



# **ANNUAL REPORT 2006**

U.S. DEPARTMENT OF HEALTH AND  
HUMAN SERVICES  
Agency for Toxic Substances and Disease Registry

Division of Health Studies  
Surveillance and Registries Branch  
Atlanta, Georgia

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 U.S 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 health studies, registries, or other health-related activities supported by ATSDR in accordance with its legislative mandate.

Comments regarding this report are welcome. Please send your comments to the following address:

Agency for Toxic Substances and Disease Registry  
Attn: Director, Division of Health Studies (F-57)  
4770 Buford Highway, NE  
Atlanta, Georgia 30341

**Centers for Disease Control and Prevention**

Richard Besser, MD, Acting Director

**Agency for Toxic Substances and Disease Registry**

Howard Frumkin, MD, DrPH, Assistant Administrator

**Division of Health Studies**

G. David Williamson, PhD, Director

Caroline McDonald, Deputy Director

Anne Sowell, PhD, Assistant Director for Science

**Surveillance and Registries Branch**

Maureen Orr, MS, Acting Branch Chief

**Hazardous Substances Emergency Events Surveillance Staff**

Norys Guerra, MD, MPH

Kevin Horton, MSPH

Natalia Melnikova, MD, PhD

Maureen Orr, MS

Perri Zeitz Ruckart, MPH

Casetta R. Simmons

Wendy Wattigney, MStat

Jennifer Wu, MStat

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The findings and conclusions in this report are those of the authors and do not necessarily represent the views of the Agency for Toxic Substances and Disease Registry.

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# *Executive Summary*

## **Overview.**

The Hazardous Substances Emergency Events Surveillance (HSEES) system, maintained by the Agency for Toxic Substances and Disease Registry (ATSDR), utilizes state health departments to actively collect information describing the public health consequences of acute hazardous substances incidents. Data collected are used for preparedness, prevention, and response. This report summarizes the characteristics of the 7,268 events reported in 2006 and the major activities performed by the state programs.

## **Substances**

- There were 9,462 released or threatened to be released. (A threatened release is an imminent release that did not occur but caused a public health action, such as an evacuation.)
- 20 substances accounted for 46.8% of all substances.
- Substances in the categories “Volatile organic substances” and “Mixtures across chemical categories” were those most often released.

## **Evacuation and Sheltering**

- Evacuations were ordered in 6.9% of incidents.
- In-place sheltering was ordered in 1.0% of incidents.

## **Victims**

- 9.4% of all reported events resulted in a total of 2,190 victims, 69 of whom died
- The most frequently reported injuries were:
  - Respiratory irritation
  - Headaches
  - Dizziness/central nervous system symptoms
- Personal protective equipment (PPE) was not worn by 757 of 1,003 employee-victims and 74 of 159 responder-victims. PPE use was unknown for 35 employee and 21 responder victims.
- Of the 2,098 victims for whom decontamination status was known, 1,773 were not decontaminated.

## **Pilot in India and Poland**

In 2006, pilot HSEES data collection was implemented in the State of Gujarat, India and in Poland.

- In India, 168 events were reported, most of which (81.0%) occurred in a fixed facilities.
- Of the 25 districts in Gujarat, India, the events occurred most frequently in Vadodra (22.0%) and Ahmedabad (19.0%).
- In Poland, 177 events were reported in 2006, of which 53.7% occurred in fixed facilities.
- Of the 16 Polish voivodships (regions), events occurred most often in Mazowieckie (18.6%) and Slaskie (16.4%).

## ***Introduction***

**Purpose** The 2006 annual report provides an overview of Hazardous Substances Emergency Events Surveillance (HSEES) activities in the participating states. It summarizes the characteristics of acute releases of hazardous substances and their associated public health consequences, and it demonstrates how the system data are translated into prevention activities to protect the public's health.

HSEES provides industry, responders, and the general public with information that can be used to help prevent chemical releases and reduce morbidity and mortality.

**Surveillance** is “*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 that is linked to public health programs*”<sup>[1]</sup>.

**Background** Since 1990, the Agency for Toxic Substances and Disease Registry (ATSDR) has maintained an active, state-based 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 due to specific reporting requirements, as in case of the HMIS, which did not record events involving intrastate carriers or fixed facilities. 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 from hazardous substances so that informed prevention activities could be undertaken.

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.

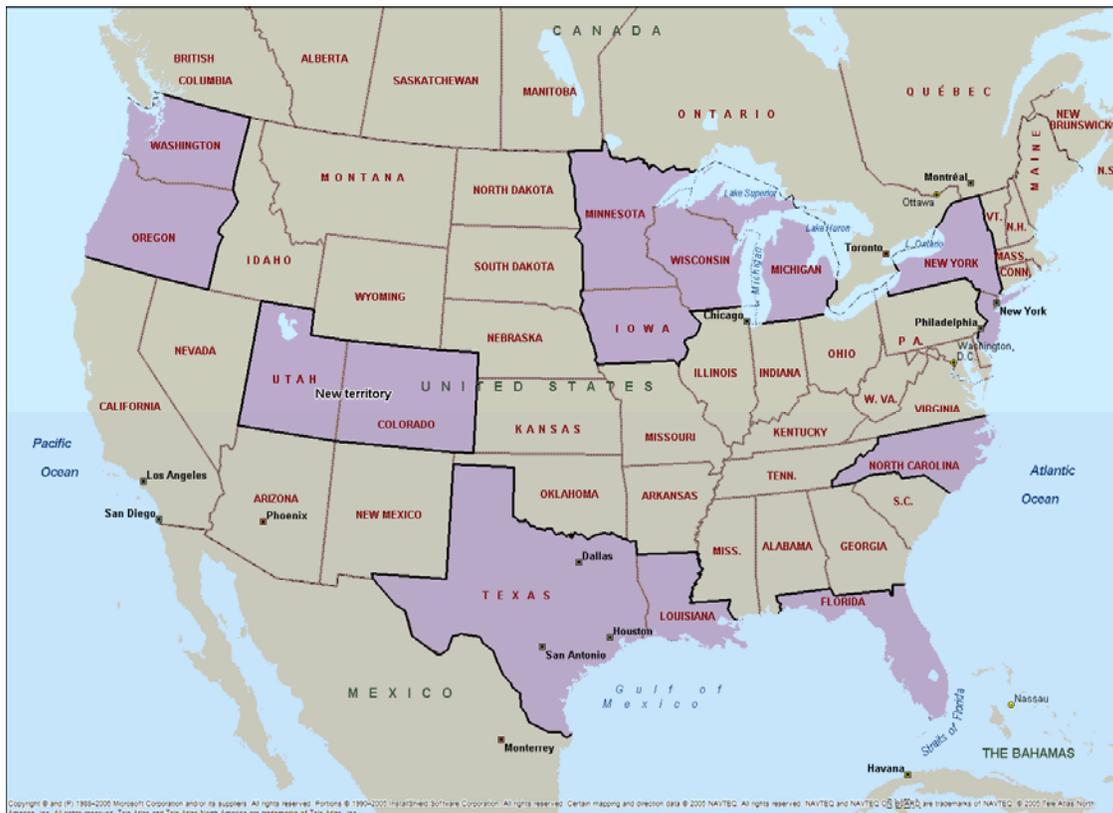
**HSEES Goals** The goals of HSEES are to:

- Describe the distribution and characteristics of acute hazardous substances releases
- Describe the morbidity and mortality among employees, responders, and the general public resulting from hazardous substances released, and
- Develop strategies that might reduce future morbidity and mortality resulting from the release of hazardous substances.

## Methods

**Description** In 2006, 14 state health departments participated in HSEES: Colorado, Florida, Iowa, Louisiana, Michigan, Minnesota, North Carolina, New Jersey, New York, Oregon, Texas, Utah, Washington, and Wisconsin (Figure 1). Information was collected about each event, including substance(s) released, victims, injuries (adverse health effects and symptoms), and evacuations. Due to staff shortages, New Jersey was unable to collect complete data for the entire year; therefore, it is excluded from this report.

**Figure 1. Participating states, Hazardous Substances Emergency Events Surveillance, 2006**



Analysis of the number of employees in key industries shows that the fourteen states currently participating in HSEES are representative of all 50 states<sup>[3]</sup>. Several industries were over-represented. For example, the oil and gas industry is over-represented in HSEES due to the large number of these facilities in Texas.

A demographic comparison was made of HSEES states and the US by income, race/ethnicity, level of education, age, and employment by industry. The five demographic factors studied show that the populations of the 14 HSEES states are generally representative of the entire United States, however Hispanics are over-represented by about 12%, and Native Americans are under represented by about 30%<sup>[3]</sup>.

**Data Sources** Information about the events came from various data sources. 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. U.S. Census Bureau data were used to estimate the number of residents in the vicinity of the events. All data were entered by use of an approved data collection form into a Web-based data entry system provided by ATSDR.

**Definitions** A *hazardous substances emergency event* is an acute, uncontrolled, or illegal release or threatened release of hazardous substances. Threatened releases are imminent releases that did not occur but led to an action (for example, evacuation) that could have affected the health of employees, emergency responders, and/or members of the general public.

Events are defined as *transportation-related* if they occur:

- (a) during surface, air, pipeline, or water transport of hazardous substances; and
- (b) before the substance is totally unloaded from a vehicle or vessel.

All other events are considered *fixed-facility* events.

HSEES defines *victims* as persons 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 may have more than one injury type or symptom.

**Reporting changes** Starting in 2006, ATSDR changed the inclusion/exclusion criteria for HSEES to improve the uniformity of reporting among states and reduce investigation of incidents that had minimal public health impact.

#### *Minimum quantity*

Before 2006, the reporting guidelines called for a report of any release in an amount that federal, state, or local law required to be cleaned up. In 2006, that requirement was changed to require a report of any release in which the amount of substance released (or that might have been released) was greater than 10 pounds/1 gallon, or any amount released of a substance on the HSEES mandatory reporting list, regardless of the amount released. This had the effect of increasing some types of incidents and decreasing others.

#### *Exclusions*

Also in 2006, reports of smoke stack emissions above permitted values of carbon monoxide (CO), sulfur oxides (SO<sub>x</sub>), and/or nitrogen oxides (NO<sub>x</sub>) were removed, since these rarely result in acute public health impact.

Events releasing only petroleum (i.e., crude oil, gasoline), have always been excluded as specified in the CERCLA authorizing legislation.

## Results

**Events** For 2006, 7,268 acute hazardous substances events met criteria for inclusion in HSEES. This is an average of roughly 560 per state. In 2005 the average was roughly 575 and in 2004 600, however changes in reporting criteria and participating states make comparisons difficult.

The number of events occurring in fixed facilities was 4,952 (68.1%), and 2,316 (31.9%) occurred during transportation. Two states, Texas and New York, reported 43.6% of all events (Table 1).

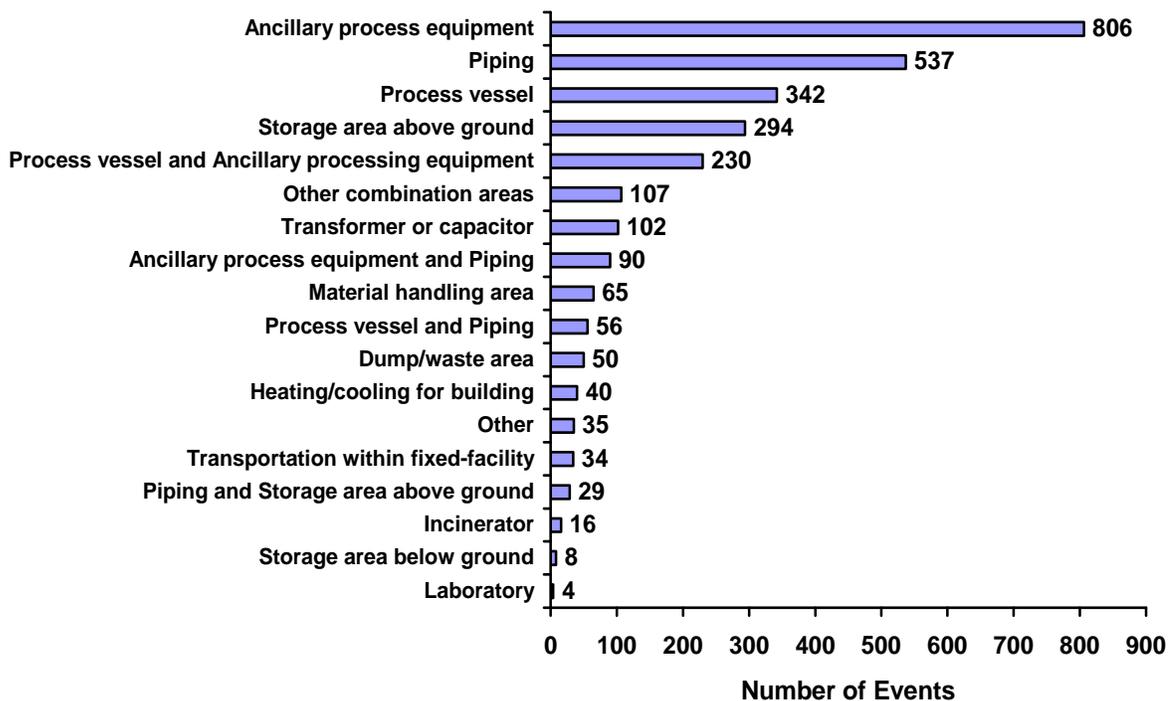
**Table 1. Number of events meeting the surveillance definition, by state and type of event, Hazardous Substances Emergency Events Surveillance, 2006**

STATE	Fixed Facility		Transportation		Total Events
	Number of Events	*%	Number of Events	*%	
Colorado	58	28.4	146	71.6	204
Florida	171	46.2	199	53.8	370
Iowa	204	74.7	69	25.3	273
Louisiana	515	78.0	145	22.0	660
Michigan	239	70.7	99	29.3	338
Minnesota	342	62.6	204	37.4	546
North Carolina	138	40.1	206	59.9	344
New York	799	72.1	309	27.9	1,108
Oregon	151	63.2	88	36.8	239
Texas	1,593	77.3	468	22.7	2,061
Utah	375	87.0	56	13.0	431
Washington	229	70.0	98	30.0	327
Wisconsin	138	37.6	229	62.4	367
Total	4,952	68.1	2,316	31.9	7,268

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

**Fixed facility events** For each fixed-facility event in the North American Industry Classification System (NAICS) *industry categories 21 Mining, 22 Utilities, 23 Construction, and 31-33 Manufacturing*, reporters could select one or two area or types of equipment involved. Of 2,875 fixed-facility events in these categories, 2,333 reported only one area and 512 reported a combination of two areas. Area was not reported for 30 events. The main areas were classified as follows: ancillary processing equipment, piping, process vessel, storage above ground, and ancillary process equipment along with a process vessel (Figure 2).

**Figure 2. Areas of fixed facilities involved in events, Hazardous Substances Emergency Events Surveillance, 2006**



**Transportation events** Of the 2,316 transportation-related events, 87.2% occurred during ground transport (e.g., truck, van, or tractor), and 8.5% involved transport by rail. Fewer events involved water (2.5%), pipeline (1.3%), air (0.5%), or multiple transportation modes (0.1%). Most ground transportation events (82.6%) involved trucks.

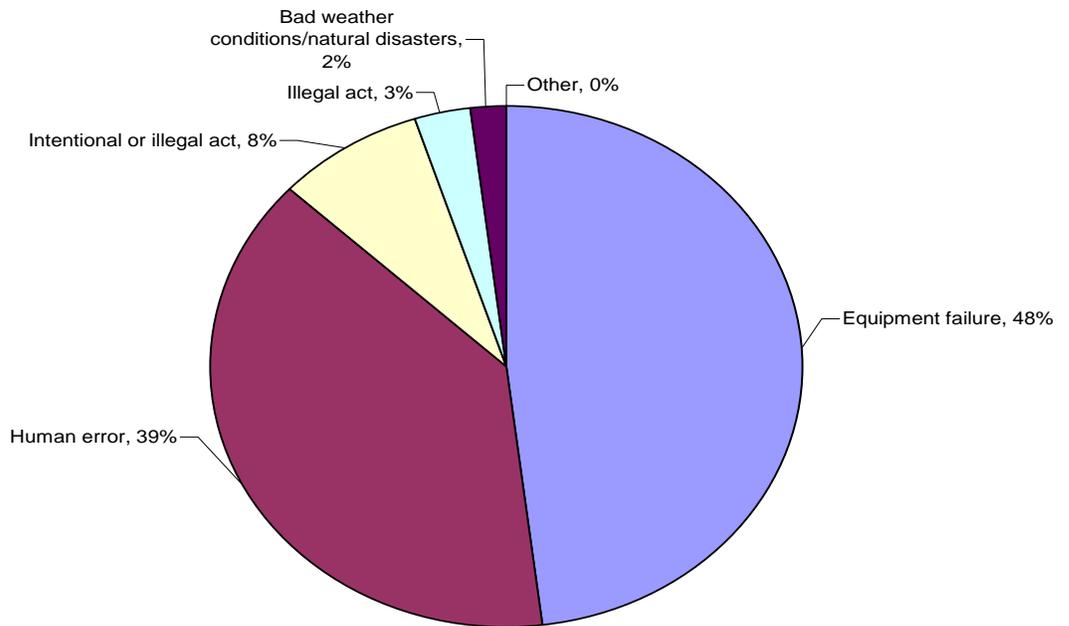
Most of the 2,316 transportation-related events involved vehicle/vessel unloading (764) or releases en route later discovered at a fixed facility (700). Fewer (572) involved releases from a moving vehicle or vessel or from a stationary vehicle or vessel (271). The transportation phase of the release was not reported for 9 incidents.

**Timing of Events** The number of events ranged from 497 (6.8%) in February to 837 (11.5%) in June, with the spring and summer months (April-August) having the highest number of events. Events were approximately twice as likely to occur on a weekday as on a Saturday or Sunday. The majority of events occurred during daytime business hours. Of the 7,180 events for which time of day was reported, 2,456 (34.2%), occurred from 6:00 AM to 11:59 AM and 2,247 from 12:00 PM to 5:59 PM (31.3%). The later evening and early morning hours of 6:00 PM to 11:59 PM (1300, 18.1%) and midnight to 5:59 AM (1177, 16.4%) had fewer events.

**Contributing factors** Contributing factors consisted of primary (root) and secondary (contributing) causes. Primary factors were reported for 7,202 (99.1%) events (Figure

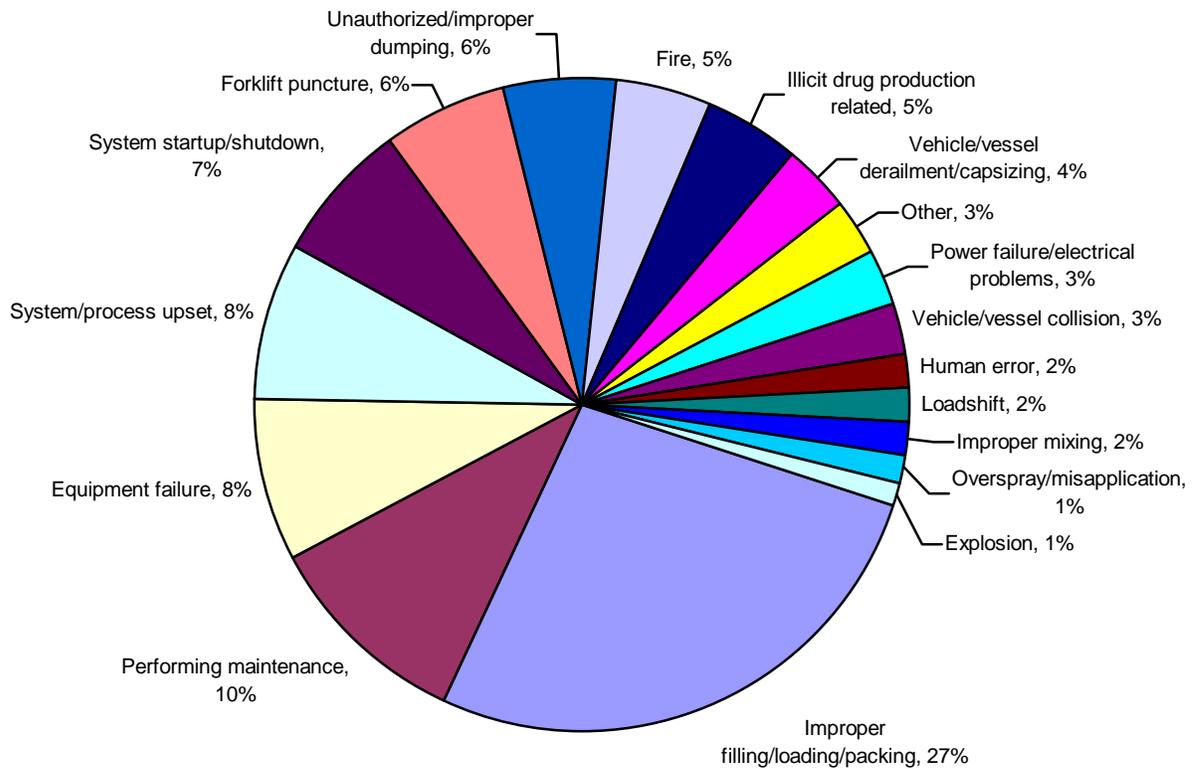
3a). Equipment failure and human error were the leading primary causal factors. However, causal factors differed by location: for fixed-facility events the leading factor was equipment failure, and for transportation-related events the leading factor was human error.

**Figure 3a. Primary factors reported as contributing to events, Hazardous Substances Emergency Events Surveillance, 2006**



Secondary factors were not always present. They were reported for 2,454 fixed-facility events and 1,596 transportation events (Figure 3b). The most often reported secondary factor for fixed-facility events (191) involved performing maintenance. The most often reported secondary factor for transportation-related events (613) involved improper filling, loading, or packing.

**Figure 3b. Secondary factors reported as contributing to events, Hazardous Substances Emergency Events Surveillance, 2006**



**Industries**

Industries are coded using the North American Industry Classification System (NAICS). The largest number of HSEES events was associated with the manufacturing NAICS 31-33 (2,580) and transportation and warehousing NAICS 48-49 (2,208) industries (Table 2). The manufacturing segment NAICS 32 consisting of wood, paper, printing, petroleum and coal, chemical, plastic and rubber, and non-metallic mineral manufacturing (2,212) accounted for the largest proportion of the events (30.4%). This segment also had the highest total number of victims (347), followed by NAICS 61 educational services (292), and NAICS 81 other services (272). The NAICS 81 other services category had the largest number of events with victims (118). Although NAICS 32 manufacturing and NAICS 48 transportation and warehousing resulted in the largest proportion of events, only 2.4% and 3.5% of those events respectively involved victims. In contrast, although NAICS 72 accommodation and food services accounted for only 0.7% of all events, 47.9% of events from that industry involved victims, resulting in a total of 100 victims.

**Table 2. Industries involved in hazardous substances events, by category, Hazardous Substances Emergency Events Surveillance, 2006**

Industry Category	Total Events		Victims	
	Number of events	% of Events	Number of events with victims	Total number of victims
2-digit NAICS Classification*				
(11) Agriculture, Forestry, Fishing and Hunting	142	2.0	29	65
(21) Mining	85	1.2	3	6
(22) Utilities	333	4.6	18	34
(23) Construction	36	0.5	8	21
(31) Manufacturing	151	2.1	24	81
(32) Manufacturing	2,212	30.4	52	347
(33) Manufacturing	217	3.0	25	98
(42) Wholesale Trade	465	6.4	14	29
(44) Retail Trade	88	1.2	21	69
(45) Retail Trade	24	0.3	8	49
(48) Transportation and Warehousing	1,965	27.0	69	197
(49) Transportation and Warehousing	243	3.3	6	14
(51) Information	4	0.1	0	0
(52) Finance and Insurance	4	0.1	1	5
(53) Real Estate and Rental and Leasing	95	1.3	26	113
(54) Professional, Scientific, and Technical Services	21	0.3	3	8
(55) Management of Companies and Enterprises	1	0.0	0	0
(56) Administrative, Support, Waste Management and Remediation Services	91	1.3	15	48
(61) Educational Services	132	1.8	48	292
(62) Health Care and Social Assistance	68	0.9	16	42
(71) Arts, Entertainment, and Recreation	39	0.5	11	26
(72) Accommodation and Food Services	48	0.7	23	100
(81) Other Services	322	4.4	118	272
(82) Public Administration	96	1.3	21	88
Not an Industry	310	4.3	80	131
Unknown	76	1.0	44	55
<b>Total</b>	<b>7,268</b>		<b>683</b>	<b>2,190</b>

\*<http://www.census.gov/epcd/naics02/naicod02.htm> U.S. Census Bureau North American Industry Classification System 2002

31 Includes food, beverage, tobacco, textile, apparel, and leather & allied products manufacturing

32 Includes wood, paper, printing, petroleum & coal, chemical, plastic & rubber, and non-metallic mineral manufacturing

33 Includes metal, machinery, electronics, appliances, transportation equipment, furniture and miscellaneous manufacturing

44 Includes motor vehicle, furniture & home furnishings, electronics & appliances, building materials & garden equipment, food & beverages, health & personal care, gasoline, and clothing & accessories

45 Includes sporting goods, hobby, book & music supplies, general merchandise, and miscellaneous

48 Includes transportation by air, rail, water, truck, transit and ground passenger, pipeline, scenic and sightseeing, and transportation support activities.

49 Includes postal service, couriers and messengers, and warehousing and storage.

### **Substances**

In most (96.1%) events, all substances involved were actually released, 2.0% of events were only threatened releases, and 1.9% of events had substances both threatened and actually released. Of the 9,462 substances in events reported to HSEES in 2006, 8,873 (93.8%) were actually released and 589 (6.2%) were threatened to be released. The majority of events, 6,359, involved only one substance. Two substances were involved in 375 events, and more than two substances were involved in 534 events (Table 3). Fixed-facility events were more likely to have two or more substances than transportation events (15.5% and 6.2% respectively).

**Table 3. Number of substances involved per event, by type of event, Hazardous Substances Emergency Events Surveillance, 2006**

Number of substances	Type of event						All events		
	Fixed facility			Transportation			Number of events	%	Total Substances
	Number of events	%	Total substances	Number of events	%	Total substances			
1	4,186	84.5	4,186	2,173	93.8	2,173	6,359	87.5	6,359
2	259	5.2	518	116	5.0	232	375	5.2	750
3	83	1.7	249	18	0.8	54	101	1.4	303
4	330	6.7	1,320	6	0.3	24	336	4.6	1,344
>=5	94	1.9	685	3	0.1	21	97	1.3	706
Total	4,952		6,958	2,316		2,504	7,268		9,462

During 2006, the five substances most frequently released or threatened to be released were: carbon monoxide, ammonia, paints not otherwise specified, sulfur dioxide, and organic compounds not otherwise specified (Appendix A). The substance categories most commonly released or threatened to be released in fixed-facility events were volatile organic compounds (21.7%), other inorganic substances (20.7%), and mixtures (12.7%) (Table 4). In transportation-related events, the most common substance categories released or threatened to be released were paints and dyes (19.1%), acids (16.1%), and volatile organic compounds (15.9%).

A single release type was reported for 8,953 (94.6%) substances: air (4,370), spills (3,841), threatened releases (589), fire (114), explosion (31), and radiation (8). Two release types were reported for 508 (5.4%) substances: spill and air (338), spill and fire (91), air and fire (39), fire and explosion (22), spill and explosion (9), and air and explosion (9). The release type for one substance was missing.

**Table 4. Number of substances involved, by substance category and type of event, Hazardous Substances Emergency Events Surveillance, 2006**

Expanded Substance Category	Type of Event				All events	
	Fixed facility		Transportation		Number of substances	%
	Number of Substances	%	Number of substances	%		
Acids	456	6.6	402	16.1	858	9.1
Agricultural chemicals, pesticides	204	2.9	161	6.4	365	3.9
Ammonia	432	6.2	73	2.9	505	5.3
Bases	197	2.8	291	11.6	488	5.2
Category not assigned	7	0.1	3	0.1	10	0.1
Chlorine	192	2.8	32	1.3	224	2.4
Formulations	10	0.1	1	0.0	11	0.1
Hetero-organics	37	0.5	23	0.9	60	0.6
Hydrocarbons	94	1.4	25	1.0	119	1.3
Mixture across chemical category*	885	12.7	66	2.6	951	10.1
Other †	346	5.0	159	6.3	505	5.3
Other inorganic substances ‡	1,437	20.7	151	6.0	1,588	16.8
Oxy-organics	749	10.8	140	5.6	889	9.4
Paints and dyes	132	1.9	479	19.1	611	6.5
PCB's	101	1.5	7	0.3	108	1.1
Polymers	169	2.4	94	3.8	263	2.8
Volatile organic compounds	1,510	21.7	397	15.9	1,907	20.2
Total	6,958		2,504		9,462	

\*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.

### **Victims**

There were 2,190 victims in 683 events (9.4% of all events) (Table 5). Of the events with victims, 398 (58.3%) had only one victim. Four mass casualty (>50 victims) events occurred involving 78, 82, 88 and 109 victims. Most victims, 89.5%, were injured in fixed-facility events. Fixed-facility events were more likely to have three or more victims per event (28.2%) than were transportation-related events (13.9%). An additional 500 persons were observed at a hospital or medical facility but had no symptoms resulting from the event and were not, therefore, counted as victims.

**Table 5. Number of victims per event, by type of event, Hazardous Substances Emergency Events Surveillance, 2006**

Number of Victims per Event	Type of Event						All Events		
	Fixed Facility			Transportation			Number of Events	%	Total Victims
	Number of Events	%	Total Victims	Number of Events	%	Total Victims			
1	313	55.1	313	85	73.9	85	398	58.3	398
2	95	16.7	190	14	12.2	28	109	16.0	218
3	34	6.0	102	5	4.3	15	39	5.7	117
4	27	4.8	108	4	3.5	16	31	4.5	124
5	26	4.6	130	0	0.0	0	26	3.8	130
>=6	73	12.9	1117	7	6.1	86	80	11.7	1203
Total	568		1,960	115		230	683		2,190

Events were classified by only one substance category, even if multiple substances were involved. If multiple substances from the same category were involved, that category was used for the event. If multiple substances from different categories were involved, the event was categorized as “multiple substances.” To judge the relative threat of a substance, we looked at what percentage of events in that substance category had victims (Table 6). The most frequently released substances were not necessarily the ones most likely to involve victims. For example, events categorized as volatile organic compounds (VOCs) were reported more often than events in any other category (15.5%); however, only 4.7% of all events with victims involved VOCs. Oxy-organics accounted for only 7.7% of all events, yet constituted the largest percent of events with victims (28.0%). Carbon monoxide (CO) is the most frequently released oxy-organic and can be very lethal. Events involving mixtures across different categories (11.1%) and ammonia (10.2%) also accounted for many of the events with victims.

Carbon monoxide was released into a private elementary school due to a malfunctioning boiler. Most of the victims (80) were students although eight workers were affected. All victims were treated at the scene. One also was treated at the hospital. The health effects involved central nervous (headache, dizziness) and gastrointestinal problems (nausea.) The CDC carbon monoxide poisoning Website <http://www.cdc.gov/co/> has guidance documents on preventing and treating CO poisoning.

**Table 6. Frequency of substance categories in all events and events with victims, Hazardous Substances Emergency Events Surveillance, 2006**

Substance Category	All Events		Events with victim		
	Number	%	Number	% of all events with victims	% of events in substance category with victims
Category not assigned	7	0.1	2	0.3	28.6
Acids	641	8.8	52	7.6	8.1
Ammonia	456	6.3	70	10.2	15.4
Bases	396	5.5	24	3.5	6.1
Chlorine	203	2.8	49	7.2	24.1
Formulations	8	0.1	0	0.0	0.0
Hetero-organics	51	0.7	6	0.9	11.8
Hydrocarbons	73	1.0	4	0.6	5.5
Mixture across chemical categories	928	12.8	76	11.1	8.2
Multi-substance	640	8.8	31	4.5	4.8
Other	316	4.3	33	4.8	10.4
Other inorganic substances	640	8.8	42	6.1	6.6
Oxy-organics	560	7.7	190	27.8	33.9
Paints and dyes	558	7.7	7	1.0	1.3
Pesticides	321	4.4	49	7.2	15.3
PCBs	99	1.4	1	0.1	1.0
Polymers	242	3.3	15	2.2	6.2
Volatile organic compounds	1,129	15.5	32	4.7	2.8
Total	7,268		683		9.4

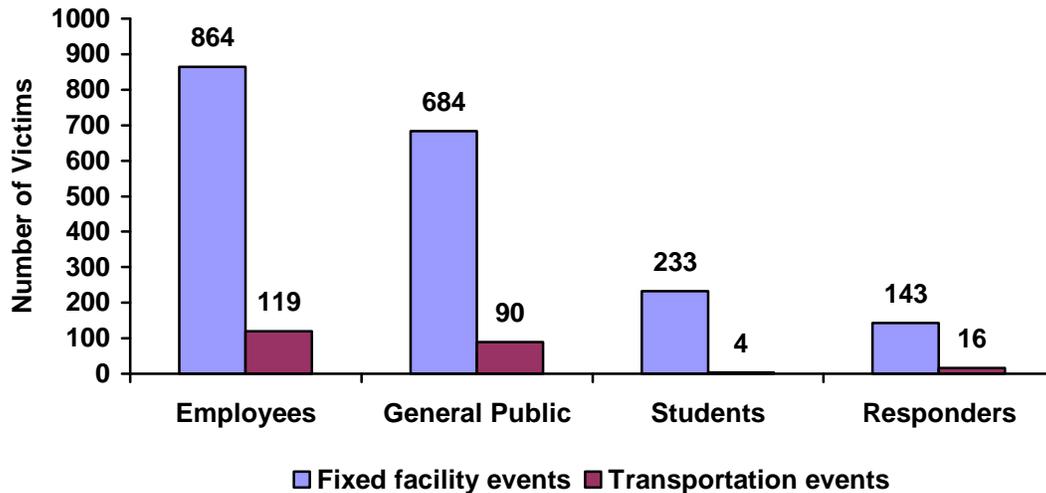
**Victim's sex** Sex was known for 1,797 of the victims; of these, 1,151 were males and 646 were females. Of the employees and responders for whom sex was reported, 71.8% were males.

**Victim's age** For the 1,804 victims for whom an age category was reported, 36 (2.0%) were < 5 years of age, 249 (13.8%) were 5–14 years of age, 128 (7.1%) were 15–19 years of age, 962 (53.3%) were 20–44 years of age, 394 (21.8%) were 45–64 years of age, and 35 (1.9%) were ≥65 years of age. Of the 386 victims for whom age was not reported, 220 were presumably adults (because their population group was reported as responders or employees), and 2 were students.

Workers purging a pipeline near a high school released methyl-mercaptan during maintenance. Twelve employees and 66 students were affected. One victim was treated at the hospital and released; the others were treated at the scene. Their symptoms included dizziness, headaches, shortness of breath, and other respiratory and gastrointestinal problems.

Employees (1,003) constituted the largest proportion of the population groups affected, followed by members of the general public (774). The distribution of victims by population group and type of event is depicted in Figure 4.

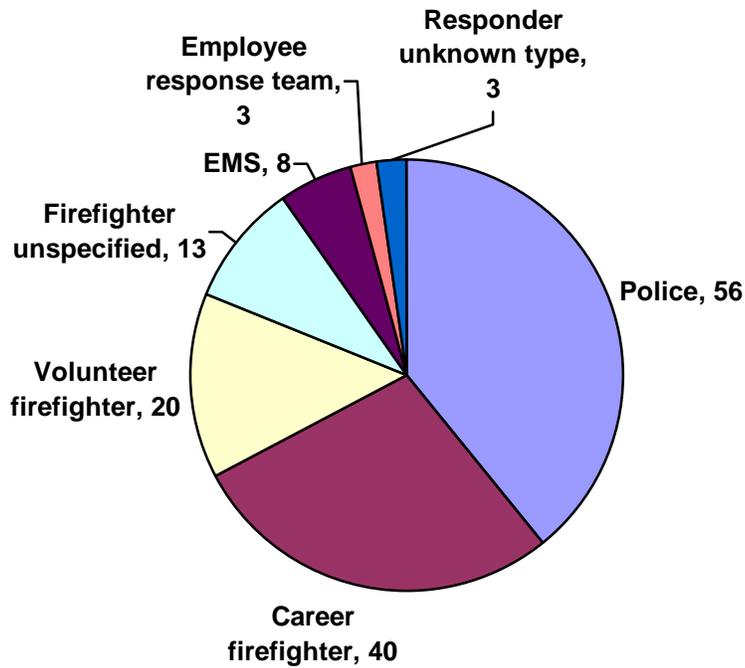
**Figure 4. Number of victims, by population group and type of event, Hazardous Substances Emergency Events Surveillance, 2006**



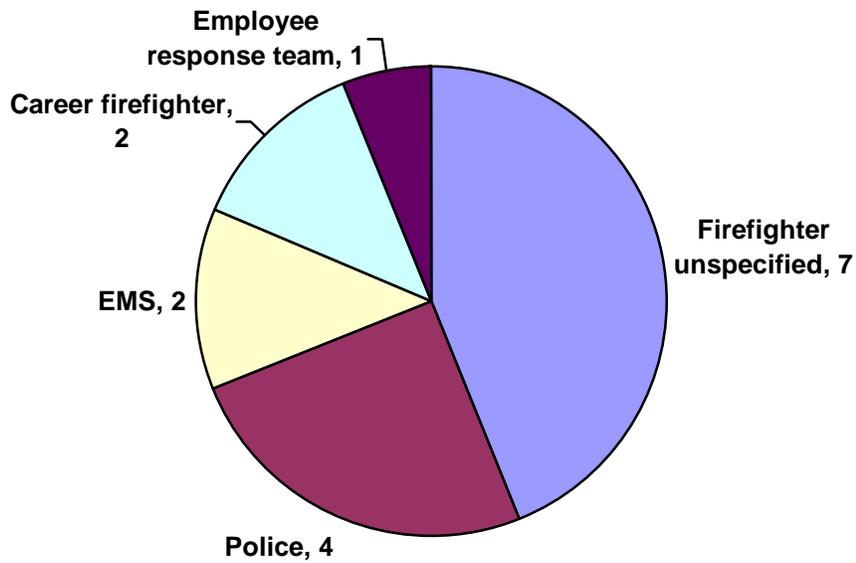
\*The category or type of event was missing for 37 persons.

In fixed-facility events, 143 emergency response personnel were affected (Figure 5a). In transportation-related events, 16 responders were affected (Figure 5b). Police officers were affected more frequently in fixed-facility events and firefighters of unknown type in transportation-related events.

**Figure 5a. Distribution of responders injured in fixed facility events, Hazardous Substances Emergency Events Surveillance, 2006**



**Figure 5b. Distribution of responders injured in transportation events, Hazardous Substances Emergency Events Surveillance, 2006**



A total of 3,390 injuries or symptoms were reported (Table 7). Some victims had more than one injury or symptom. Of all reported injuries or symptoms, the most common in fixed-facility events were respiratory tract irritation (29.7%), headaches (17.7%), dizziness or other central nervous system symptoms (14.9%), and gastrointestinal symptoms (11.6%). In transportation-related events, respiratory tract irritation (35.9%), trauma (26.1%), skin irritation (7.7%), and eye irritation (7.3%) were reported most frequently. Most (87.3%) of the trauma injuries in transportation-related events were from vehicle accidents that resulted in the release of a hazardous substance and not from exposure to the substance itself.

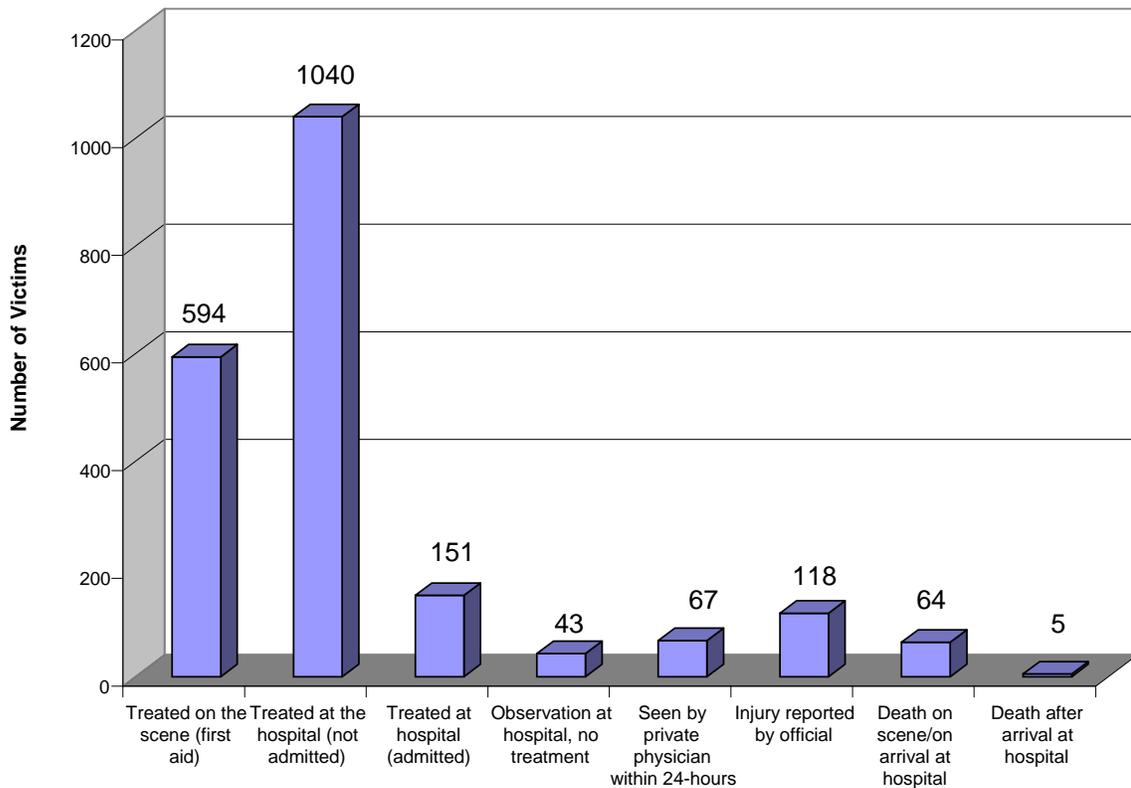
**Table 7. Frequency of injuries/symptoms, by type of event, Hazardous Substances Emergency Events Surveillance, 2006**

Type of Injury/Symptom	Fixed facility		Transportation		All events	
	Number of injuries/symptoms	%	Number of injuries/symptoms	%	Number of injuries/symptoms	%
Burns	145	4.7	13	4.5	158	4.7
Dizziness/Central Nervous System Symptoms	461	14.9	20	7.0	481	14.2
Eye Irritation	254	8.2	21	7.3	275	8.1
Gastrointestinal	360	11.6	6	2.1	366	10.8
Headache	549	17.7	9	3.1	558	16.5
Heart Problem	15	0.5	0	0.0	15	0.4
Heat Stress	9	0.3	0	0.0	9	0.3
Other	69	2.2	10	3.5	79	2.3
Respiratory Irritation	921	29.7	103	35.9	1,024	30.2
Shortness of Breath	110	3.5	8	2.8	118	3.5
Skin Irritation	126	4.1	22	7.7	148	4.4
Trauma	84	2.7	75	26.1	159	4.7
Total	3,103		287		3,390	

\*The number of injuries is greater than the number of victims (2,190) because a victim could have more than one injury per event.

Of the 2,190 victims, 1,040 were treated at hospitals without admission, and 594 were treated at the scene; 69 deaths were reported (Figure 6). Disposition was unknown for 108 victims.

**Figure 6. Injury disposition, Hazardous Substances Emergency Events Surveillance, 2006**



\*Disposition unknown for 108 victims

**Personal Protective Equipment** Selection of appropriate personal protective equipment (PPE) is a complex process that should take into account identification of the hazards, or suspected hazards; the routes of potential hazard (e.g., inhalation, skin absorption, ingestion, and eye or skin contact); and the performance of the PPE materials (and seams) in providing a barrier to these hazards. The amount of protection provided by PPE is material-/hazard-specific. PPE is divided into four categories Level A-D, based on the degree of protection afforded with level A being the most protective. The Occupational Safety and Health Administration defines Level A as positive pressure, full face-piece self-contained breathing apparatus (SCBA), or positive pressure-supplied air respirator with escape SCBA, totally-encapsulating chemical-protective suit, gloves, outer, chemical-resistant, gloves, inner, chemical-resistant, boots, chemical-resistant, steel toe and shank. Level D protection, is the least protective of the four categories, it consists of coveralls, boots/shoes (chemical-resistant leather, steel toes and shank), safety glasses or chemical splash goggles, and hard hats. Level B and C fall in between as far as protection. Firefighter turnout gear is protective clothing usually worn by firefighters during structural firefighting operations; it is similar to Level D protection.

PPE was not worn by 757 of 1,003 employee-victims and 74 of 159 responder-victims. Status of PPE use was unknown for 35 employee victims and 21 responder victims. Of

the employee-victims who wore PPE (211), most (198) wore level D or less (e.g. gloves, eye protection, hard hat, and steel-toed shoes), 8 wore level C, 2 wore level B, 2 wore level A, and 1 person wore firefighter turn out gear with respiratory protection. Among the 64 injured firefighters who wore PPE, 28 (i.e., 22 career and 6 volunteer) wore firefighter turnout gear with respiratory protection, and 25 (i.e., 12 career, 10 volunteer, and 3 unspecified type) wore firefighter turnout gear without respiratory protection. One police officer and one member of the company response team wore level D. Five career firefighters wore level A, two EMS responders wore gloves, two firefighters of unspecified type wore level B.

Of the 7 persons wearing level A who were injured, 1 person clearly was not wearing it when the release occurred, and one suffered trauma and burns against which level A does not adequately protect. It is unclear whether the others exhibited symptoms because they were not wearing the equipment properly, or whether the symptoms were a side effect of the PPE itself.

A release of sulfuric acid involving human error injured 109 employees. They suffered respiratory symptoms. Seventy-six victims were treated at the scene; 29 were treated at the hospital without admission; and 4 were treated at the hospital and admitted. All victims had worn Level D protection.

### ***Nearby Populations***

The proximity of an event to selected vulnerable areas was automatically determined by use of geographic information systems (GIS) or by the health department if more accurate data were available. Information about proximity to selected populations was missing altogether for 212 events. Industries or other businesses were within ¼ mile of 6,825 events, residences within ¼ mile of 5,814 events, licensed daycare centers within ¼ mile of 909 events, schools within ¼ mile of 873 events, recreational areas within ¼ mile of 852 events, nursing homes within ¼ mile of 294 events, and hospitals within ¼ mile of 73 events.

The number of persons at risk for exposure was determined primarily from US census data by drawing concentric rings of various sizes around the event using GIS. There were 4,698,553 persons living within ¼ mile of the events; 18,183,678 persons within ½ mile; and 69,854,820 persons within 1 mile. Information was missing on the number of persons living within ¼ miles for 248 events, ½ miles for 249 events, and 1 mile for 253 events.

Chlorine is a highly toxic and volatile substance. A chlorine release following an equipment failure at a manufacturing facility injured 82 members of the general public. All the victims sought treatment for inhalation of chlorine. Seventy-nine of the victims were treated at the scene, and 3 were treated at the hospital and admitted. The clinical symptoms among the victims were eye irritation with respiratory and gastrointestinal problems. The area affected was > ½ mile to 1 mile from the point of release.

### ***Evacuations***

Evacuations were ordered in 503 (6.9%) of 7,241 events for which evacuation status was reported. Of these evacuations, the majority (80.6%) were of the building or affected areas of the buildings. Fewer were of a defined circular area surrounding the event (9.6%); areas downwind or downstream (3.3%); a circular and downwind or downstream area (3.7%); and no defined criteria (2.9%). The number of persons evacuated was known for 353 (70.2%) events and ranged from 0 to 2,000 persons, with a median of 20. Six ordered evacuations were reported as having no evacuees, the reasons being unknown. The median duration of evacuation was 2 hours (range: 0 hours to 30 days). The duration of evacuation was missing for 40 (8.0%) events. Sheltering in-place was ordered by an official in only 75 incidents (1.0%). Sheltering-in-place means to stay inside, seal the windows and doors, and shut off any ventilation from the outside. In-place sheltering is ordered when there is a threat of exposure, but the safest option is to stay put and to avoid evacuating through the cloud.

Of all 7,268 events, 1,801 (24.8%) had access to the affected area restricted; whether or not restriction occurred was unknown in 41 (0.6%) events

### ***Decontamination***

Of the 2,098 victims for whom decontamination status was known, 1,773 were not decontaminated.

Decontamination is the removal of contamination from the body by removing contaminated clothing and rinsing the contaminated area with water (or another approved rinse agent). Persons only need to be decontaminated if they have chemicals on the body and potential exists for health effects or secondary contamination (spread of substance from person to person causing illness). Of the 2,098 victims for whom decontamination status was known, it is not known how many had actually been in contact with chemicals.

Most victims, 1,773 (84.5%) were not decontaminated. Of those who were decontaminated, 174 were decontaminated at the scene, 74 were decontaminated at medical facilities, and 77 were decontaminated both at the scene and medical facilities.

Some types of responders are trained to decontaminate, thus they may be more likely to do so, even if only as a precaution. Of the responder victims, 60% of EMS, 42% of firefighters, 33% of company response team members, 16% of police, and none of the responders of unknown type were decontaminated. Non-responders may not be as aware of the need for decontamination. Of the non-responder victims, 20% of employees, 6% of students, and 10% of the general public received decontamination.

There were 1009 exposed non-victims (non-symptomatic) who were decontaminated. Decontamination was largely done at the scene. Those affected were primarily responders (n=576), employees (n=286), and students (n=115). The median number was 4 persons per event (range: 1-110 persons). Decontamination was done at a medical facility for 29 exposed non-victims: 9 employees, 13 responders, and 7 members of the general public.

***Response***

Of the 7,256 events with information on responder types, no responders were reported for 1,215; one responder category was reported for 4,424; and 1,617 reported multiple responder categories. The most frequently reported responder group was the company response team (4,332), followed by fire departments (1,116), third party clean-up contractors (858), law enforcement agencies (843), and certified HazMat teams (568).

**Table 8. Distribution of responder categories, Hazardous Substances Emergency Events Surveillance, 2006**

<b>Responder Category</b>	<b>Number of events</b>
Company's Response Team	4,332
Fire Department	1,116
Third Party Clean-up Contractors	858
Law Enforcement Agency	843
Certified HazMat Team	568
Environmental Agency/EPA Response Team	448
Emergency Medical Technicians	416
Department of Works/Utilities Transportation (includes Coast Guard)	228
State, County or Local Emergency Managers/Coordinators/Planning Committees	163
Health Department/Health Agency	143
Other	43
Hospital Personnel/Poison Control Center	39
Specialized Multi-agency Teams	20

Total (9,217) is greater than the total number of events with information on responder categories (7,256) because multiple responder categories could be reported per event.

### ***Reporting timeliness***

Of the 4,952 events that occurred in fixed facilities, 61.5% were reported within 48 hours of the event, while 27.1% of the 2,316 transportation events were reported within 48 hours. Because obtaining information about transportation-related releases from federal or state departments of transportation were not timely, 1,322 of 2,316 transportation events were reported more than one month after occurrence.

## ***HSEES Pilots in India and Poland***

In 2004, ATSDR began collaborating with India's National Institute of Occupational Health (NIOH), part of the Indian Council on Medical Research in Gujarat, India, and the Nofer Institute of Occupational Medicine (NIOM) in Lodz, Poland to conduct pilot surveillance projects of acute chemical releases in these two countries using HSEES.

### **India**

The case definitions were modified to meet the needs of India. In India, releases of petroleum are included if the amount released is greater than 1,000 liters. Mass poisonings are also included.

Surveillance for the pilot project was limited to Gujarat state, where NIOH is located. Gujarat is a large state in Western India with a population of more than 50 million. In a recent business census, Gujarat was found to be home to more than 14,000 factories and industrial facilities. Major industries include oil and petroleum products, refineries, mining, and heavy manufacturing operations producing steel and aluminum. The primary notification source for events is the media, although reporting mechanisms have been established with the fire brigade and police. Regional data collectors are responsible for data collection, and data are entered by a central data entry person, with oversight provided by the principal investigator.

In 2006, 168 events were reported, most of which (136 [81.0%]) occurred in a fixed facility. Of the 25 districts in Gujarat, India, events occurred most frequently in Vadodra (37 [22.0%]) and Ahmedabad (32 [19.0%]). The leading industry categories where releases occurred included: manufacturing (47 [28.0%]), transportation (31 [18.5%]), and agriculture, forestry, fishing and hunting (28 [16.7%]). The most frequently reported primary factors were human error (48.1%) and equipment failure (47.4%), and the most frequently reported secondary factor was fire (43.8%). The substance categories most frequently involved in releases were other substances (26.6%) and pesticides (19.8%). Of the 168 events, 104 (61.9%) involved a total of 290 victims, of whom 86 died. The victims included employees (178 [61.4%]), members of the general public (110 [37.9%]), and volunteer firefighters (2 [0.7%]). The most frequently reported injuries were chemical burns (27.9%) and respiratory irritation (25.6%). Evacuations were ordered in 14 events.

## **Poland**

Poland collected data for the entire country. The Poland HSEES program used the Fire Department Headquarters in Warsaw as its main reporting source. Other sources were the Regional Inspectorate for Environmental Protection in Lodz; the Chief Sanitary Inspectorate in Warsaw; the Clinic of Acute Poisonings (NIOM); the Department of Environmental Health Hazards (NIOM); the Bureau for Chemical Substances and Preparations in Lodz; and the Department of Health Care Organization (NIOM).

In Poland, 177 events were reported in 2006, of which 95 (53.7%) occurred in fixed facilities. Of the 16 voivodships (regions), events occurred most often in Mazowieckie (33 [18.6%]) and Slaskie (29 [16.4%]). The leading industry categories where releases occurred included transportation and warehousing (83 [46.9%]) and manufacturing (31 [17.5%]). The most frequently reported primary factors were human error (52.0%) and equipment failure (43.5%). The most frequently reported secondary factor was improper filling/loading/packing (43.5%). The substance categories most frequently associated with releases were other inorganic substances (27.9%) and acids (20.8%). Of the 177 events, 21 (11.9%) involved a total of 88 victims, of whom one died. The victims included members of the general public (42 [47.7%]), students (21 [23.9%]), employees (21 [23.9%]), responder, unknown type (3 [3.4%]), and unknown (1 [1.1%]). The most frequently reported injury was respiratory tract irritation (67.4%). Evacuations were ordered in 34 events.

The findings from the international projects indicate that the HSEES system can be successfully implemented abroad and can be used as a tool in protecting the health of citizens from hazardous substances releases and subsequent exposures.

## ***Summary of Results, 1993–2006***

HSEES has been supported by a series of 5-year competitive cooperative agreements funded by ATSDR with additional support in recent years from the Centers for Disease Control and Prevention's Coordinating Office for Terrorism Preparedness and Emergency Response. Funded states have changed over the years (Table 9). During 1993–2006, the largest proportion of events occurred in fixed facilities (Table 10). The 1999 addition of the U.S. Department of Transportation's Hazardous Materials Information System as a primary notification source for transportation events reported to HSEES resulted in an increase in the number of transportation events.

**Table 9. Time period each state participated in Hazardous Substances Emergency Events Surveillance, 1993–2006**

<b>State</b>	<b>Years Participated</b>
Alabama	1993-2003
Colorado	1993-2006
Florida	2005-2006
Iowa	1993-2006
Louisiana	2001-2006
Michigan	2005-2006
Minnesota	1995-2006
Mississippi	1995-2003
Missouri	1994-2005
New Hampshire	1993-1996
New Jersey	2000-2006*
New York	1993-2006
North Carolina	1993-2006
Oregon	1993-2006
Rhode Island	1993-2001
Texas	1993-2006
Utah	2000-2006
Washington	1993-2006
Wisconsin	1993-2006

\*NJ was unable to collect complete data during 2006 and was excluded from this report.

A comparison of the year 2006 to the previous five years shows that the number of reported events and substances released has decreased as fewer states participated and the minimum reporting quantity changed. However, the number of victims was the highest it has been in the last 6 years indicating that prevention activities are more necessary than ever before.

Respiratory tract irritation is still the most frequently reported symptom, Employees were still the group most often injured. Having proper respiratory training and PPE may alleviate some of these injuries. Members of the general public constitute a large proportion of the victims, and having proper emergency plans in place may alleviate some of these injuries as well (Figure 7). The number of deaths associated with acute hazardous substances events was higher than ever the last 2 years (69). However many of these deaths were traumas attributed to non-chemical circumstances surrounding the events (e.g., a crash resulting from high-speed travel of a truck pulling an ammonia tank).

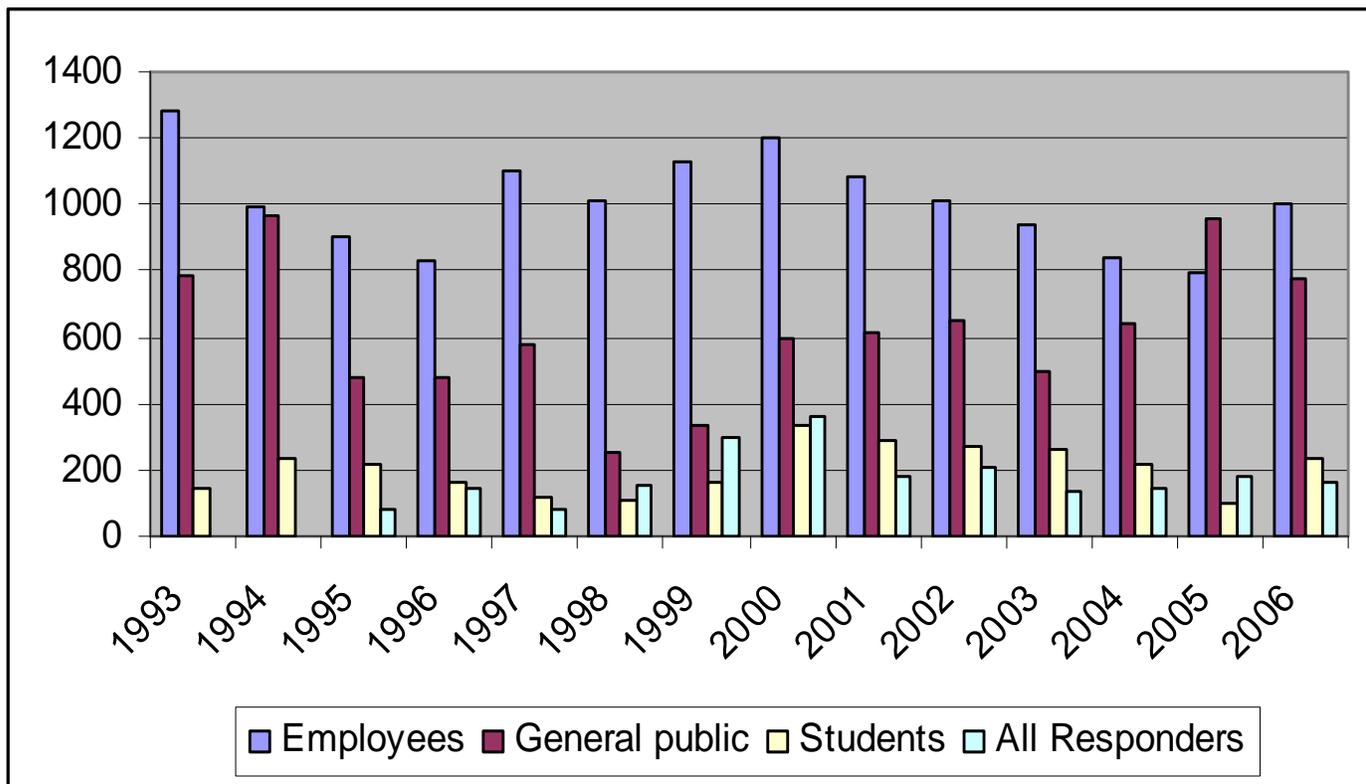
**Table 10. Cumulative data by year,  
Hazardous Substances Emergency Events Surveillance, 1993-2006\***

Year	Number of States Participating	Type of Event			Number of substances released	Number of victims	Number of deaths	Events with victims	
		Fixed Facility	Transportation	Total†				Number	%
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	13	4,327	1,159	5,488	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	15	4,634	1,626	6,260	6,974	1,912	30	504	8.1
2000	16	5,499	2,049	7,548	8,342	2,513	44	752	10.0
2001	15	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
2004	13	5,687	2,057	7,744	10,323	1,838	41	620	8.0
2005	15	6,386	2,216	8,603	11,506	2,034	69	778	9.0
2006	13	4,952	2,316	7,268	9,462	2,190	69	683	9.4

\*Numbers in the table may differ from those reported in previous years because of edits.

†The total number of events does not include one event in 2002 and one in 2005 for which the type of event was unknown.

**Figure 7. Number of victims, by category and year, Hazardous Substances Emergency Events Surveillance, 1993–2006**



## *Uses of HSEES Data*

In 2006, ATSDR continued responding to requests for HSEES information from local, state, and federal agencies and organizations. Staff from ATSDR and the state health departments presented HSEES data in many local, state, national, and international conferences. The ATSDR HSEES Internet Web site contains annual reports, published journal articles, public use datasets, and other information. The site also contains Internet links to the 14 HSEES state Web sites.

**Visit the HSEES public Web site**

<http://www.atsdr.cdc.gov/HS/HSEES/>

**Public Use Dataset** ATSDR has created a public use HSEES dataset to enable public health professionals and other interested parties to analyze the data. A data dictionary provides users with detailed instructions for working with the dataset. This dataset resides on the HSEES public Web site. Data contained in the file are related to events that occurred in the 17 states participating in HSEES from 1996–2001 and the years 2002–2004.

## ***Prevention/Outreach Activities***

The HSEES program makes an important contribution in its role in building capacity within each participating state health department to target prevention activities related to acute spills and their associated public health consequences. The HSEES system is also building capacity to alert the proper authorities when a public health action needs to be implemented immediately.

State HSEES coordinators conduct activities, often in collaboration with other local and state agencies. The program has been working over the years with several CDC Public Health Prevention Specialists, building capacity to develop sound prevention activities that can be evaluated for their effectiveness. In 2006, a CDC Public Health Prevention Service fellow developed a “HSEES Prevention Outreach and Evaluation Activity Planning Guide” for states to use. On the HSEES webpage are links to state HSEES WebPages where many of the prevention/outreach materials are posted. Examples of prevention activities for 2006 included:

**Awareness promoting activities** It is important to raise awareness of the public health significance of acute chemical releases and their impacts. This is done mainly through presentations at meetings and distribution of HSEES materials. While it is anticipated that increased awareness will result in reductions in hazardous substance releases and public health impacts, these results are harder to link to HSEES efforts. They may in fact lead to increases, as increased awareness of the program may produce better reporting. Thus, for these activities, states measure the impact of their activity mainly by the number of people they reach.

- An expert panel on “Railroad Routing of Hazardous Materials” was convened with representatives from general industry, community, academia, and federal government to discuss railroad routing safety, catastrophe avoidance routing, accident prevention, emergency response, and reporting data.
- Specific products promoting awareness including:
  - HSEES Health Profiles,
  - HSEES Health Report Cards, and
  - Legislative Fact Sheets.

**Targeted activities** It is important to identify high risk groups and the types of media they are accustomed to using in order to target prevention messages. Little has been done in this arena, and novel approaches have been tried at times. These approaches will undergo further evaluation to measure their effectiveness. Targeted activities in 2006 included:

- Louisiana developed a summary of lessons learned from Hurricane Katrina and Rita related events. The report was distributed to all stakeholders by posting on the LA HSEES Web site. LA HSEES used a questionnaire to obtain feedback from industry stakeholders on emergency response plans developed/implemented and/or engineering control designs to improve or reduce future releases and injuries associated with severe weather conditions.

- Colorado developed and disseminated a “trucking incident data report” to target Colorado trucking companies and prevent transportation events.
- Texas distributed a baseline survey, fact sheet, and follow-up survey to 39 trucking companies representing 54 trucking terminals in Texas identified as having multiple events. Seventeen of the companies representing 39 of the terminals responded to the baseline survey, and 14 of the companies, representing 33 of the terminals, responded to the follow-up survey. Nearly 90% confirmed they had received the survey and read the fact sheet. Fourteen percent of the companies (representing 6% percent of the terminals) said the materials provided new information; 36% were going to incorporate some portion of the information found in the survey or communication intervention into employee training.
- HSEES staff presented descriptions of successful spill prevention methods implemented by trucking firms at the Council of State and Territorial Epidemiologists annual conference.
- Wisconsin hospitals received HSEES data in support of disaster preparedness planning and an article published in the *Wisconsin Hospital Association Newsletter* to promote better preparedness.
- Washington HSEES provided educational materials, including a monthly calendar and newsletter entitled “Alternatives” (highlighting the 10 most frequently released chemicals), to numerous chemical manufacturing facilities storing and producing large supplies of hazardous chemicals to inform them of safer guidelines for hazardous chemical storing.

**Substance-specific prevention activities by HSEES states** Participating states targeted common and dangerous substances including mercury, carbon monoxide, chlorine, sulfuric acid, sulfur dioxide, ammonia, pesticides and other agricultural substances for prevention activities in 2006. States measure immediate effects such as audience numbers and mid-term effects such as continued interest and requests for information or changes in behavior. States will follow up in subsequent years to see if their efforts reduced these types of events and public health consequences. Examples of activities performed include:

- Colorado and Florida HSEES trained county health department staff to reduce the number of carbon monoxide events and injuries. The targets were emergency responders at the Department of Community Affairs, law enforcement personnel, firefighters, State Emergency Response Commission, the Local Emergency Planning Committee (LEPC), and the general public.
- HSEES presented a poster exhibit on chlorine release prevention at the Rural Water Association’s 18<sup>th</sup> Annual Wisconsin State Convention.
- Educational materials on HSEES incidents related to chemical releases from anhydrous ammonia, pesticides, and other agricultural chemicals were disseminated to agricultural and meat industries in IA, MN and NC. Following an agricultural chemical safety exhibit at a Farm Progress Show, Iowa HSEES evaluations demonstrated increased awareness of elevated incidents resulting from agricultural chemical releases.
- HSEES, in collaboration with OSHA and academia in Wisconsin, introduced the “Best Evidence/Best Practices Prevention/Outreach Initiative,” to reduce the number of ammonia releases in closed-system refrigeration sectors.

- HSEES and the Center for Environmental Health's Outreach and Education Unit in New York established a partnership with other agencies and educational stakeholders to prevent future mercury spills in schools.
- Three peer-reviewed articles were published on the following chemical-related topics (See Appendix B): home produced biodiesel, acute pesticide-related illness among emergency responders, chemicals that may be used as weapons of terrorism.

**Illicit methamphetamine (meth)-related educational activities** Illicit

methamphetamine production has been a serious problem detected by HSEES since 1996. Over the years states have conducted many activities targeting these labs and precursor chemical theft or purchase. Activities have resulted in legislation to reduce these labs and their harmful affects by various means. Many states have seen marked reductions in the seizures of illegal labs, yet the public health problem still exists. Among this year's activities were:

- Educational materials about hazardous substances in clandestine drug laboratories and the role of the local health departments were disseminated. Speaking engagements followed to increase awareness.
- Educational materials on methamphetamine laboratory chemical exposures and injuries among emergency responders, firefighters, and law enforcement officials were developed and disseminated.

## ***The Future of Hazardous Substance Surveillance***

An external peer review of the HSEES program in 2005 recommended the development of a national approach to chemical events surveillance. A national system will strengthen the impact of prevention/outreach activities and research programs leading to nationally applicable lessons learned, expanded partnerships, improved emergency response planning and preparedness, and enhanced cost effectiveness and cost benefit of the program. In 2006, a large part of ATSDR's focus of the HSEES program was to obtain input and to plan for establishment of a national program. Implementation of the plan is expected to begin in fiscal year 2010.

## *References*

1. Centers for Disease Control and Prevention. Comprehensive plan for epidemiologic surveillance. Atlanta: US Department of Health and Human Services; 1986.
2. Binder S. Death, injuries, and evacuations from acute hazardous materials releases. *Am J Public Health* 1989;70:1042–4.
3. Developing a Roadmap for the Future of National Hazardous Substances Incident Surveillance. Mary Kay O'Connor Process Safety Center Chemical Engineering Department Texas Engineering Experiment System, Texas A&M University System. Unpublished draft. December 2008.

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## Appendix A

### The 20 substances most frequently released or threatened to be released, Hazardous Substances Emergency Events Surveillance, 2006

Rank	Substance	Number Events
1	Carbon monoxide	548
2	Ammonia	492
3	Paint NOS*	407
4	Sulfur dioxide	393
5	Organic compounds NOS*	348
6	Sulfuric acid	289
7	Sodium hydroxide	279
8	Nitrogen oxide	266
9	Hydrochloric acid	212
10	Mercury	177
11	Benzene	147
12	Chlorine	134
13	Vinyl chloride	125
14	Ethylene glycol	122
15	Paint or coating NOS*	110
16	Polychlorinated biphenyls	108
17	Hydrogen sulfide	70
18	Nitrogen dioxide	70
19	Acetone	67
20	Resin NOS *	61

\*NOS=Not Otherwise Specified.

## **Appendix B**

### **2006 HSEES Publications**

Centers for Disease Control and Prevention (CDC). Hazardous Materials Event Resulting from the Home Production of Biodiesel— Colorado, May 2006. *MMWR* 2006; 55(45):1227-1228.

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