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# Executive Summary

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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 of acute releases of hazardous substances in 15 states. This report summarizes the characteristics of events reported to ATSDR by all participating state health departments in 2003. Information about acute events involving hazardous substances was collected, including the substance(s) released, number of victims, number and types of injuries, and number of evacuations. The data were computerized using an ATSDR-provided Web-based data entry system.

A total of 9,105 events were reported. In 8,060 (88.5%) events, only one substance was released. The

most commonly reported categories of substances were other inorganic substances (excluding chemicals in the categories of acids, bases, ammonia, and chlorine), volatile organic compounds, and mixtures involving substances from different categories that were mixed or formed from a reaction before release. During this reporting period, 720 events (7.9% of all reported events) resulted in a total of 1,835 victims, of whom 51 (2.8%) died. The most frequently reported injuries were respiratory irritation, headaches, and gastrointestinal system problems. Evacuations were ordered for 531 (5.9%) events.

The findings regarding the percentage of events with victims and the distribution of the types of injuries reported have been consistent in recent years. Prevention outreach efforts continue to focus on chemicals that are likely to result in victims.

# Introduction

The Centers for Disease Control and Prevention defines surveillance as the

*“ongoing, systematic collection, analysis, and interpretation of health data essential to the planning, implementation, and evaluation of public health practice, closely integrated with the timely dissemination of these data to those who need to know. The final link of the surveillance chain is the application of these data to prevention and control. A surveillance system includes a functional capacity for data collection, analysis, and dissemination linked to public health programs”*<sup>[1]</sup>.

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 of releases of hazardous substances. The decision to initiate a surveillance system of this type was based on a study published in 1989 about the reporting of hazardous substances releases to three national databases: the National Response Center Database, the Hazardous Material Information System (HMIS), and the Acute Hazardous Events Database<sup>[2]</sup>.

A review of these databases indicated limitations. Many events were missed because of specific reporting requirements (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 of releases of hazardous substances.

HSEES has several goals:

- To describe the distribution and characteristics of acute hazardous substances releases;
- To describe morbidity and mortality among employees, responders, and the general public that resulted from hazardous substances releases; and to
- To develop strategies that might reduce future morbidity and mortality resulting from the release of hazardous substances.

For a surveillance system to be useful, it must not only be a repository for data, but the data must also be used to protect public health.

In the last few years, the last goal of the HSEES system has been emphasized; i.e., to develop strategies to reduce subsequent morbidity and mortality by having each participating state analyze its data and develop appropriate prevention outreach activities. These activities are intended to provide industry, responders, and the general public with information that can help prevent chemical releases and reduce morbidity and mortality if a release occurs.

This report provides an overview of HSEES for 2003 in all participating states, summarizes the characteristics of acute releases of hazardous substances and their associated public health consequences, and demonstrates how data from the system are translated into prevention activities to protect public health.



# Methods

In 2003, fifteen state health departments participated in HSEES: Alabama, Colorado, Iowa, Louisiana, Minnesota, Mississippi, Missouri, New Jersey, New York, North Carolina, Oregon, Texas, Utah, Washington, and Wisconsin.

Beginning in 2002, a newly updated data-collection form, approved by the Office of Management and Budget, went into effect. Information was collected about each event, including substance(s) released, victims, injuries (adverse health effects and symptoms), and evacuations.

Various data sources were used to obtain information about these events. These sources included records and oral reports of state environmental protection agencies, the U.S. Department of Transportation, the National Response Center, police and fire departments, and hospitals. Census data were used to estimate the number of residents in the vicinity of the events. All data were computerized using a Web-based data entry system provided by ATSDR.

HSEES defines hazardous substances emergency events as acute uncontrolled or illegal releases or threatened releases of hazardous substances. Events involving releases of only petroleum are excluded. Events are included if (a) the amount of substance 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 (b) the release of a substance was threatened, but the threat led to an action (for example, evacuation) that could

have affected the health of employees, emergency responders, or members of the general public. HSEES defines victims as people who experience at least one documented adverse health effect within 24 hours after the event or who die as a consequence of the event. Victims who receive more than one type of injury or symptom are counted once in each applicable injury type or symptom. Events are defined as transportation-related if they occur (a) during surface, air, pipeline, or water transport of hazardous substances, or (b) before being unloaded from a vehicle or vessel. All other events are considered fixed-facility events.

For data analyses, the substances released were categorized into 16 groups. The category “mixture” comprises substances from different categories that were mixed or formed from a reaction before the event; the category “other inorganic substances” comprises all inorganic substances except acids, bases, ammonia, and chlorine; and the category “other” comprises substances that could not be grouped into one of the other existing categories.

## Results

For 2003, a total of 9,105 acute hazardous substances events were reported to HSEES: 300 (3.3%) of these events were threatened releases. Fifty-six (0.6%) were events in which substances were both threatened to be released and actually released. A total of 6,782 (74.5%) events occurred in fixed facilities. Two states, Texas and New York, reported 42.6% of all releases (Table 1).

For each fixed-facility event, one or two types of area or equipment involved in the fixed facility where the

**Table 1. Number of events meeting the surveillance definition, by state and type of event—Hazardous Substances Emergency Events Surveillance, 2003**

State	Type of event				Total no. events (%)
	Fixed facility		Transportation		
	No. events	%*	No. events	%*	
Alabama	90	48.4	96	51.6	186 (2.0)
Colorado	55	29.3	133	70.7	188 (2.1)
Iowa	240	73.4	87	26.6	327 (3.6)
Louisiana	587	87.1	87	12.9	674 (7.4)
Minnesota	323	73.7	115	26.3	438 (4.8)
Mississippi	107	56.9	81	43.1	188 (2.1)
Missouri	225	52.3	205	47.7	430 (4.7)
New Jersey	508	72.5	193	27.5	701 (7.7)
New York	852	75.7	273	24.3	1,125 (12.4)
North Carolina	195	52.1	179	47.9	374 (4.1)
Oregon	189	73.8	67	26.2	256 (2.8)
Texas	2,482	90.1	272	9.9	2,754 (30.2)
Utah	364	76.8	110	23.2	474 (5.2)
Washington	380	65.5	200	34.5	580 (6.4)
Wisconsin	185	45.1	225	54.9	410 (4.5)
<b>Total</b>	<b>6,782</b>	<b>74.5</b>	<b>2,323</b>	<b>25.5</b>	<b>9,105 (100.0)</b>

\* Percentage = (number of events by type of event per state/total number of events in that state) x 100

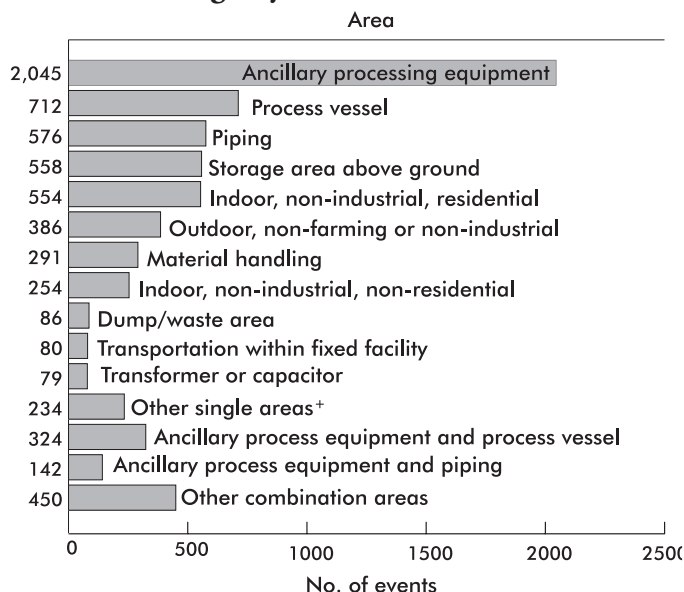
event occurred could be selected. Of all 6,782 fixed-facility events, 5,855 (86.3%) reported one type of area and 916 (13.5%) reported a combination of two area types. Type of area was not reported for 11 (0.2%) events. Among events with one type of area reported, the main areas were classified as follows: 2,045 (34.9%) ancillary processing equipment, 712 (12.2%) process vessel (a reaction chamber in which chemicals are processed), and 576 (9.8%) piping (Figure 1). Of the events with two areas, 497 (54.2%) involved ancillary processing equipment in combination with other types of areas.

Of the 2,323 transportation-related events, 2,010 (86.5%) occurred during ground transport (e.g., truck, van, or tractor) and 198 (8.5%) involved transport by

rail (Figure 2). Fewer events involved water, air, and pipeline transportation modes. Most (82.2%) ground transportation events involved trucks. The largest proportions of transportation-related events occurred during unloading of a stationary vehicle or vessel (900 [38.8%]) and from a moving vehicle or vessel (737 [31.8%]). Of the 2,323 transportation-related events, 635 (27.4%) involved a release en route that was later discovered at a fixed facility.

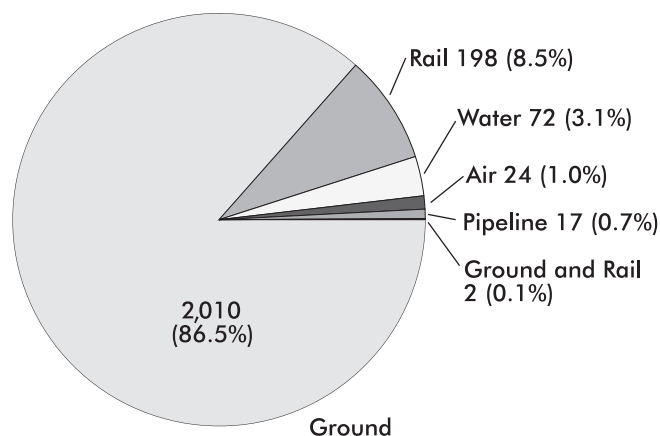
Factors contributing to the events consisted of primary and secondary entries. Primary factors were reported for 9,008 (98.9%) events (Figure 3a). Of the reported primary factors, most (58.7%) fixed-facility events involved equipment failure, and most (65.7%) transportation-related events involved human error.

**Figure 1. Areas of fixed facilities involved in events—Hazardous Substances Emergency Events Surveillance, 2003\***

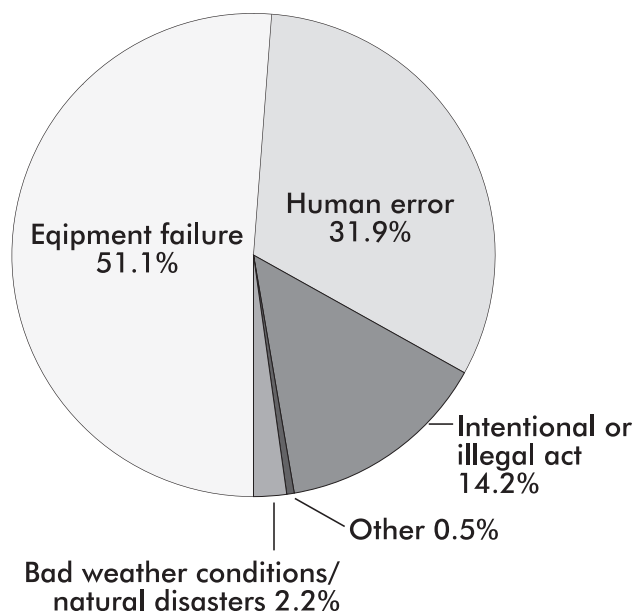


\* Of all 6,782 fixed-facility events, 5,855 had one type of area reported, 916 had a combination of two area types, and type of area was missing for 11 events.  
 + Of all 234 other single areas, 65 were heating/cooling for building; 65 were outdoor, farming, or industrial areas; 56 were laboratories; 33 were incinerators; and the remainder were other types of areas.

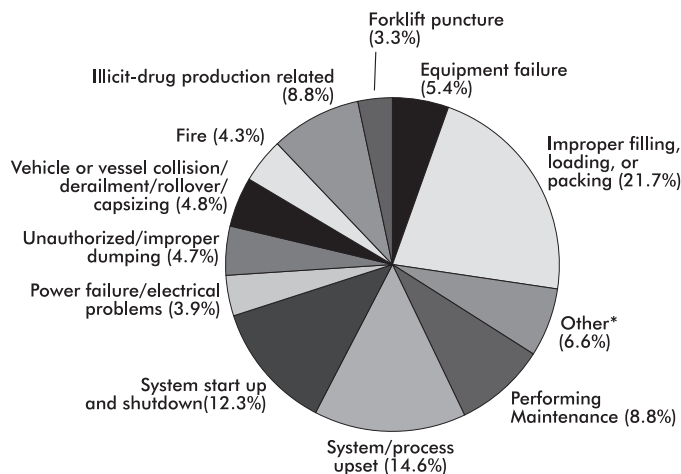
**Figure 2. Distribution of transportation-related events, by type of transport—Hazardous Substances Emergency Events Surveillance, 2003**



**Figure 3a. Primary factors reported as contributing to events—Hazardous Substances Emergency Events Surveillance, 2003**



**Figure 3b. Secondary factors reported as contributing to events—Hazardous Substances Emergency Events Surveillance, 2003**



\* includes human error, improper mixing, explosion, overspray/misapplication, loadshift, and all other secondary factors

**Table 2. Number of substances involved per event, by type of event—Hazardous Substances Emergency Events Surveillance, 2003**

No. substances	Type of event						All events		
	Fixed facility			Transportation			No. events	%	Total substances
	No. events	%	Total substances	No. events	%	Total substances			
1	5,873	86.6	5,873	2,187	94.1	2,187	8,060	88.5	8,060
2	353	5.2	706	90	3.9	180	443	4.9	886
3	144	2.1	432	28	1.2	84	172	1.9	516
4	261	3.9	1,044	13	0.6	52	274	3.0	1,096
≥ 5	151	2.2	1,416	5	0.2	44	156	1.7	1,460
<b>Total</b>	<b>6,782</b>	<b>100.0</b>	<b>9,471</b>	<b>2,323</b>	<b>100.0</b>	<b>2,547</b>	<b>9,105</b>	<b>100.0</b>	<b>12,018</b>

Secondary factors were reported for 6,091 (66.9%) events (Figure 3b). Of the reported secondary factors, most (20.2%) fixed-facility events involved system/process upset, and most (55.7%) transportation-related events involved improper filling, loading, or packing.

More than 88% of all events involved the release of only one substance. Two substances were released in approximately 5% of the events, and approximately 7% involved the release of more than two substances (Table 2). Fixed-facility events were more likely than transportation events to have two or more substances released in an event (13.4% vs. 5.9%).

The number of events by month ranged from 613 (6.7%) in February to 915 (10.1%) in July, with the largest proportions occurring from June through August. The proportion of events ranged from 15.9% to 17.2% during weekdays, and from 8.7% to 9.5% during weekend days. Of all 8,908 (97.8%) events for which time of day or time category was reported, 34.9% occurred from 6:00 AM to 11:59 AM, 31.8% from 12:00 PM to 5:59 PM, 18.6% from 6:00 PM to

11:59 PM, and the remainder during the early hours of the day.

## *Industries*

The largest proportions of HSEES events were associated with the manufacturing (3,880 [42.6%]) and transportation (2,167 [23.8%]) industries (Table 3). Within manufacturing, chemical and allied products manufacturing (1,996 [51.4%]) and petroleum and coal manufacturing (1,251 [32.2%]) accounted for most of the events. The largest number of events with victims occurred from non-industrial illegal activity (illicit drug related) (125 [17.4%]). The total number of victims was greatest in the manufacturing industry (365 [19.9%]) followed by the number of victims in professional services (279 [15.2%]) and illegal activity (illicit drug related) (125 [11.7%]). The subcategory food and kindred products manufacturing accounted for 26.3% of all victims in the manufacturing industry. Although the manufacturing industry resulted in a large proportion of events with victims and a large number of victims, only 3.0% of all manufacturing

**Table 3. Industries involved in hazardous substance events, by category— Hazardous Substances Emergency Events Surveillance, 2003**

Industry category	Total events		Events with victims		Percentage events with victims	Total no. victims Number (maximum)*
	No.	%	No.	%		
Abandoned†	147	1.6	4	0.6	2.7	6 (3)
Agriculture	185	2.0	30	4.2	16.2	148 (85)
Business and repair services	64	0.7	15	2.1	23.4	22 (5)
Communication	7	<0.1	1	0.1	14.3	1 (1)
Construction	107	1.2	20	2.8	18.7	38 (11)
Entertainment	38	0.4	9	1.3	23.7	25 (9)
Finance and Real estate	31	0.3	11	1.5	35.5	57 (16)
Illegal activity (illicit drug related)	515	5.7	125	17.4	24.2	215 (11)
Illegal activity (non-illicit drug related)	48	0.5	16	2.2	33.3	54 (15)
Manufacturing	3,880	42.6	118	16.4	3.0	365 (40)
Mining	252	2.8	2	0.3	0.8	2 (1)
Personal services	255	2.8	60	8.3	23.5	148 (26)
Private vehicle or property	50	0.5	9	1.3	18.0	17 (5)
Professional services	222	2.4	77	10.7	34.7	279 (44)
Public administration	88	1.0	22	3.1	25.0	52 (20)
Retail trade	143	1.6	42	5.8	29.4	103 (18)
Transportation	2,167	23.8	94	13.1	4.3	176 (15)
Utilities	533	5.9	36	5.0	6.8	69 (6)
Wholesale trade	316	3.5	20	2.8	6.3	44 (10)
Unspecified and unknown	57	0.6	9	1.3	15.8	14 (3)
<b>Total‡</b>	<b>9,105</b>	<b>99.9</b>	<b>720</b>	<b>100.3</b>	<b>7.9</b>	<b>1,835</b>

\* Minimum number of victims per event =1.

† Includes chemical dumped on highway or other property and currently nonoperating former businesses.

‡ Percentages do not total 100% because of rounding.

events resulted in victims. Conversely, 35.5% of all events in the finance and real estate industry resulted in victims, but this industry represents a small proportion (1.5%) of events with victims.

## Substances

A total of 12,018 substances were released in all events, of which 1,125 (9.4%) substances were reported as threatened to be released. The substances most frequently released were ammonia, sulfur dioxide, carbon monoxide, and nitrogen oxide (NOX)

(Appendix A). Substances were grouped into 16 categories. The substance categories most commonly released in fixed-facility events were other inorganic substances (2,407 [25.5%]), volatile organic compounds (1,666 [17.7%]), and mixtures (1465 [15.5%]) (Table 4). In transportation-related events, the most common substance categories released were volatile organic compounds (493 [19.5%]), acids (362 [14.3%]), and other (250 [9.9%]).

Two types of releases for each substance (e.g., spill and air) could be reported. Only one type of release

**Table 4. Number of substances involved, by substance category and type of event—Hazardous Substances Emergency Events Surveillance, 2003**

Substance category	Type of event				All events	
	Fixed facility		Transportation		No. substances	%
	No. substances	%	No. substances	%		
Acids	660	7.0	362	14.3	1,022	8.5
Ammonia	519	5.5	72	2.8	591	4.9
Bases	265	2.8	231	9.1	496	4.1
Chlorine	202	2.1	33	1.3	235	2.0
Formulations	14	0.1	3	0.1	17	0.1
Hetero-organics	83	0.9	44	1.7	127	1.1
Hydrocarbons	108	1.1	53	2.1	161	1.3
Mixture*	1,465	15.5	72	2.8	1,537	12.8
Other†	593	6.3	250	9.9	843	7.0
Other inorganic substances‡	2,407	25.5	230	9.1	2,637	22.0
Oxy-organics	710	7.5	171	6.8	881	7.4
Paints and dyes	168	1.8	170	6.7	338	2.8
Pesticides	353	3.7	242	9.6	595	5.0
Polychlorinated biphenyls	80	0.8	3	0.1	83	0.7
Polymers	142	1.5	103	4.1	245	2.0
Volatile organic compounds	1,666	17.7	493	19.5	2,159	18.0
<b>Total<sup>§</sup></b>	<b>9,435</b>	<b>99.8</b>	<b>2,532</b>	<b>100.0</b>	<b>11,967</b>	<b>99.7</b>

\* Substances from different categories that were mixed or formed from a reaction before the event.

† Not belonging to one of the existing categories.

‡ All inorganic substances except for acids, bases, ammonia, and chlorine.

§ Of a total of 12,018 substances, 51 were excluded because they were not assigned a substance category: 36 occurred in fixed facilities and 15 during transportation. Percentages do not total 100% because of rounding.

was associated with the following: air release (5,527 [48.3%]), spill (4,352 [38.0%]), threatened release (1,133 [9.9%]), fire (357 [3.1%]), explosion (60 [0.5%]), and radiation (11 [0.1%]). Of events with two types of releases, the following combinations were reported: spill and air releases (370 [64.6%]), spill and fire (76 [13.3%]), fire and explosion (70 [12.2%]), spill and explosion (47 [8.2%]), and the remaining 10 (1.7%) involved other combinations of release types. The release type was missing for 5 substances.

## *Victims*

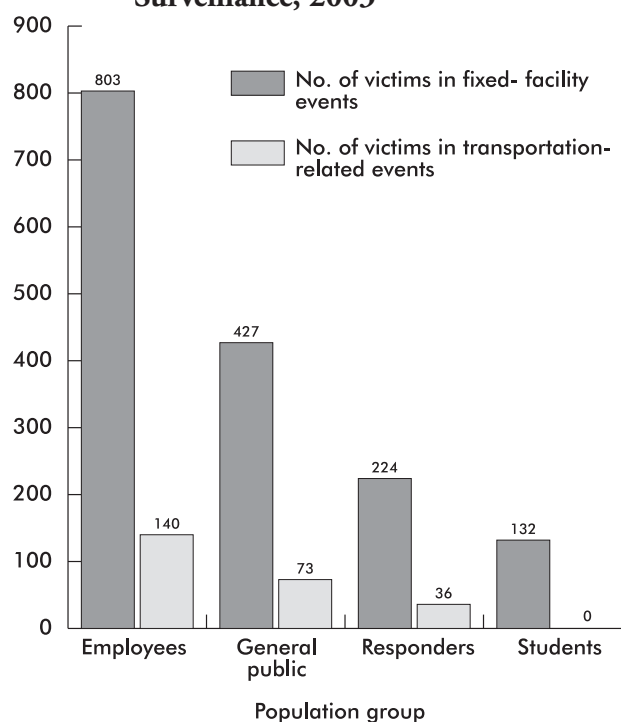
A total of 1,835 victims were involved in 720 events (7.9% of all events) (Table 5). Of the 720 events with victims, 456 (63.3%) events involved only one victim, and 123 (17.1%) involved two victims. Of all victims, 1,586 (86.4%) were injured in fixed-facility events. Fixed-facility events were more likely to have three or more victims per event (21.1%) than were transportation-related events (13.6%). Additionally, 347 persons in 115 events (1.3% of all events) were observed at a hospital or medical facility but did not

**Table 5. Number of victims per event, by type of event—Hazardous Substances Emergency Events Surveillance, 2003**

No. victims	Type of event						All events		
	Fixed facility			Transportation			No. events	%	Total victims
	No. events	%	Total victims	No. events	%	Total victims			
1	364	63.5	364	92	62.6	92	456	63.3	456
2	88	15.4	176	35	23.8	70	123	17.1	246
3	40	7.0	120	8	5.4	24	48	6.7	144
4	16	2.8	64	5	3.4	20	21	2.9	84
5	15	2.6	75	5	3.4	25	20	2.8	100
>6	50	8.7	787	2	1.4	18	52	7.2	805
<b>Total</b>	<b>573</b>	<b>100.0</b>	<b>1,586</b>	<b>147</b>	<b>100.0</b>	<b>249</b>	<b>720</b>	<b>100.0</b>	<b>1,835</b>

have symptoms resulting from the event and, therefore, were not counted as victims.

To represent the magnitude of the effects of substances involved in injuries, the number of events in a specific substance category was compared with the number of events in the same category that resulted in victims.

**Figure 4. Number of victims, by population group and type of event—Hazardous Substances Emergency Events Surveillance, 2003**

In events that involved one or more substances from the same substance category, substances were counted once in that category. In events that involved two or more substances from different categories, substances were counted once in the multiple substance category. Substances released most often were not necessarily the most likely to result in victims (Table 6). For example, events categorized as other inorganic substances constituted 16.9% of all events; however, only 2.9% of these events resulted in injuries. Conversely, events involving chlorine and ammonia exclusively accounted for 2.3% and 5.1% of all events respectively, but 23.4% of the chlorine events and 15.9% of ammonia events resulted in injuries.

Employees (943 [51.4%]) constituted the largest proportion of the population groups injured, followed by members of the general public (500 [27.2%]) (Figure 4). In fixed-facility events, 224 emergency response personnel were injured. Of those, 112 (50.0%) were police officers, 35 (15.6%) were volunteer firefighters, and 28 (12.6%) were career firefighters (Figure 5). Thirty-six responders were injured in transportation-related events. Of these, most (34 [94.4%]) were police

**Table 6. Frequency of substance categories in all events and events with victims—Hazardous Substances Emergency Events Surveillance System, 2003\***

Substance category	All events		Events with victims		
	No.	%	No.	Percentage of all releases with victims	Percentage of events with victims in substance category
Acids	665	7.3	95	13.3	14.3
Ammonia	466	5.1	74	10.4	15.9
Bases	369	4.1	28	3.9	7.6
Chlorine	205	2.3	48	6.7	23.4
Formulations	16	0.2	1	0.1	6.3
Hetero-organics	80	0.9	4	0.6	5.0
Hydrocarbons	94	1.0	6	0.8	6.4
Mixture <sup>†</sup>	1,459	16.1	47	6.6	3.2
Multiple substance category	842	9.3	117	16.4	13.9
Other <sup>‡</sup>	569	6.3	82	11.5	14.4
Other inorganic substances <sup>§</sup>	1,533	16.9	44	6.2	2.9
Oxy-organics	550	6.1	59	8.3	10.7
Paints and dyes	289	3.2	13	1.8	4.5
Pesticides	407	4.5	31	4.3	7.6
Polychlorinated biphenyls	79	0.9	0	0.0	0.0
Polymers	193	2.1	11	1.5	5.7
Volatile organic compounds	1,256	13.8	54	7.6	4.3
<b>Total<sup>¶</sup></b>	<b>9,072</b>	<b>100.1</b>	<b>714</b>	<b>100.0</b>	<b>7.9</b>

\* Substances in events that involved multiple substances were counted only once in a substance category when all the substances were associated with the same category. If events involved multiple substances from different substance categories, they were counted only once in the multiple substance category.

<sup>†</sup> Substances from different categories that were mixed or formed from a reaction before the event.

<sup>‡</sup> Not classified.

<sup>§</sup> All inorganic substances except for acids, bases, ammonia, and chlorine.

<sup>¶</sup> Percentages do not total 100% because of rounding. Of a total of 9,105 events, 33 were excluded because they were not assigned a substance category. Of the 33 events, 32 involved one substance each, and 1 event involved two substances that could not be categorized. Six of the excluded events had victims.

officers, 1 (2.8%) was a firefighter of unknown type, and 1 (2.8%) was a responder of unknown type. Police officers were injured more frequently in transportation-related events (94.4%) than in fixed facility-events (50.0%).

Victims were reported to sustain a total of 2,964 injuries or symptoms (Table 7). Some victims had more than one injury or symptom. Of all reported injuries/symptoms, the most common injuries/symptoms in fixed-facility events were respiratory

irritation (825 [31.1%]), headaches (381 [14.3%]), and gastrointestinal problems (354 [13.3%]). In transportation-related events, trauma (97 [31.5%]), respiratory irritation (78 [25.3%]), and eye irritation (28, 9.1%) were reported most frequently. Most (93.5%) of the trauma injuries in transportation-related events were not substance-related; these injuries resulted from a chain of events, such as a motor vehicle accident leading to the release of a hazardous substance, and not from exposure to the substance itself.



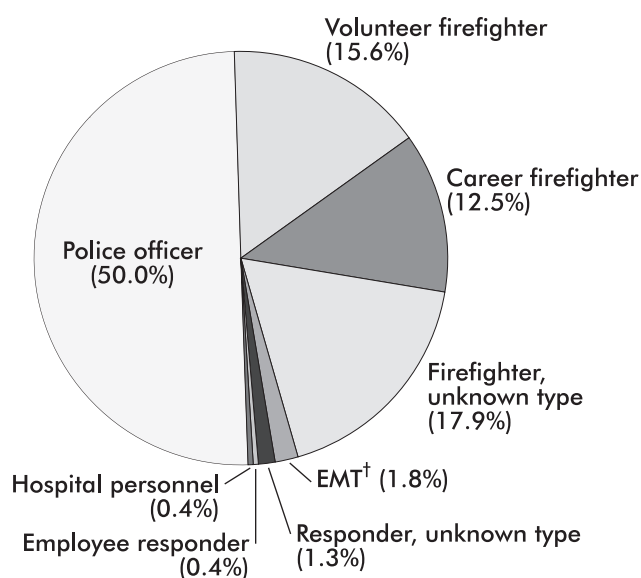
**Table 7. Frequencies of injuries/symptoms, by type of event\*—Hazardous Substances Emergency Events Surveillance, 2003**

Injury/symptom	Fixed facility		Transportation		All events	
	No. injuries	%	No. injuries	%	Total no.	%
Chemical burns	91	3.4	20	6.5	111	3.7
Dizziness/central nervous system symptoms	302	11.4	11	3.6	313	10.6
Eye irritation	268	10.1	28	9.1	296	10.0
Gastrointestinal system problems	354	13.3	15	4.9	369	12.4
Headache	381	14.3	27	8.8	408	13.8
Heart problems	10	0.4	1	0.3	11	0.4
Heat stress	11	0.4	0	0.0	11	0.4
Other	28	1.1	2	0.6	30	1.0
Respiratory irritation	825	31.1	78	25.3	903	30.5
Shortness of breath	47	1.8	7	2.3	54	1.8
Skin irritation	162	6.1	13	4.2	175	5.9
Thermal burns	76	2.9	9	2.9	85	2.9
Trauma <sup>†</sup>	101	3.8	97	31.5	198	6.7
<b>Total<sup>‡</sup></b>	<b>2,656</b>	<b>100.1</b>	<b>308</b>	<b>100.0</b>	<b>2,964</b>	<b>100.1</b>

\* The number of injuries is greater than the number of victims (1,835) because a victim could have had more than one injury.

<sup>†</sup> Of the 198 trauma injuries, 39 were chemical-related, 134 were not chemical-related, 7 were both chemical and non-chemical related, and the type of trauma was missing for 13 injuries.

<sup>‡</sup> The injuries of one victim were not reported. Percentages do not total 100% because of rounding.

**Figure 5. Distribution of responders injured in fixed-facility events,\* by type of responder—Hazardous Substances Emergency Events Surveillance, 2003**

\* A total of 224 responders were injured in fixed-facility events.

<sup>†</sup> Emergency medical technician.

The median age of the 745 (40.6%) victims for whom exact age was reported was 35 years (range: 1–96 years). For the 1,359 (74.1%) injured persons for whom an age category was reported, 11 (0.8%) were < 5 years of age, 131 (9.6%) were 5–14 years of age, 62 (4.6%) were 15–19 years of age, 861 (63.4%) were 20–44 years of age, 274 (20.2%) were 45–64 years of age, and 20 (1.5%) were ≥65 years of age. Of the 476 injured persons for whom age was not reported, 322 (67.6%) were presumably adults (because their population group was reported as responders or employees), and 154 (32.4%) could have been adults or children (because their population group was reported as members of the general public).

Sex was known for 1,447 (78.9%) of the victims; of these, 981 (67.8%) were males. Of all employees and responders for whom sex was reported, 75.4% were males.

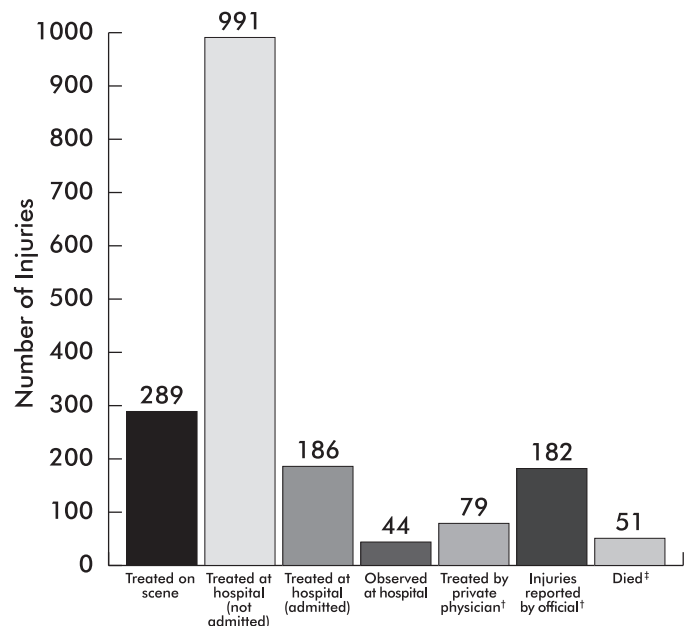
Of the 1,835 victims, 991 (54.4%) were treated at a hospital without admission and 289 (15.9%) were treated at the scene. Fifty-one (2.8%) deaths were reported (Figure 6). Severity was unknown for 13 (0.7%) victims.

The status of personal protective equipment (PPE) use was reported for 822 (87.2%) employee-victims and for 234 (90.0%) responder-victims. Most of the employee-victims (91.0%) and 31.6% of the responder-victims had not worn any form of PPE. Employee-victims who wore PPE most often used eye protection (23 [31.1%]) and gloves (17 [23.0%]). Among injured emergency responders who wore PPE, 60 (25.6%) wore firefighter turnout gear with respiratory protection, 60 (25.6%) wore gloves, and 21 (9.0%) wore firefighter turnout gear without respiratory protection.\*

Only one event involved more than 50 injured people. Eighty-five employees were injured due to carbon monoxide exposure from three forklifts that were operating at an onion processing plant. The release was caused by human error. All of the victims reported headaches and gastrointestinal system problems, and 28 (32.9%) also reported dizziness/central nervous system symptoms and respiratory irritation. Seventy-two employee-victims were treated at a hospital and released, and 13 were admitted to a hospital. Ninety-two people were evacuated from the building for 20 hours, and access to the building was restricted. A fire department and certified HazMat team responded to this event.

\* Firefighter turnout gear is protective clothing usually worn by firefighters during structural firefighting operations and is similar to Level "D" protection. The Occupational Safety and Health Administration defines Level "D" protection as coveralls, boots/shoes (chemical-resistant leather, steel toe and shank), safety glasses or chemical splash goggles, and hard hats. Level "D" provides limited protection against chemical hazards.

**Figure 6. Injury disposition—Hazardous Substances Emergency Events Surveillance, 2003\***



\* Injury disposition was missing for 13 victims.

<sup>†</sup> Occurred within 24 hours.

<sup>‡</sup> Of all 51 deaths, 44 people died at the scene or on arrival at the hospital, and 7 died after arrival at the hospital.

## *Nearby populations*

The proximity of the event location in relation to selected populations was determined using geographic information systems (GIS) or health department records. Residences were within ¼ mile of 6,155 (68.6%) events, schools within ¼ mile of 1,007 (11.3%) events, hospitals within ¼ mile of 119 (1.3%) events, nursing homes within ¼ mile of 344 (3.9%) events, licensed daycares within ¼ mile of 1,053 (11.8%) events, industries or other businesses within ¼ mile of 8,138 (91.1%) events, and recreational areas within ¼ mile of 910 (10.2%) events. Information for proximity of the event location in relation to selected populations was missing for 131–195 events.

The number of events at which persons were at risk of exposure was determined primarily using GIS. There were 6,082 (70.0%) events with persons living within  $\frac{1}{4}$  mile of the event; 7,050 (81.2%) events with persons living within  $\frac{1}{2}$  mile; and 7,866 (90.5%) events with persons living within 1 mile. Information on the number of people living within  $\frac{1}{4}$ ,  $\frac{1}{2}$ , and 1 mile of the event was missing for 421, 420, and 411 events, respectively.

## *Evacuations*

Evacuations were ordered in 531 (5.9%) of 9,009 events where evacuation status was reported. Of these evacuations, 72.1% were of buildings or affected parts of buildings; 14.7% were of defined circular areas surrounding the event locations; 5.5% were of areas downwind or downstream of the event; and the remainder were of circular and downwind or downstream areas, of no criteria, or not known. The number of people evacuated was known for 461 (86.8%) events and ranged from 1 to 3,300 people, with a median of 15 people. However, 3 ordered evacuations were reported as having no evacuees. The median length of evacuation was 2 hours (range: 12 minutes to 7 days). Evacuation length was missing for 31 (5.8%) events. Of all 9,105 events, 1,827 (20.0%) had access to the area restricted. Fifty-eight events had in-place sheltering ordered by an official.

## *Decontamination*

Of the 1,566 (85.3%) victims for whom decontamination status was known, 1,316 (84.0%) were not decontaminated, 128 (8.2%) were decontaminated



at the scene, 85 (5.4%) were decontaminated at a medical facility, and 37 (2.4%) were decontaminated at both the scene and a medical facility.

In events where uninjured persons were decontaminated, the median number of uninjured decontaminated individuals was 4 persons per event (range: 1–56 persons). Decontamination at a medical facility was done for 8 uninjured employees, 27 uninjured responders, 73 uninjured members of the general public, and 28 uninjured students. Decontamination at the scene was done for 157 uninjured employees, 815 uninjured responders, 77 uninjured members of the general public, and 4 uninjured students.

## *Response*

Of the 7,929 (87.1%) events with information on who responded to the event, 19.8% reported 2 or more categories of personnel who responded, 9.9% reported 3 or more categories, and 5.7% reported 4

**Table 8. Distribution of personnel who responded to the event—Hazardous Substances Emergency Events Surveillance, 2003**

Responder category	No.	%*
Certified HazMat team	908	11.5
Department of works/ utilities/ transportation	75	0.9
Emergency medical technicians	464	5.9
Environmental agency	599	7.6
EPA <sup>†</sup> response team	19	0.2
Fire department	1,405	17.7
Health department/health agency	141	1.8
Hospital personnel	20	0.3
Law enforcement agency	1,272	16.0
Other	135	1.7
Response team of company where release occurred	5,940	74.9
Specialized multi-agency team	73	0.9
State, county, or local emergency managers/coordinators/planning committees	92	1.2

\* Percentages total greater than 100% because multiple responder categories could be reported per event.

<sup>†</sup> Environmental Protection Agency.

or more categories. The response team of the company where the release occurred (74.9%) responded most frequently to events, followed by fire departments (17.7%), law enforcement agencies (16.0%), and certified HazMat teams (11.5%) (Table 8).

## Summary of Results, 1993–2003

During 1993–2003, the largest proportion of events occurred in fixed facilities (Table 9). However, the number of reported transportation-related events has increased in recent years. The increase is partially due to the 1999 addition of the U.S. Department of Transportation's Hazardous Materials Information System as a primary notification source for transportation events. In addition, the total number

of events continued to increase. The increase in the number of events may have been due, at least in part, to the expansion of reporting sources.

The number of substances released has also increased. The percentage of events with victims was highest in 1993 (12.1%) and lowest in 1997 (6.7%). With the exception of 2000, the average percentage of events with victims during 1999–2003 was 8.0%, which is similar to the percentage of events with victims during the total time period 1993–2003.

Respiratory irritation has consistently been the most frequently reported injury.

Employees continue to be the most commonly reported victims of acute chemical releases. However, members of the general public constitute a large proportion of

**Table 9. Cumulative data by year—Hazardous Substances Emergency Events Surveillance, 1993-2003\***

Year	No. participating states	Type of event			No. substances released	No. victims	No. deaths	Events with victims	
		Fixed facility	Transportation	Total				No.	%†
1993	11	3,199	634	3,833	4,361	2,230	16	464	12.1
1994	12	3,321	912	4,233	5,072	2,181	21	414	9.8
1995	14	4,273	1,037	5,310	6,027	1,688	14	402	7.6
1996	14	4,327	1,159	5,486	5,861	1,622	33	390	7.1
1997	13	4,385	1,128	5,513	6,089	1,896	28	372	6.7
1998	13	4,729	1,252	5,981	6,486	1,533	36	405	6.8
1999	13	4,634	1,626	6,260	6,974	1,912	30	504	8.0
2000	15	5,499	2,049	7,548	8,342	2,513	44	752	10.0
2001	16	6,736	2,242	8,978	11,764	2,168	22	710	7.9
2002	15	6,493	2,520	9,013‡	11,009	2,150	47	739	8.2
2003	15	6,782	2,323	9,105	12,018	1,835	51	720	7.9
<b>Total</b>		<b>54,378</b>	<b>16,882</b>	<b>71,260‡</b>	<b>84,003</b>	<b>21,728</b>	<b>342</b>	<b>5872</b>	<b>8.2</b>

\* 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.

‡ The total number of events does not include one event occurring in 2002 because the type of event was not known.

the victims as well (Figure 7). The number of injured responders has increased recently, and this increase likely results from police officers who are injured when responding to events involving the manufacture of methamphetamine.

The number of deaths associated with acute hazardous substances events has increased in recent years. Many of these deaths were attributed to nonchemical circumstances surrounding the events (e.g., a crash resulting from high-speed travel of a truck pulling an ammonia tank).

## Public Use Dataset

ATSDR has created a public-use HSEES dataset. This dataset will enable public health professionals and other interested parties to perform their own analyses. A data dictionary provides users with detailed instructions for working with the dataset. This dataset is available for download from the ATSDR Web site. The data contained in the file are related to events that occurred in the 17 participating HSEES states from 1996 to 2001 (Table 10). The public use dataset contains 39,764 records and 71 variables. More information about the public use dataset can be accessed at <http://www.atsdr.cdc.gov/HS/HSEES>.

# Prevention Activities

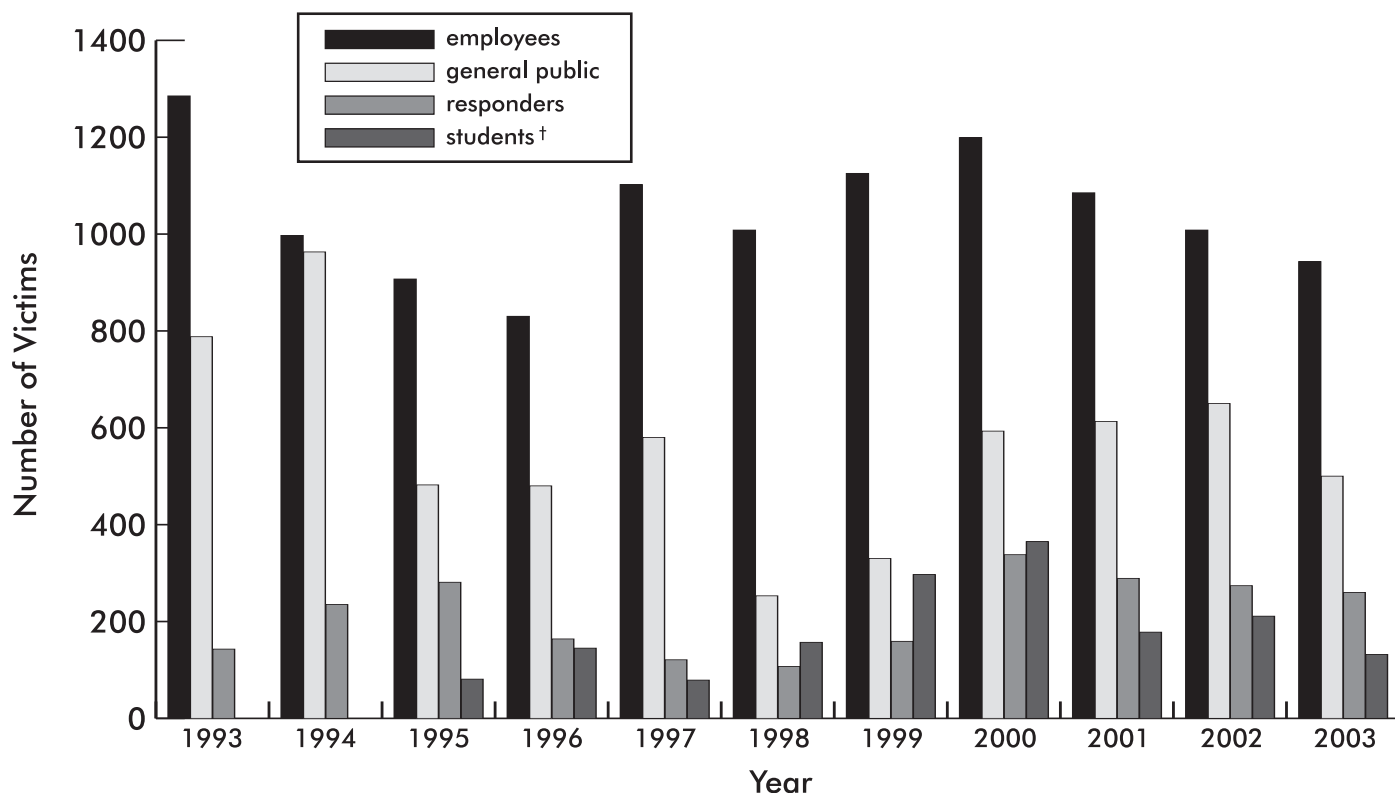
During 2003, the state HSEES coordinators performed various prevention activities. These activities included:

- Distribution of a comprehensive report on anhydrous ammonia releases to more accurately determine the precise cause of such releases. The report was based on a survey distributed in 2001–2002 to previously responsible parties. The goal of the report was to increase awareness of the stringent safety and security measures that must be taken to prevent these types of releases and to reinforce the need for education of employees, responders, and the general public about the hazards of anhydrous ammonia.
- Distribution of a brochure on HSEES data related to carbon monoxide events to local emergency planning committees (LEPCs), emergency responders, and local health departments. The goal of the brochure was to prevent injury and/or death from exposure to carbon monoxide related to improper use of heating sources such as charcoal, propane, and other heat sources during extended power outages.
- Continued collaboration in a partnership to reduce mercury in schools by developing (a) informational brochures, (b) an inventory tool to assist school personnel in identifying possible sources of mercury and mercury-containing items, and (c) guidance for cleaning up small mercury spills. The materials were distributed to schools, the agencies involved

in the partnership, and other interested parties. The goal of this outreach effort is to prevent mercury contamination in schools and on school grounds.

- Distribution of quarterly reports and county-specific HSEES data to identify trends in the numbers of events, number of events resulting in victims, and the number of victims. Information was made available in print and electronic media to county emergency management personnel, LEPCs, county and local fire and police departments, area hospitals, local public health agencies, and other interested parties.
- Collaboration with a hospital association to produce a hospital needs assessment of facilities with emergency departments. The needs assessment ascertained the hospital's ability to treat patients presenting with symptoms of chemical exposure with regard to equipment, decontamination and isolation areas, resources, and guidelines for treatment. The results of the needs assessment indicated that many hospitals are not fully equipped to handle patients exposed to hazardous substances. ATSDR's Managing Hazardous Materials Incidents guidelines were given to the hospitals to assist in preparing for patients who present with symptoms of chemical exposure. Additionally, the hospital association is developing recommendations for treating patients who have been exposed to hazardous substances.

**Figure 7. Number of victims, by category and year—Hazardous Substances Emergency Events Surveillance, 1993-2003\***



\* The population category was unknown or missing for 72 victims.

† The student category was not available before 1995. Before 1995, students were included in the general public category.

## Uses of HSEES Data

During 2003, ATSDR continued to respond to requests for HSEES information from local, state, and federal agencies and organizations. HSEES data have been analyzed for articles published in peer-reviewed journals (Appendix B) and for presentations in international, national, and state conferences. In 2003, ATSDR presented HSEES data at several conferences, including the Medical and Biological Aspects of Chemical Weapons Stockpile Demilitarization symposium in Volgograd, Russia; the American Public Health Association (APHA) annual meeting in San Francisco; the American Occupational Health

Conference (AOHC) in Atlanta; the ATSDR Partners Meeting in Atlanta; the Sixth National Environmental Public Health Conference in Atlanta, GA; and a Comprehensive HazMat Emergency Response Capability Assessment Program (CHERCap) meeting in Boston. The ATSDR HSEES Internet Web site page is available at <http://www.atsdr.cdc.gov/HS/HSEES/>. At this site, annual reports and other information can be downloaded. Internet links to other relevant Web sites and a public use dataset are also available.

Current HSEES-related activities include collaborations with other agencies and organizations that are involved with response to chemical terrorism, emergency

**Table 10. Time period each state participated in Hazardous Substances Emergency Events Surveillance, 1993–2003**

State	Years Participated
Alabama	1993–2003
Colorado	1993–2003
Iowa	1993–2003
Louisiana	2001–2003
Minnesota	1995–2003
Mississippi	1995–2003
Missouri	1994–2003
New Hampshire	1993–1996
New Jersey	2000–2003
New York	1993–2003
North Carolina	1993–2003
Oregon	1993–2003
Rhode Island	1993–2003
Texas	1993–2003
Utah	2000–2003
Washington	1993–2003
Wisconsin	1993–2003

response, hazardous substances, and public health (e.g., the U.S. Environmental Protection Agency). HSEES is also collaborating with international partners to pilot test the system in India and Poland. In India, HSEES is partnering with the National Institute of Occupational Health (NIOH) and in Poland, HSEES is partnering with the Nofer Institute for Occupational Health.

An important contribution of HSEES data is that it helps build capacity within each participating state health department to target prevention activities related to acute spills and their associated public health consequences. In 2003, target audiences included school personnel, first responders, industry, local health departments, occupational health and safety professionals, health care providers, and the general public. Activities are conducted by state HSEES coordinators, often in collaboration with other local and state agencies. The activities are evaluated to measure their effectiveness.

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# Appendices

## Appendix A.

*The 102 most frequent substances involved in events, Hazardous Substances Emergency Events Surveillance, 2003.*

	Substance	No. Events
1.	Ammonia	569
2.	Sulfur dioxide	537
3.	Carbon monoxide	452
4.	Nitrogen oxide (NOX)	365
5.	Hydrochloric acid	342
6.	Sodium hydroxide	250
7.	Sulfuric acid	238
8.	Volatile organic compounds NOS*	229
9.	Mercury	199
10.	Nitric oxide	196
11.	Methamphetamine chemicals NOS*	169
12.	Paint NOS*	159
13.	Oxides of nitrogen NOS*	154
14.	Chlorine	130
15.	Acetone	124
16.	Benzene	118
17.	Ethylene glycol	112
18.	Solvent NOS*	101
19.	Hydrogen sulfide	98
20.	Methyl alcohol	91
21.	Ethyl alcohol	85
22.	Polychlorinated biphenyls	81
23.	Resin NOS*	79
24.	Corrosive NOS*	78
25.	Toluene	78
26.	Lithium	77
27.	Acid NOS*	73
28.	Flammable liquid NOS*	72
29.	Adhesive NOS*	70
30.	Phosphoric acid	70
31.	Nitrogen dioxide	69
32.	Mix: carbon monoxide/hydrogen sulfide/nitrogen oxide (NOX)/sulfur dioxide	68
33.	Phosphorus	67
34.	Xylene	67
35.	Hydrogen peroxide	65
36.	Iodine	65
37.	Ethylene	63
38.	Potassium hydroxide	63
39.	Paint or coating NOS*	61
40.	Mix: carbon monoxide/hydrogen sulfide/oxides of nitrogen NOS*/sulfur dioxide	61
41.	Isopropyl alcohol	59
42.	Nitrous oxide	58
43.	Sodium hypochlorite	57
44.	Vinyl chloride	57

45.	Butadiene	54
46.	Fluorocarbon	50
47.	Ethyl ether	45
48.	Freon	45
49.	Alcohol NOS*	41
50.	Pesticide NOS*	39
51.	Mix: carbon monoxide/oxides of nitrogen NOS*/sulfur dioxide/volatile organic compounds NOS*	39
52.	Propane	38
53.	Mix: carbon monoxide/nitrogen oxide (NOX)/propylene	38
54.	Asbestos	36
55.	Diesel fuel	36
56.	Hydraulic oil	32
57.	Hydraulic fluid	31
58.	Propylene	31
59.	Ether NOS*	30
60.	Methyl ethyl ketone	30
61.	Antifreeze	29
62.	Battery acid	29
63.	Coleman fuel	29
64.	Ink NOS*	29
65.	Nitric acid	28
66.	Ethylene oxide	27
67.	Methylene chloride	27
68.	Fertilizer NOS*	26
69.	Mix: acetylene/carbon monoxide/hydrogen sulfide/of nitrogen NOS*	26
70.	Mix: carbon monoxide/nitrogen oxide (NOX)	26
71.	Mix: carbon monoxide/oxides of nitrogen NOS*/volatile organic compounds NOS*	25
72.	Acetic acid	24
73.	Ammonium nitrate	24
74.	Mix: carbon monoxide/oxides of nitrogen NOS*	24
75.	Ethylene dichloride	23
76.	Heptane	23
77.	Mix: carbon monoxide/nitrogen oxide (NOX)/volatile organic compounds NOS*	22
78.	Mix: carbon monoxide/nitrogen oxide (NOX)/sulfur dioxide/volatile organic compounds NOS*	22
79.	Chloroform	21
80.	Calcium oxide	20
81.	EPA f039: multi-code treatment, storage, or disposal leachate	20
82.	Latex paint	20
83.	Paint thinner NOS*	20
84.	Mix: hydrogen sulfide/sulfur dioxide	20
85.	Formaldehyde	19
86.	Naphtha	19
87.	Sodium hydroxide NOS*	19
88.	Mix: carbon monoxide/ethylene/nitrogen oxide (NOX)	19
89.	3M light water AFFF	18
90.	Ammonium hydroxide	18
91.	Cleaning agent NOS*	18
92.	Ephedrine	18
93.	Bleach	17
94.	Corrosive liquid acidic inorganic NOS*	17
95.	Nitrogen fertilizer	17
96.	Sodium chloride	17
97.	Sulfuric acid NOS*	17
98.	Base NOS*	16
99.	Caustic NOS*	16
100.	Chlorpyrifos	16
101.	Coal tar creosote	16
102.	Tetrachloroethylene	16

\*NOS = not otherwise specified.

# Appendix B.

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