
56.	Base NOS	37
57.	Ethylene Oxide	37
58.	Hydraulic Oil	36
59.	Urea Ammonium Nitrate	36
60.	EPA F039: Multi-code Treatment, Storage, or Disposal Leachate	35
61.	Hydrofluoric Acid	35
62.	Malathion	35
63.	Sulfur	35

64.	Battery Acid NOS	33
65.	Fertilizer NOS	32
66.	Mix: Dimethyl Disulfide/Dimethyl Sulfide/Hydrogen Sulfide/Methyl Mercaptan	32
67.	Pendimethalin	31
68.	Vinyl Chloride	31
69.	Acrolein	30
70.	Ammonium Nitrate	30
71.	Calcium Hypochlorite	30
72.	Isopropylamine Glyphosate	30
73.	Mix: Nitric Oxide/Sulfur Dioxide	30
74.	Trifluralin	29
75.	VOCs NOS	29
76.	Ephedrine	28
77.	Methamphetamine Chemical NOS	28
78.	O-Chlorobenzylidene Malononitrile	28
79.	Styrene	28
80.	Chlorpyrifos	27
81.	Mix: Nitric Oxide/Nitrogen Dioxide/Sulfur Dioxide	27
82.	Phosphorus	27
83.	Ether NOS	25
84.	Iodine	25
85.	Methyl Mercaptan	25
86.	Urea	25
87.	Naphtha	24
88.	Carbon Dioxide	23

89.	Alcohol NOS	23
90.	Chloroform	23
91.	Transformer Oil NOS	23
92.	Xylene NOS	22
93.	Black Liquor†	22
94.	Nitrous Oxide	22
95.	Phenol	22
96.	Propylene Glycol	22
97.	Ammonium Hydroxide	21
98.	Calcium Oxide	21
99.	Carbon Black	21
100.	Diazinon	21
Total		9,169

VOCs--Volatile organic compounds.
NOS--Not otherwise specified.
*Unable to assign a standardized name for 128 substance.
†This is a substance used in pulp processing; it is not for consumption.

Appendix B-- Profiles of Events With Fatalities in Fixed Facilities, Hazardous Substances Emergency Events Surveillance, 1999-2000.

Industry/ Location	Type of release	Chemicals (quantities)	Factors	Victim Category	Sex*	Injury	PPE*
Specialty plastic	Explosion	Tetrafluoroethylene	Human error	Employee	2 F 1 M	Thermal burns	Unknown
Industrial chemical mfg.*	Fire	Sulfur dioxide (1,000 lb)	Other	Employee	M	Respiratory irritation	Eye protection, hard had, steel-toed shoe
Private residence	Spill + Air emission	Oxidizer (liter) Vinegar (liter) Sodium hydroxide Sodium hypochlorite Sodium silicate (liter)	Improper mixing	Employee	F	Respiratory irritation	None
Tire mfg.	Spill + Fire	Drain cleaner (liter)	Unknown	Employee	M	Trauma	None
Illegal drug lab	Fire + Explosion	Carbon black Ethanol Hexane	Illegal activity	General public	M	Respiratory irritation	None

Fireworks	Fire + Explosion	Black powder	Unknown	Employee	F	Trauma, thermal burns	None
Private residence/ Business Fireworks	Explosion	Black powder Pyrotechnic chemicals	Unknown	General public	M	Trauma, thermal burns	Unknown
Fireworks	Spill + Air emission	Black powder Pyrotechnic chemicals	Human error	Employee	F	Trauma	None
Special chemical mfg.	Spill + Air emission	Sodium hydrosulfide	Human error	Employee	M	Asphyxia	Eye protection, hard hat
Powder and magnesium mfg.	Explosion	Magnesium Teflon Viton	Other	Employee	M	Trauma, chemical and thermal burns	None
Dairy farm/Agriculture	Air emission	Ammonia Carbon dioxide Hydrogen sulfide Methane	Human error	Employee	M M	Other, respiratory irritation	None
Fireworks disposal	Explosion	Black powder Sodium chlorate Potassium perchlorate (100lb)	Human error	Employee	M	Thermal burns	None
Restaurant	Air emission	Ammonium Calcium hypochlorite	Equipment failure	Employee	M	Respiratory irritation, other	None
Private residence	Fire	Acid Base Solvent Cyanide	Unknown	Employee	M	Trauma	None
Hospital	Air emission	Nitrogen	Equipment failure	Employee	M	Asphyxia	Unknown
Private residence	Air emission	Hydrochloric acid (2kg)	Human error	General public	M	Respiratory and eye irritation, chemical burns	Unknown
Organic chemicals mfg.	Fire	Di-tert-butyl peroxide (138 gal)	Human error	Employee	M	Thermal burns	Gloves hard hat, eye protection
Polyethylene mfg.	Explosion + Spill + Air emission + Fire	12 different chemicals (22.5)	Improper mixing	Employee	M	Trauma, chemical and thermal burns	Eye protection, hard hat, steel toed shoe.
Private property/ Illegal drug	Fire	Acetone	Human error	General public	M F	Thermal burns	None

Single family residence	Air emission	Carbon monoxide	Unknown	General public	1 M 2 F	Suffocation	None
Mfg. thermal controls	Spill	Mixture	Unknown	Employee	M	Chemical and thermal burns	Unknown
Boy Scout camp	Air emission	Carbon monoxide	Unknown	Employee	M	Suffocation	None

*Personal protective equipment.

Appendix C-- Profiles of Events With Fatalities in Transportation Events, Hazardous Substances Emergency Events Surveillance, 1999-2000.

Industry/ Location	Type of release	Chemicals (quantities)	Victim Category	Sex*	Injury	PPE*
Truck transportation	Spill	Sulfur (900 gal)	Employee	M	Trauma	None
Transportations	Spill	Acrylic acid polymer	Employee	2 M	Trauma	Unknown
Aerial pesticide applicators	Spill + Air emission	Imazapyr Triclopyr(13 lb)	Employee	2 M	Trauma	Unknown
Motor freight transportation	Spill + fire	2-(2-Aminoethyoxyl)-ethanol (8 ton) Diesel fuel Chlorimuron-ethyl Metribuzine (10 tons)	Employee	M	Trauma	None
Grain elevator	Spill	Imazethapyr	Employee	M	Trauma	None
Motor freight transportation	Spill	Sulfur (3,200 gal)	General public	M	Trauma	None
Motor freight transportation	Spill + Fire	Fire fighting foam (28 tons) Household cleaners (28 tons) Diesel fuel	Employee	2 M	Trauma	None
Motor freight transportation	Air emission	Nitrogen (50 lb)	Employee	M	Trauma	None
Truck transportation	Spill	Potassium chloride Diesel fuel	Employee	M	Trauma	None
Illegal meth drug lab	Explosion	Ammonia (20 lb)	General public	M	Trauma, chemical burns, respiratory	None
Truck transportation	Spill	Sodium hydroxide (6 gal)	Employee	M	Trauma	None
Multi-vehicle accident	Spill + Fire	Hydrochloric acid (8 gal)	General public	2 F 8 M	Trauma, asphyxia,	None

		Gasoline			respiratory, thermal burns	
Truck	Spill + Fire	Dichlobenil (20 tons)	General public	F	Trauma	None
Truck	Spill	Hydramethylnon (360 lb)	Employee	M	Trauma	None
Private vehicles	Spill	Sulfuric acid (gal) Methanol Formaldehyde	General public	M	Trauma, heart problems	None
Environmental transport	Spill	Diesel fule Sodium hypochlorite (35 gal)	Employee	M	Trauma	Unknown
Truck	Spill	Diesel fuel (200 gal) Vitamins	Employee	M	Trauma	None
Aerial spraying	Spill + Fire	Diesel fuel Sulfur oil	Employee	M	Trauma	Unknown
Truck	Spill	Calcium carbonate (200 lb)	General public	Unk	Trauma	Unknown
Private contractor	Spill + Threat	Diesel fuel (150 gal) Ethyl lactate (4,370 gal)	Employee	M	Trauma	None
Truck	Spill	Diesel fuel (75 gal) Hydrochloric acid (10 gal)	General public	M	Trauma	None
Motor freight carrier	Spill	Sodium hypochlorite (2,000 gal)	Employee	M	Trauma	None
Pool chemical supply	Spill	Hydrochloric acid (150 gal)	General public	M	Trauma	None
Crop duster	Spill	Atrazine 2,4-D Metasulfuron-methyl (20 gal)	Employee	M	Trauma	Eye protection, hard hat
Crop duster	Spill + Air emission	Malathion (100 gal)	Employee	M	Trauma	Hard hat
Motor freight carrier	Spill	Sodium hypochlorite (150 gal)	Employee	M	Trauma	None
Motor freight carrier	Threat	Helium (9,600 gal)	Employee	F M	Trauma	None
Truck	Spill	Phosphoric acid	Employee	M	Trauma	None

Private citizen	Fire	Radioactive material Plutonium	General public	F	Heart problems	None
Chemical transport	Air emission	Carbon dioxide (1 ton)	Employee	M	Trauma	None
Truck	Threat	Black liquor (6,500 lb)	General public	M	Trauma	None
Manufacturing adhesive and resins	Spill	Phenon (ton)	Employee	M	Respiratory irritation	None

*PPE = Personal protective equipment; mfg. = manufacturing; M = male; F = female.

Appendix D-Hazardous Substances Emergency Events Surveillance-Related Publications

Agency for Toxic Substances and Disease Registry. Hazardous Substances Emergency Events Surveillance annual report, 1993. Atlanta: US Department of Health and Human Services; 1994.

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