



ANNUAL REPORT 2002

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

Division of Health Studies
Epidemiology and Surveillance Branch
Atlanta, Georgia

DISCLAIMER

Use of trade names and commercial sources is for identification only and does not imply endorsement by the Agency for Toxic Substances and Disease Registry or the U.S. Department of Health and Human Services.

Contents

	Page
Disclaimer.....	ii
List of Tables.....	iv
List of Figures.....	v
List of Appendices.....	v
Executive Summay.....	1
Introduction.....	2
Methods.....	3
Results.....	4
Industries.....	8
Substances.....	8
Victims.....	9
Evacuations.....	15
Response.....	15
Uses of the HSEES Data.....	16
Prevention Activities.....	17
Acute Releases of Hazardous Substances In Schools During 2002.....	17
Summary of Results, 1993-2002.....	18
Reference.....	21
Appendices.....	22

List of Tables

	Page
Table 1. Number of events meeting the surveillance definition, by state and type of event, Hazardous Substances Emergency Events Surveillance, 2002.....	5
Table 2. Number of substances involved per event, by type of event, Hazardous Substance Emergency Events Surveillance, 2002	8
Table 3. Industries involved in hazardous substances events, by category, Hazardous Substances Emergency Events Surveillance, 2002.....	9
Table 4. Number of substances involved, by substance category and type of event, Hazardous Substances Emergency Events Surveillance, 2002	10
Table 5. Number of victims per event, by type of event, Hazardous Substances Emergency Events Surveillance, 2002.....	10
Table 6. Frequency of substance categories in all events and events with victims, Hazardous Substances Emergency Events Surveillance, 2002	11
Table 7. Frequencies of injuries/symptoms, by type of event, Hazardous Substances Emergency Events Surveillance, 2002.....	14
Table 8. Cumulative data for all states, by year, for the states reporting to the Hazardous Substances Emergency Events Surveillance, 2002.....	19

List of Figures

	Page
Figure 1. Areas of fixed facilities involved in events, Hazardous Substances Emergency Events Surveillance, 2002.....	6
Figure 2. Distribution of transportation-related events, by type of transport, Hazardous Substances Emergency Events Surveillance, 2002	6
Figure 3. Factors reported as contributing to events, Hazardous Substances Emergency Events Surveillance, 2002.....	7
Figure 4. Number of victims, by population group and type of event, Hazardous Substances Emergency Events Surveillance, 2002	12
Figure 5a. Distribution of responders injured in fixed-facility events, by type of responder, Hazardous Substances Emergency Events Surveillance, 2002.....	13
Figure 5b. Distribution of responders injured in transportation events, by type of responder, Hazardous Substances Emergency Events Surveillance, 2002.....	13
Figure 6. Injury disposition, Hazardous Substances Emergency Events Surveillance 2002.....	15
Figure 7. Cumulative data for all participating states, Hazardous Substances Emergency Events Surveillance, 1993-2002	19
Figure 8. Number of victims by category and year, Hazardous Substances Emergency Events Surveillance, 1993-2002.....	20

List of Appendices

Appendix A. The hundred most frequent substances involved in events, Hazardous Substances Emergency Events Surveillance, 2002.....	22
Appendix B. Hazardous Substances Emergency Events Surveillance-Related Publications	25



Executive Summary

The Hazardous Substances Emergency Events Surveillance (HSEES) system, maintained by the Agency for Toxic Substances and Disease Registry (ATSDR), actively collects information to describe the public health consequences of the release of hazardous substances. This report summarizes the characteristics of events reported to the 15 state health departments that participated in HSEES in 2002. 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 9014 events were reported. In 8153 (90.4%) events, only one substance was released. The most commonly reported categories of substances were

inorganic substances (excluding acids, bases, ammonia, and chlorine); mixtures involving multiple substances from different substance categories that had been mixed before the event; and volatile organic compounds. During this reporting period, 739 events (8.2% of all reported events) resulted in a total of 2150 victims, of whom 47 (2.2%) died. The most frequently reported injuries were respiratory symptoms, eye irritation, dizziness or other central nervous system symptoms, and headache. Evacuation reportedly was ordered for 545 (6.0%) events.

The findings regarding the percentages of events with victims and events with evacuations and the distributions of the numbers and types of injuries reported have overall been consistent over time.



Introduction

The Centers for Disease Control and Prevention defines surveillance as “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”[1].

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 the release 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 [2]. A review of these databases indicated limitations. Many events were missed because of incomplete reporting (for example, the HMIS did not record events involving intrastate carriers or fixed-facility events). Other important information was not recorded, such as the demographic characteristics of victims, the types of injuries sustained, and the number of persons evacuated. As a result of this review, ATSDR implemented the HSEES system to more fully describe the public health consequences of the release of hazardous substances.

HSEES has four 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;
- To identify risk factors associated with the morbidity and mortality; and
- To identify 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 also useful to protect public health.

In the last few years, ATSDR has emphasized the fourth goal of the HSEES system; 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 2002, 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 2002, 15 state health departments (Alabama, Colorado, Iowa, Louisiana, Minnesota, Mississippi, Missouri, New York, New Jersey, North Carolina, Oregon, Texas, Utah, Washington, and Wisconsin) collected data for HSEES. Beginning in 2002, a newly updated data-collection form, approved by the Office of Management and Budget, went into effect. For each event, information was collected about the event, substance(s) released, victims, injuries, and evacuations.

Various data sources were used to obtain information about these events. These sources included, but



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 suffer at least one adverse health effect within 24 hours or who die as a consequence of the event. Victims who receive more than one type of injury are counted once in each applicable injury type. Events are defined as transportation-related if they occur during surface, air, pipeline, or water transport of hazardous substances, or before being unloaded from a vehicle or vessel. All other events are considered fixed-facility events.

For the data analyses in this report, the substances released were categorized into 16 groups. The category “mixture” comprises substances from different categories that were mixed before the event, and the category “other inorganic substances” comprises all inorganic substances, except acids, bases, ammonia, and chlorine.

Results

For 2002, 9014 hazardous substances emergency events were reported to HSEES: 198 (2.2%) of these events were threatened releases. A total of 6493 (72.0%) occurred in fixed facilities. Two states, Texas and New York reported 43% of all releases (Table 1).

For each fixed-facility event, states can select one or two types of area involved in the release. Of all 6493 fixed-facility events, 5557 (85.6%) had one type of area reported; 893 (13.7%), a combination of two

Table 1. Number of events meeting the surveillance definition, by state and type of event, Hazardous Substances Emergency Event Surveillance, 2002.

State	Type of event				Total no. events
	Fixed facility		Transportation		
	No. events	%*	No. events	%*	
Alabama	80	45.5	96	54.5	176
Colorado	90	45.9	106	54.1	196
Iowa	231	73.3	84	26.7	315
Louisiana	630	83.8	122	16.2	752
Minnesota	230	64.6	126	35.4	356
Missouri	201	51.0	193	49.0	394
Mississippi	98	51.6	92	48.4	190
North Carolina	123	39.5	188	60.5	311
New Jersey	406	73.0	150	27.0	556
New York	737	66.6	369	33.4	1106
Oregon	173	61.3	109	38.7	282
Texas	2482	89.6	289	10.4	2771
Utah	329	73.8	117	26.2	446
Washington	410	65.6	215	34.4	625
Wisconsin	273	50.8	264	49.2	537
Total†	6493	72.0	2520	28.0	9013

* Percent=(no. of events per type of event per state / total no. of event in that state)x100

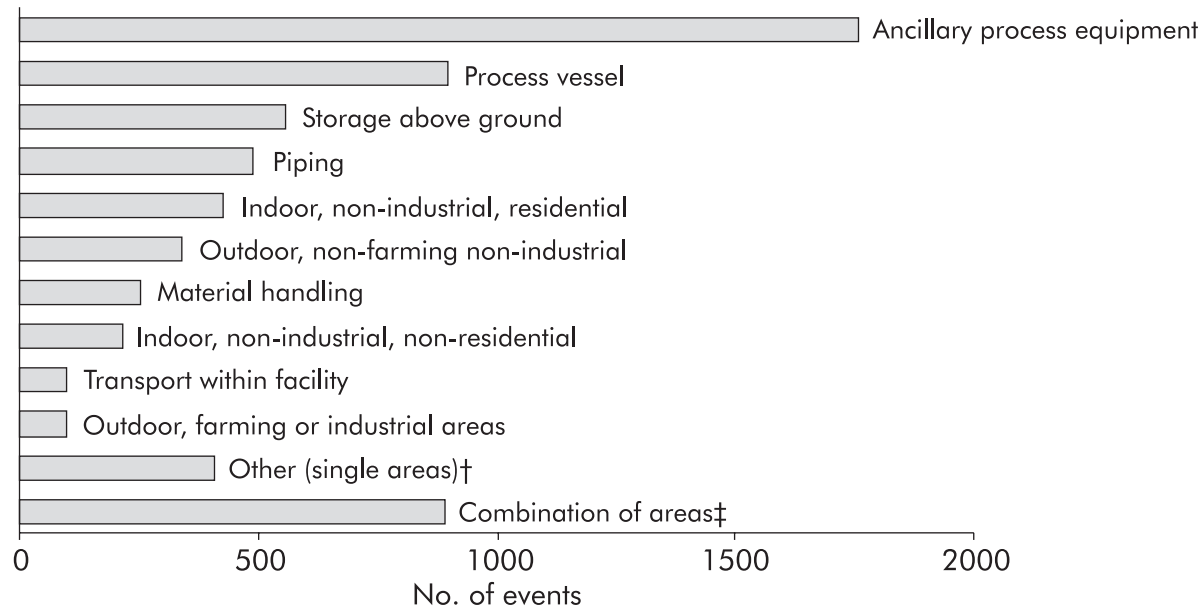
† Of a total of 9014 events, one event was excluded. This event was reported by NJ and had an unknown type of event.

area types; and 43 (0.7%), no type of area reported. Among events with one type of area reported, the main areas were classified as follows: 1761 (31.7%) ancillary processing equipment, 895 (16.1%) process vessel (a reaction chamber in which chemicals are processed), 559 (10.1%) storage areas above ground (i.e., tank, storage shed, and warehouse), and 491 (8.8%) piping. Of the 893 events with two areas, 479 (53.6%) involved ancillary processing equipments in combination with other types of area (Figure 1). Of the 2520 transportation-related events, 2155 (85.5%) occurred during ground transport (e.g., truck, van, or tractor), and 241 (9.6%) involved transport by rail (Figure 2). Fewer events involved water, air, and

pipeline transportation modes. The largest proportion of transportation-related events occurred during loading or unloading of a stationary vehicle or vessel (45.3%) and from a moving vehicle or vessel (32.7%).

Factors contributing to the events consisted of primary and secondary entries and were reported for 8965 (99.5%) events (Figure 3). Of reported factors, more than half, (3420, 52.9%), of fixed-facility events and 751 (29.9%) of transportation-related events involved equipment failure as the primary factor; 1266 (19.6%) of fixed-facility and 1593 (63.5%) of transportation-related events involved human error as the primary factor.

Figure 1. Areas of fixed facilities involved in events, Hazardous Substances Emergency Surveillance, 2002.*

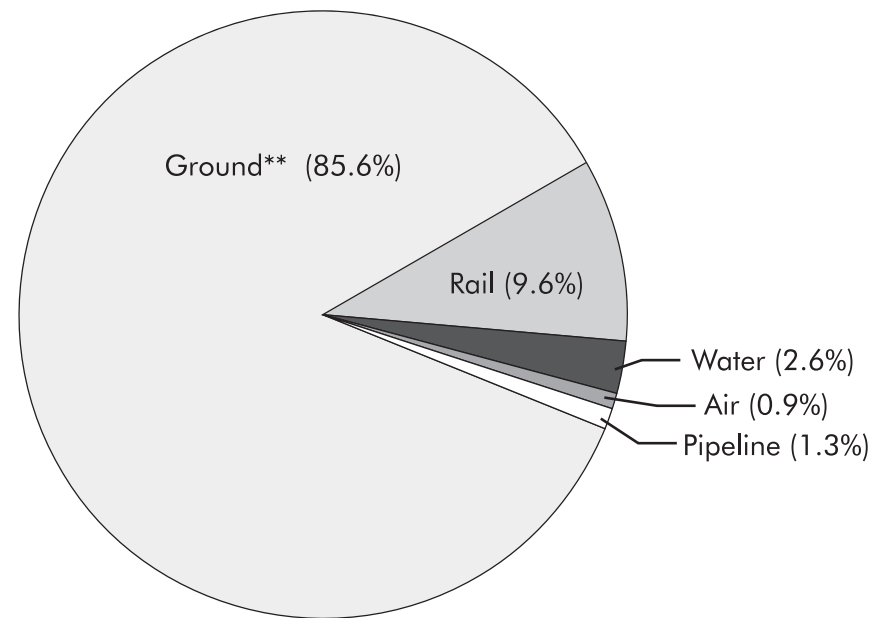


* Of all 6493 fixed facility events, 43 had missing areas, 5557 had one type of area and 893 had a combination of areas reported.

† Of 411 other single areas, 95 were transformer/capacitor, 86 dump/waste, 75 heating/cooling in building, 66 incinerator, 45 laboratory, and the remainder were other areas.

‡ Of 893 combinations of areas, 271 were process vessel and ancillary process equipment, 107 were piping and ancillary process equipment, and the remainder were other type of combinations.

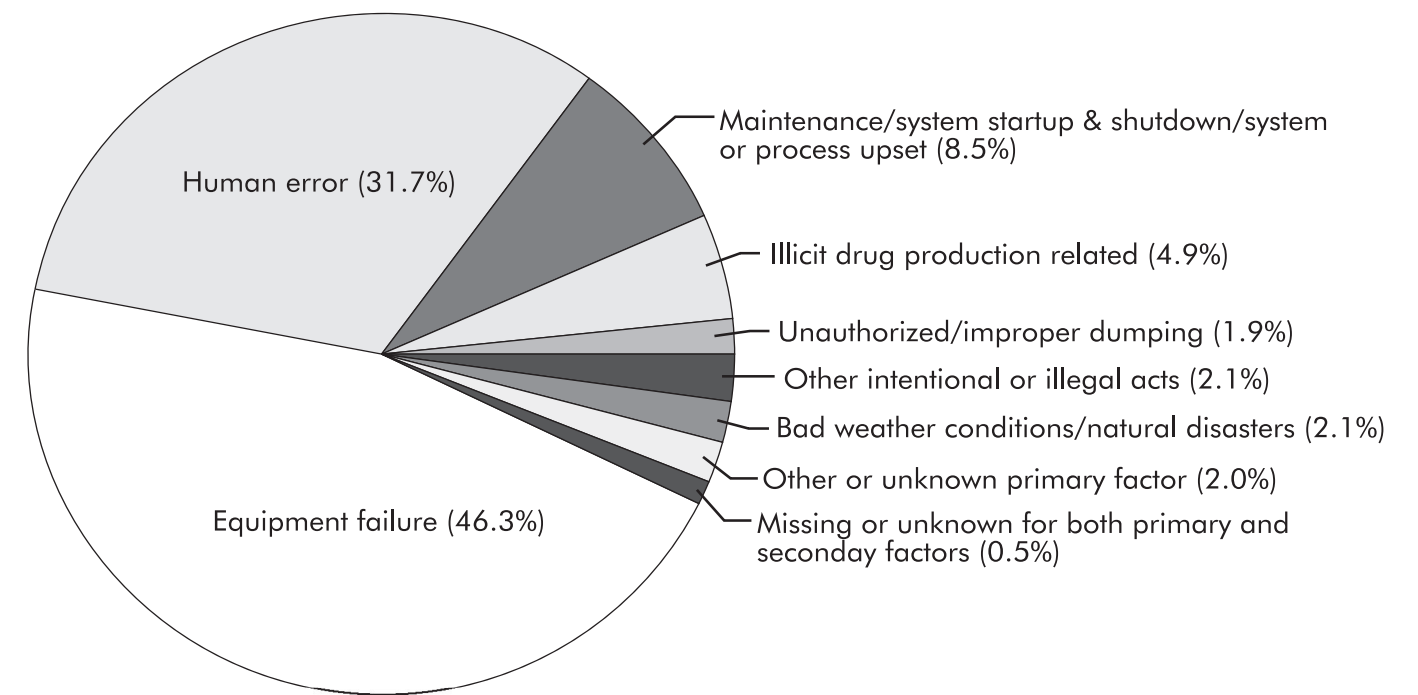
Figure 2. Distribution of transportation-related events, by type of transport, Hazardous Substances Emergency Surveillance, 2002.*



* The type of transport was not reported for two events.

** One event had a combination of ground and rail and another had a combination of ground and water transport.

Figure 3. Factors reported as contributing to events, Hazardous Substances Emergency Surveillance, 2002.*



* Both primary and secondary factors were missing or unknown for 49 events.

Of 4171 equipment failures, 1852 were in combination with the following: system/process upset (632), system start up and shutdown (363), subsequent failure of another equipment (177), maintenance performance (160), power failure/electrical problem (142), improper filling, loading or packing (96), fire (95), and the remainder with other factors.

Of 2860 human error primary factors, 2211 were in combination with the following: improper filling, loading or packing (1068), equipment failure (199), forklift puncture (198), vehicle or vessel derailment (128), vehicle or vessel collision (103) and the remainder with other factors.

Of 187 weather related primary factors, 155 were in combination with the following: equipment failure (58), and the remainder with other factors.

Of the 177 events with other or unknown primary factor 57 involved fire and 31 involved power failure.

For events which did not involve human error or equipment failure where the secondary factor was associated with unauthorized/improper dumping; maintenance, system startup and shutdown, and system or process upset; and other intentional or illegal acts and for events with a secondary factor associated with illicit drug production, both primary and secondary factors were combined to make separate categories.

More than 90% of all events involved the release of only one substance. Two substances were released in 392 (4.4%) events, and approximately 5% 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 involved in an event (11.7% vs. 4.0%).

A total of 11,009 substances were either released or threatened to be released during the 9014 events. States could report two types of release for each chemical (e.g., spill and air). Of a total of 10,953 substances having type of release reported, only one release was reported for the following: air releases (5324, 48.6%), spills (4201, 38.3%), fires (376, 3.4%), and explosions (66, 0.6%). Two types of release most commonly reported together were spill and air releases (398, 3.6%), fires and explosions (45, 0.4%) spill and fire (43, 0.4%) and air release and fire (42, 0.4%); the remainder involved

Table 2. Number of substances involved per event, by type of event, Hazardous Substances Emergency Events Surveillance, 2002.

No. substances	Type of event						All events*		
	Fixed facility			Transportation					
	No. events	%	Total substances	No. events	%	Total substances	No. events	%	Total substances
1	5734	88.3	5734	2418	95.9	2418	8152	90.4	8152
2	327	5.1	654	65	2.6	130	392	4.4	784
3	137	2.1	411	25	1.0	75	162	1.8	486
4	222	3.4	888	7	0.3	28	229	2.5	916
≥ 5	73	1.1	642	5	0.2	28	78	0.9	670
Total	6493	100.00	8329	2520	100.0	2679	9013	100.0	11008

* Of a total of 9014 events, one event for which the type of event was not reported was not included. This event had one substance involved.

other combinations of release types, or unknown release types.

The number of events by month ranged from 611 (6.8%) in December to 881 (9.8%) in June, with the largest proportions occurring from April to July, the peak agricultural season. The proportion of events ranged from 15.8% to 17.3% during week days, and from 8.0% to 9.3% during weekend days. Of all 8815 (97.8%) events for which time of day or time category was reported, 34.5% occurred from 6:00 a.m. to 11:59 a.m., 32.3% from 12:00 p.m. to 5:59 p.m., 18.1% from 6:00 p.m. to 11:59 p.m., and the remainder during the early hours of the day.

Industries

The largest proportions of HSEES events were associated with the manufacturing (43.3%) and the transportation (25.6%) industries (Table 3). However, the largest proportion of events with injuries occurred

in the personal services industry (24.5%), mostly in private households and in hotels and motels. The number of victims in the personal services industry was third highest (321, 14.9%) following the number of victims in the manufacturing industry (549, 25.5%) and the professional services industry (404, 18.8%). Most of the private household events were associated with illicit production of methamphetamine. Among the events in professional services, educational services constituted the largest proportion (48.4%) and had the largest number of victims (240).

Substances

A total of 11,009 substances were involved in all events, of which 436 (4.0%) were reported as threatened releases. The substances most frequently released were ammonia, sulfur dioxide, nitrogen oxide and carbon monoxide (Appendix A). These substances were grouped into 16 categories. The categories most commonly involved in fixed-facility events were other

Table 3. Industries involved in hazardous substances events, by category, Hazardous Substances Emergency Events Surveillance, 2002.

Industry category	Total events		Events with victims		Percentage events with victims	Total no. victims # (range)*
	No.	%	No.	%		
Agriculture	198	2.2	25	3.4	12.6	58 (1–9)
Mining	137	1.5	2	0.3	1.5	2 (1)
Construction	106	1.2	17	2.3	16.0	31 (1–4)
Manufacturing	3904	43.3	121	16.4	3.1	549 (1–67)
Transportation	2304	25.6	120	16.2	5.2	238 (1–23)
Communications†	4	0.0	1	0.1	25.0	3 (3)
Utilities	529	5.9	17	2.3	3.2	33 (1–4)
Wholesale trade	403	4.5	41	5.5	10.2	76 (1–11)
Retail Trade	94	1.0	28	3.8	29.8	113 (1–38)
Finance	24	0.3	10	1.3	41.7	47 (1–16)
Business Services	69	0.8	14	1.9	20.3	25 (1–6)
Personal Services	516	5.7	181	24.5	35.1	321 (1–24)
Entertainment	37	0.4	13	1.8	35.1	65 (1–20)
Professional Services	213	2.4	71	9.6	33.3	404 (1–44)
Public Administration	104	1.1	18	2.4	17.3	58 (1–18)
Unspecified and unknown	372	4.1	60	8.2	16.4	129 (1–21)
Total	9014	100.0	739	100.0	8.2	2150

* Range of number of victims per event with victims.

† Percentage of the communication in total events is 0.04.

inorganic substances (1983, 23.8%), mixtures (1525, 18.3%), and volatile organic compounds (VOCs) (1388, 16.7%). In transportation-related events, the most common releases were VOCs (457, 17.2%), acids (391, 14.7%), and pesticides and other agricultural chemicals (305, 11.4%) (Table 4).

Victims

A total of 2150 victims were involved in 739 events (8.2% of all events) (Table 5). Of the 739 events with victims, 436 (59.0%) events involved only one victim, and 130 (17.6%) involved two victims. Of all victims, 1712 (79.7%) were injured in fixed-facility events. Fixed-facility events were more likely to have

more than one victim per event (43.3%) than were transportation events (34.2%).

To represent the magnitude of the effects of substances involved on injuries, the number of events in a specific substance category was compared with the number of events in the same category that had victims. Substances in events that involved one or more substances from the same substance category were counted once in that category. Substances in events that involved two or more substances from different categories were counted once in the multiple-substance categories. Substances released most often were not necessarily the most likely to result in victims (Table 6).

Table 4. Number of substances involved, by substance category and type of event, Hazardous Substances Emergency Events Surveillance, 2002.

Substance category	Type of event				All events	
	Fixed facility		Transportation			
	No. substances	%	No. substances	%	No. substances	%
Acids	469	5.6	391	14.7	860	7.8
Other*	599	7.2	248	9.3	847	7.7
Mixture†	1525	18.3	84	3.1	1609	14.6
Ammonia	459	5.5	100	3.8	559	5.1
Bases	165	2.0	267	10.0	432	3.9
Chlorine	198	2.4	51	1.9	249	2.3
Other inorganic substances‡	1983	23.8	236	8.9	2219	20.2
Paints & dyes	150	1.8	123	4.6	273	2.5
Pesticides and other agricultural chemicals	338	4.1	305	11.4	643	5.9
Polychlorinated biphenyls	79	1.0	3	0.1	82	0.8
Volatile organic compounds	1388	16.7	457	17.2	1845	16.8
Formulations	16	0.2	8	0.3	24	0.2
Hetero-Organics	71	0.9	33	1.2	104	1.0
Hydrocarbons	132	1.6	73	2.7	205	1.9
Oxy-Organics	649	7.8	174	6.5	823	7.5
Polymers	97	1.2	112	4.2	209	1.9
Total•	8318	100.0	2665	100.0	10983	100.0

* Not classified.

† Substances from different categories that were mixed prior to the event.

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

• Of a total of 11009 substances, 26 substances were excluded. Twenty-five of these substances were not assigned a substances category and one event with one substance, categorized as VOC, was not assigned a type of event.

Table 5. Number of victims per event, by type of event, Hazardous Substances Emergency Events Surveillance, 2002.

No. victims	Type of event						All events		
	Fixed facility			Transportation					
	No. of events	%	Total victims	No. events	%	Total victims	No. events	%	Total victims
1	311	56.7	311	125	65.8	125	436	59.1	436
2*	91	16.6	182	38	20.0	76	129	17.5	258
3	47	8.6	141	10	5.3	30	57	7.7	171
4	25	4.6	100	6	3.2	24	31	4.2	124
5	12	2.2	60	2	1.0	10	14	1.9	70
≥ 6	62	11.3	918	9	4.7	171	71	9.6	1089
Total*	548	100.0	1712	190	100.0	436	738	100.0	2148

* Of all 739 events, one event with 2 victims is not included because the type of event was not known.

Table 6. Frequency of substance categories in all events and events with victim, Hazardous Substances Emergency Events Surveillance System, 2002.

Substance category	All events		Events with victims		
	No.	%	No.	%	Percentage events with victims in substance category
Acids	676	7.5	72	9.8	10.7
Other†	573	6.4	72	9.8	12.6
Mixture‡	1580	17.6	69	9.4	4.4
Ammonia	501	5.6	91	12.4	18.2
Bases	372	4.1	20	2.7	5.4
Chlorine	224	2.5	52	7.1	23.2
Other inorganic substances•	1422	15.8	56	7.6	3.9
Paints & dyes	223	2.5	4	0.5	1.8
Pesticides & other agricultural chemicals	557	6.2	59	8.0	10.6
Polychlorinated biphenyls	80	0.9	0	0.0	0.0
Volatile organic compounds	1191	13.2	50	6.8	4.2
Multiple substance categories	699	7.8	110	14.9	15.7
Formulations	13	0.1	3	0.4	23.1
Hetero organics	88	1.0	8	1.1	9.1
Hydrocarbons	138	1.5	7	1.0	5.1
Oxy-organics	481	5.3	55	7.5	11.4
Polymers	175	1.9	8	1.1	4.6
Total€	8993	100.0	736	100.0	8.2

† Not classified.

‡ Substances from different categories that were mixed prior to the event.

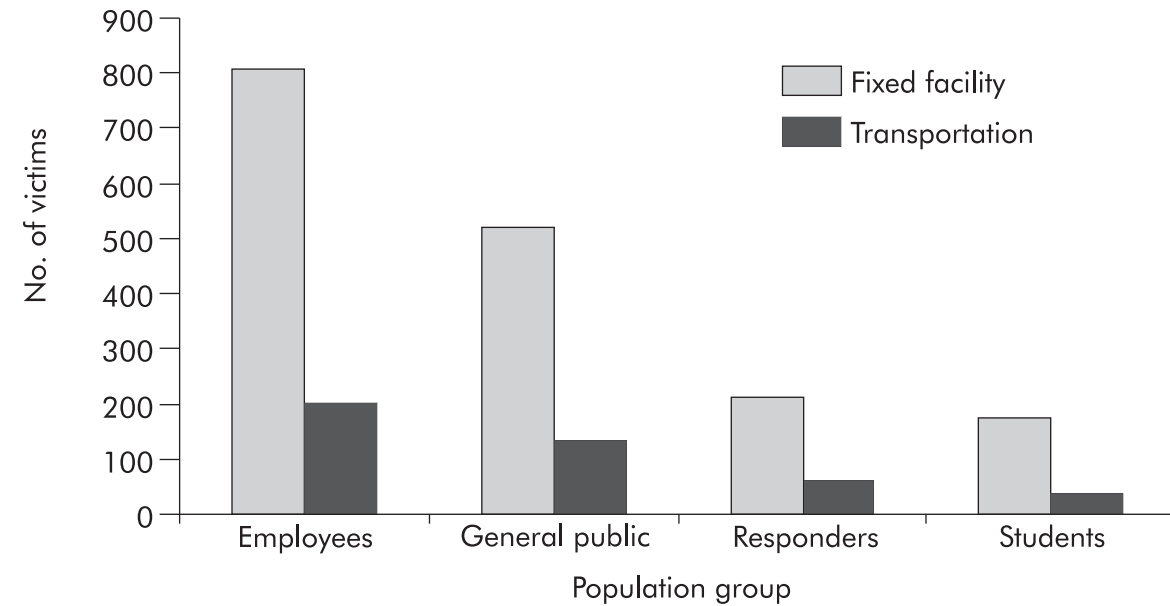
• All inorganic substances except for acids, bases, ammonia, and chlorine.

€ Of a total of 9014 events, 21 events were not included. Of the 21 events, 20 involved one substance each, and one event involved two substances of which one had its substance category missing. Three of the excluded events had four victims.

For example, events involving the substance category “other inorganic substances” constituted 15.8% of all events. However, only 3.9% of these events resulted in injuries. Conversely, events involving chlorine or ammonia exclusively comprised 2.5% and 5.6% of all events respectively, but 23.2% of these chlorine events and 18.2% of ammonia events resulted in injuries. Events involving substances from multiple categories also had a relatively large proportion of events with victims (15.7%).

Employees (1008, 46.9%) constituted the largest proportion of the population groups injured, followed by members of the general public (652, 30.3%), responders (274, 12.7%), and students (211, 9.8%) (Figure 4). Two hundred eleven emergency response personnel were injured in fixed-facility events. Of those, 117 (55.4%) were police officers, 37 (17.5%) were career firefighters, and 28 (13.3%) were volunteer firefighters (Figure 5a). Sixty-three emergency responder victims were injured in transportation-

Figure 4. Number of victims, by population group* and type of event, Hazardous Substances Emergency Events Surveillance, 2002.



* Of all 2150 victims, the population group was not known for 5 victims. Also, one event for which the type of event was not known had 2 victims in the general public category.

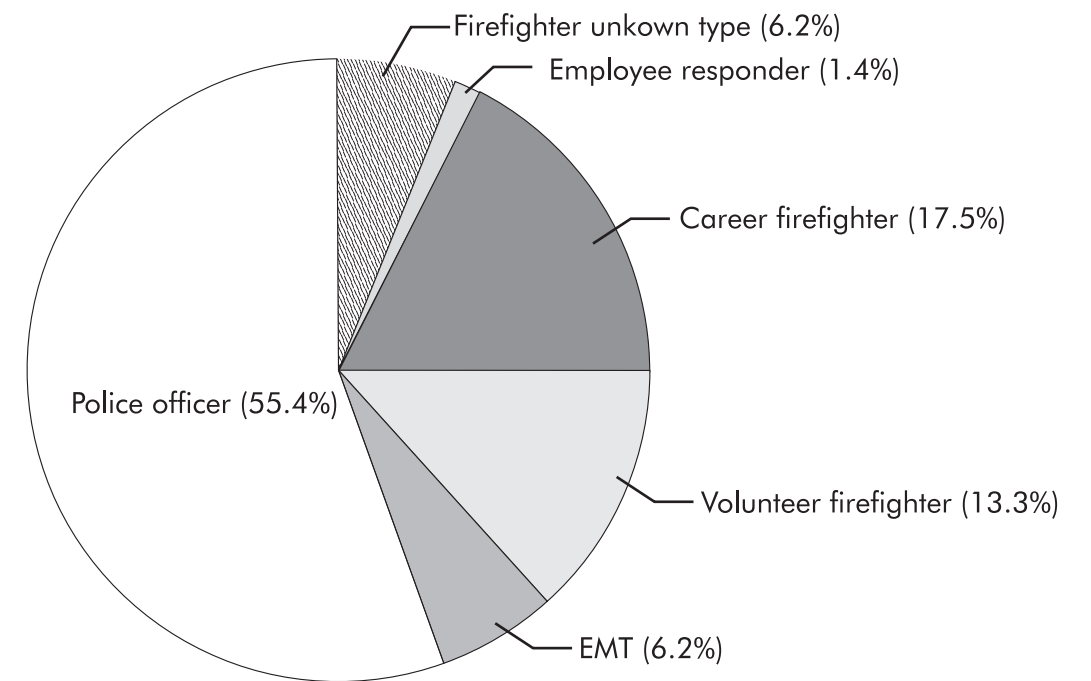
related events. Of these, most (46) were police officers (Figure 5b). Police officers were more frequently victims in transportation-related events (73.0%) than in fixed facility-events (55.4%).

Victims were reported to sustain a total of 3288 injuries (Table 7). Some victims had more than one injury. Of all reported injuries, the most common injuries in fixed-facility events were respiratory symptoms (876, 32.2%), eye irritation (342, 12.6%), dizziness or other central nervous system symptoms (339, 12.5%), headache (323, 11.9%), gastrointestinal symptoms (272, 10.0%) and burns (213, 7.8%). In transportation-related events, respiratory symptoms (205, 36.3%), trauma (104, 18.4%), eye irritation (88, 15.6%) and burns (36, 6.4%) were reported most frequently. In a large proportion of the instances, trauma might have resulted from a chain of events,

such as a motor vehicle accident, leading to the release of a hazardous substance, and not necessarily by the exposure to the substance itself.

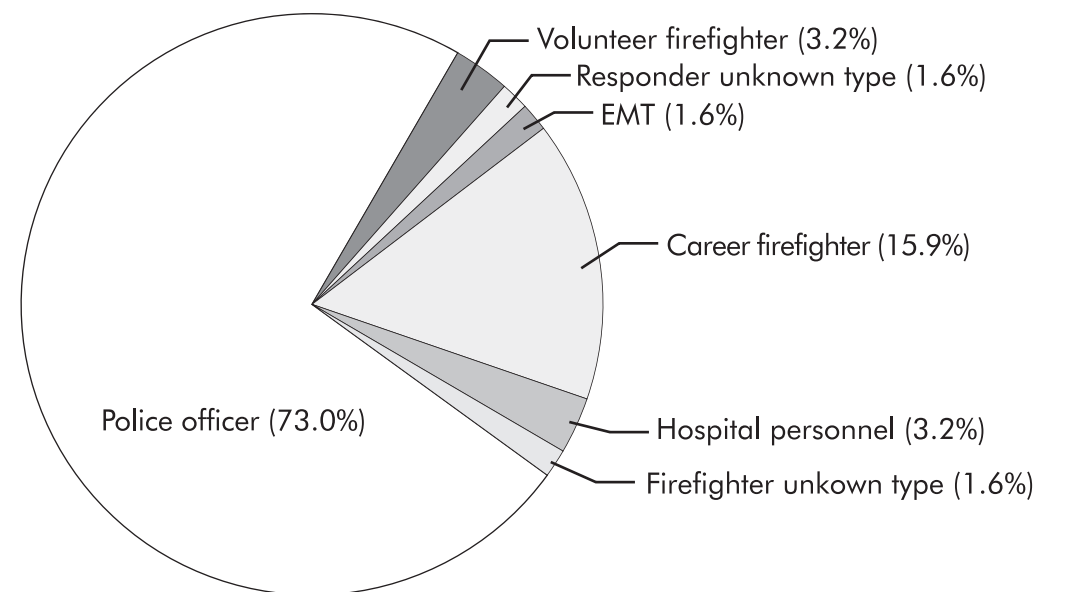
Sex was known for 1705 (79.3%) of the victims; of these 1117 (65.5%) were males. Males constituted 75.2% of all employees and responders for whom sex was reported. The median age of the 1001 (46.6%) victims for whom age was reported was 31 years (range: 0–83, where 0 includes victims <1 year old). Of these, 23 were children aged <10 years, and 182 were children aged 10–18 years. For the 1149 (53.4%) injured persons for whom the age was not reported, 738 (64.2%) were presumably adults (first responders and employees), 77 (6.7%) were students, and 334 (29.1%) could have been adults or children (members of the general public or the category of victims was not known). The largest proportion of victims

Figure 5a. Distribution of responders injured in fixed facility events,* by type of responder, Hazardous Substance Emergency Events Surveillance, 2002.



* A total of 211 responders were injured during fixed-facility events.

Figure 5b. Distribution of responders injured in transportation events,* by type of responder, Hazardous Substance Emergency Events Surveillance, 2002.



* A total of 63 responders were injured during transportation events.

Table 7. Frequencies of injuries/symptoms, by type of event,* Hazardous Substances Emergency Events Surveillance, 2002.

Injury/symptom	Fixed facility		Transportation		All events	
	No. injuries	%	No. injuries	%	Total no.	%
Trauma	94	3.4	104	18.4	198	6.0
Respiratory	876	32.2	205	36.3	1081	32.9
Eye	342	12.6	88	15.6	430	13.1
Gastrointestinal system	272	10.0	28	5.0	300	9.1
Heat stress	3	0.1	0	0	3	0.1
Chemical burns	213	7.8	36	6.4	249	7.6
Other	67	2.5	10	1.8	77	2.3
Skin	138	5.1	25	4.4	163	5.0
Dizziness or other central nervous system	339	12.5	28	5.0	367	11.2
Headache	323	11.9	39	6.9	362	11.0
Heart problems	6	0.2	2	0.4	8	0.2
Shortness of breath	48	1.8	0	0	48	1.5
Total†	2721	100.0	565	100.0	3286	100.0

* The number of injuries is greater than the number of victims (2150) because a victim could have had more than one injury.

† Of all 3288 reported injuries, two trauma injuries were not included because the type of event was not known. Also, the injuries of nine victims were not reported.

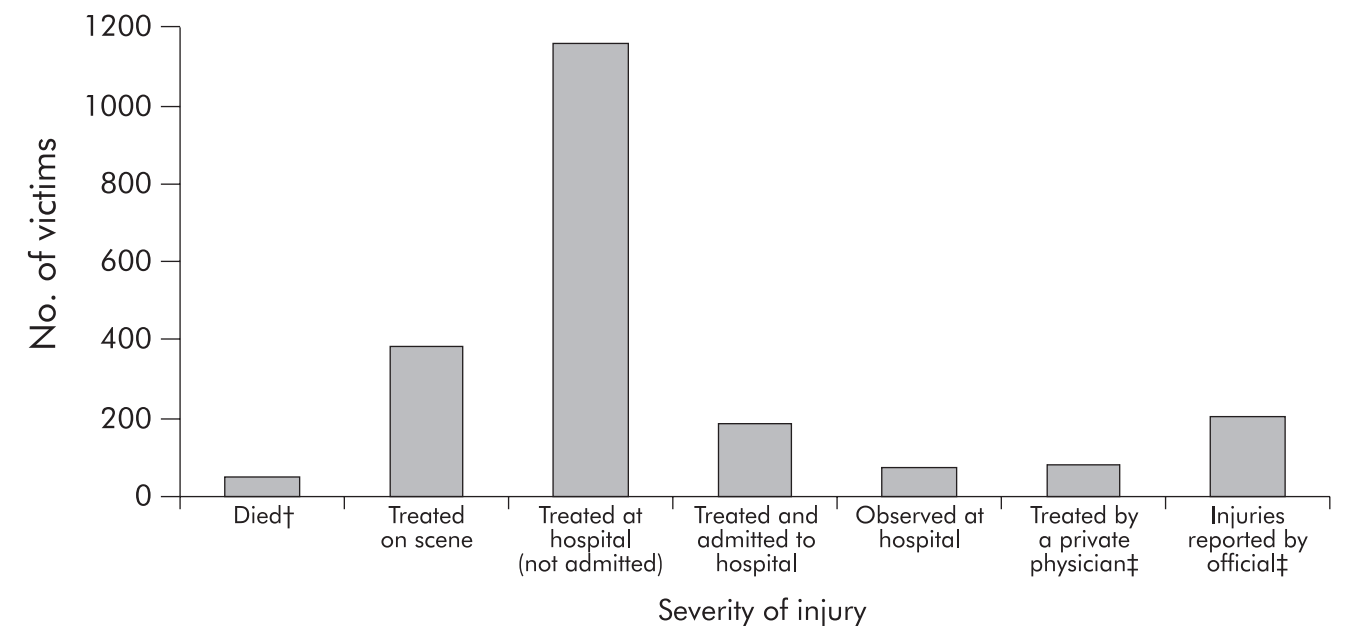
(1157, 54.3%) were transported and treated at a hospital but not admitted; 185 (8.7%) were admitted, and 47 (2.2%) died (Figure 6).

The status of personal protective equipment (PPE) use was reported for 903 (89.6%) employees and for 241 (88.0%) first-responder victims. Most of these employees (88.7%) and 39.8% of first responders had not worn any form of PPE. Employees who wore PPE, most often used gloves and eye protection (50, 49.0%). Among first responders who wore PPE, 34 (23.4%) wore firefighter turn-out gear with respiratory protection; 32 (22.1%) wore firefighter turn-out gear only; and 61 (42.1%) wore gloves.

Two events involved more than 50 injured people per event. The first resulted from a chlorine spill caused by an equipment failure in an industrial and chemical facility. This event affected 67 people, of whom 61 were members of the general public and six were employees. All victims exhibited respiratory symptoms and were transported to a hospital for treatment; two were admitted. The second event occurred in a paper and pulp products facility and resulted from air emission of carbon monoxide where the ventilation system failed to work properly due to human error. This event affected 54 employees. All but one suffered headache and dizziness; one also had respiratory symptoms; and one had skin irritation and dizziness. Four of the

Note: Firefighter turn-out gear is protective clothing normally worn by firefighters during structural fire-fighting operations and is similar to level “D” protection. Level “D” as defined by the Occupational Safety and Health Administration is coveralls, boots/shoes (leather or chemical resistant, steel toe and shank), safety glasses or chemical splash goggles, and hard hat. Level “D” provides limited protection against chemical hazards.

Figure 6. Injury disposition, Hazardous Substances Emergency Events Surveillance, 2002.*



* Injury disposition was not reported for 18 injured persons.

† Of all 47 deaths, 35 people died at scene or on arrival to hospital, and 12 died at hospital.

‡ Both categories are within 24 hours.

employees received first aid at the scene, and the other 50 were transported to a hospital for treatment but were not admitted.

Evacuations

Evacuations were ordered in 545 (6.3%) of 8607 events where evacuation status was reported. Of these evacuations, 68.6% were of a building or the affected part of a building; 16.3% were of a defined circular area surrounding the event locations; and the remainder were of a downwind or downstream area, a circular and downwind or downstream area, of no criteria, or not known. The number of people evacuated was known for 424 events and ranged from 1 to 3000 people, with a median of 23. However, 65 ordered evacuations were reported having no evacuees.

The median length of evacuation was 2 hours. In 95% of events for which evacuation was ordered, access to the area was restricted. Seventy-nine events had in-place sheltering ordered by an official.

Response

Of the 7759 (86.1%) events with information on who responded to the event; 19.6% had 2 or more categories of responders reported. The company’s response team responded to 74.9% of events, a certified haz mat team to 10.7%, the fire department to 16.9%, a law enforcement agency to 14.4%, an environmental agency to 7.0%, emergency medical services to 4.9%, hospital personnel to 1.0%, ‘other’ to 2.9%, a health department to 2.1%, and the EPA emergency response team to 0.2%.



Uses of the HSEES Data

During 2002, ATSDR continued to respond to requests for HSEES information from local, state, and federal agencies and organizations. ATSDR also continued to respond to requests from researchers for copies of the HSEES protocol, data collection form, data, and publications. HSEES data have been used for presentations in national and state conferences and for articles published in peer-reviewed journals (Appendix B). An important contribution of the data is the ability of each participating state to target prevention activities pertaining to issues related to acute spills in their state. These include school personnel, industry and labor groups, first responders, hospital personnel, and producers or users of potentially dangerous substances. HSEES coordinators, often in collaboration with other local and state agencies, conduct the activities. These activities are also being evaluated for effectiveness.

The HSEES Internet website page is available at <http://www.atsdr.cdc.gov/HS/HSEES/>. At this site, HSEES annual reports and other information can be downloaded. Internet links to other relevant websites and a public-use dataset will be available on the HSEES website in the future.

Current HSEES-related activities include collaboration with the Federal Emergency Management Agency, U.S. Chemical Safety and Hazard Investigation Board, U.S. Environmental Protection Agency, and other agencies and organizations involved with response to chemical terrorism, emergency response, hazardous substances releases, and public health. Ten years of HSEES data are now available for trend analysis, and several publications are in development or being submitted to peer-reviewed journals.

Prevention Activities

During 2002 participating state coordinators performed various prevention activities. These activities included:

- Collaboration with the local emergency planning committee to increase awareness of hazardous chemicals through training targeted to the needs of employees, first responders and the general public.
- Collaboration with a poison control center (PCC) to improve the interaction between the PCC and responders who are consulting or treating victims of hazardous substances releases.
- Distribution of ATSDR's "Managing Hazardous Material Incidents" guidelines on CD-ROM to hospital emergency departments. The guidelines are designed to help health-care providers recognize symptoms of chemical exposure and treat them accordingly.
- Collaboration with state bureau of investigation through fact sheets and information sheets to help reduce exposure and injuries among their personnel during seizures of methamphetamine laboratories.
- Provision of information on HSEES findings related to chlorine releases to managers and operators of swimming pools through telephone outreach. The goal was to increase awareness of the importance of training, storage practices, site security, and maintenance to reduce injuries and evacuations.



Acute Releases of Hazardous Substances in Schools During 2002

During 2002 13 participating states reported a total of 102 school events. Of these, 63 (61.8%) occurred in elementary and secondary schools; 36 (35.3%), in colleges and universities; and three (2.9%), in vocational schools. Thirty-six (35.3%) of these events resulted in injuries. School events were proportionally over four times as likely to have resulted in injuries and over six times as likely to have an evacuation ordered as were all other events reported to the system during that period. Of all events with evacuees, a total of 5935 people were officially evacuated (range: 6–1500; median: 60 people).

Of all 240 injured persons, students made up the highest proportion (184, 76.7%) followed by employees (50, 20.8%). The majority of victims were transported to a hospital (147, 61.2%) or treated by first aid at the scene (83, 34.6%). Only three victims were admitted to the hospital. Most victims sustained one or more symptoms, including eye irritation (n=117), respiratory symptoms (n=90), dizziness or other CNS symptoms (n=73), gastrointestinal symptoms (n=44), skin irritation (n=25), and burns (n=21). The most common cause of events was human error, followed in frequency by equipment failure and intentional or illegal acts. The substances most frequently involved in the events were mercury (19, 16.7%), hydrochloric acid (9, 7.9%), and ethylene glycol (5, 4.4%).

A case vignette illustrates the type of releases that occur at schools. A middle school student dumped mercury in the hallway of an elementary school. As a result, 543 students and staff were evacuated and decontaminated. One student rubbed his eyes with the mercury and was taken to hospital for further decontamination and evaluation. The event lasted for 6 hours.

Yearly analysis of HSEES data shows that, since 1994, mercury remains the most frequently released substance in schools. Although most of these events do not involve injuries, the cost of cleanup, time missed from school, and relocation can be substantial.

Summary of Results, 1993-2002

During 1993–2002, the largest proportion of events occurred in fixed facilities (Table 8). However, the number of reported transportation-related events is increasing. The increase is partially due to the utilization 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 over time, partially because of the addition of new states to the surveillance system (Figure 7). However, the increase also occurred among states that have participated in the system since 1993. The increase in the number of events in these states may have been due, at least in part, to the expansion of reporting sources.

In events involving victims, respiratory symptoms consistently have been most frequently reported. The number of deaths associated with events continues to suggest the need to evaluate, not only the danger posed by exposure to hazardous substances, but also the circumstances surrounding the events (e.g., a crash resulting from high-speed travel of a truck pulling an ammonia tank). Employees continue to be the most commonly reported victims of emergency events. However, members of the general public, responders, and students constitute a large proportion as well (Figure 8).

Table 8. Cumulative data for all states, by year, for the states reporting to the Hazardous Substances Emergency Events Surveillance, 1993-2002.*

Year	No. states	Type of event			No. substances involved	No. victims	No. deaths	Events with victims	
		Fixed facility	Transportation	Total				No.	%†
1993	11	3199	634	3833	4361	2230	16	464	12.1
1994	12	3321	912	4233	5072	2181	21	414	9.8
1995	14	4273	1,037	5310	6027	1688	14	402	7.6
1996	14	4327	1,159	5486	5861	1622	33	390	7.1
1997	13	4385	1,128	5513	6089	1896	28	372	6.7
1998	13	4729	1,252	5981	6486	1533	36	405	6.8
1999	13	4634	1,626	6,260	6974	1912	30	504	8.0
2000	15	5499	2,049	7548	8342	2513	44	752	10.0
2001	16	6736	2,242	8978	11764	2168	22	710	7.9
2002	15	6493	2,520	9013	11009	2150	47	739	8.2
Total‡		47596	14559	62155	71985	19893	291	5152	8.3

* 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.

Figure 7. Cumulative data for all participating states, Hazardous Substances Emergency Events Surveillance, 1993-2002.

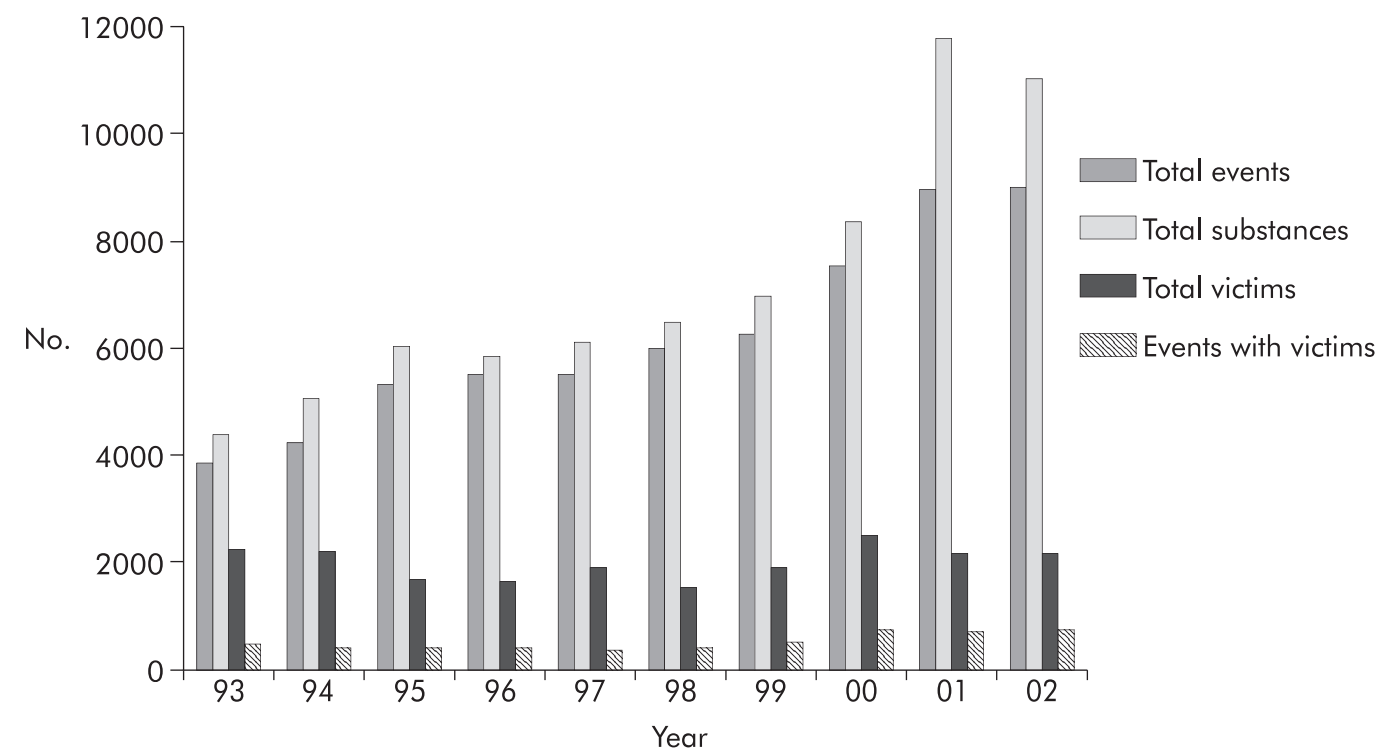
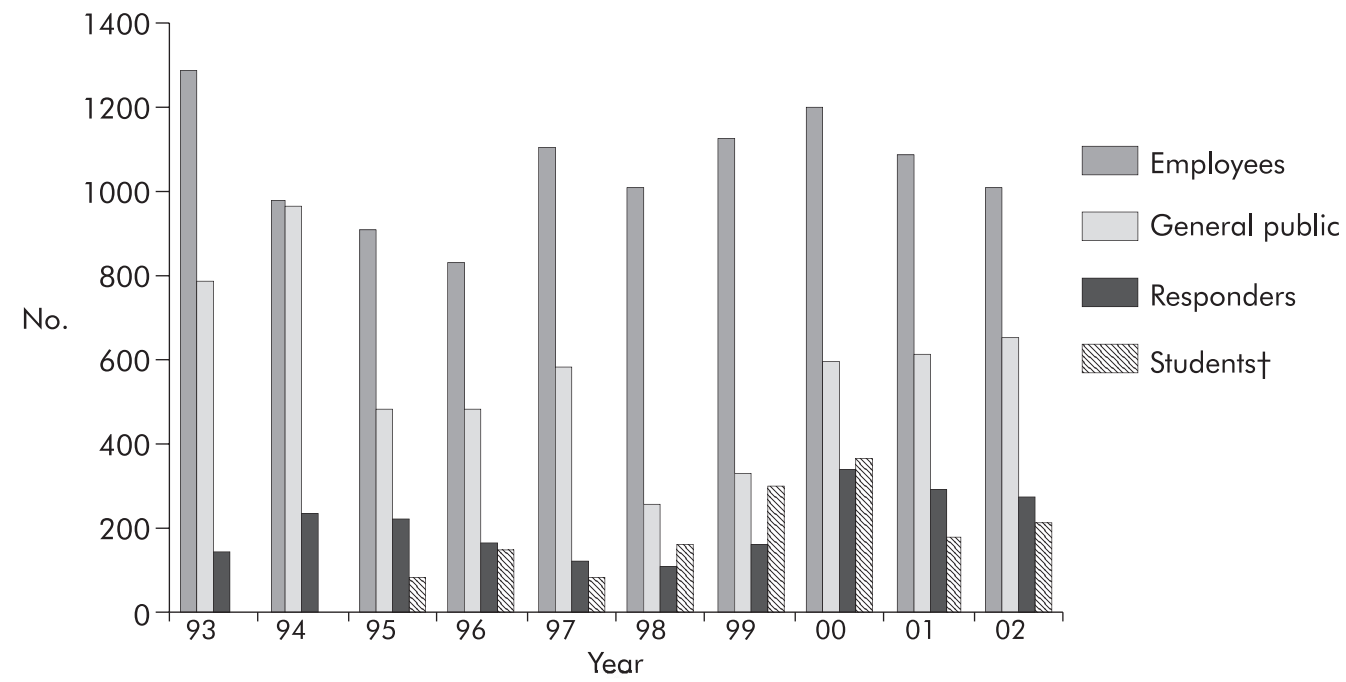


Figure 8. Number of victims by category and year, Hazardous Substances Emergency Events Surveillance, 1993-2002*



* There were 70 victims for whom the category was not known or was missing.

† The student category was not available before 1995. During that period students were included in the general public category.

The findings from the HSEES data analyses regarding the proportions of the number of events with victims and events with evacuations and the distributions of the numbers and types of injuries reported have been consistent over time.

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.

Appendices

Appendix A. — *The hundred most frequent substances involved in events, Hazardous Substances Emergency Events Surveillance, 2002.*

No.	Substance	No. involved
1	Ammonia	539
2	Sulfur Dioxide	451
3	Nitrogen Oxide (NO _x)	347
4	Carbon Monoxide	340
5	Hydrochloric Acid	231
6	Methamphetamine Chemicals NOS†‡	219
7	Volatile Organic Compounds	214
8	Sulfuric Acid	213
9	Nitric Oxide	210
10	Sodium Hydroxide	201
11	Mercury	160
12	Chlorine	137
13	Nitrogen Oxides NOS†	137
14	Benzene	126
15	Ethylene Glycol	117
16	Paint	116
17	Solvent NOS†	108
18	Hydrogen Sulfide	99
19	Polychlorinated Biphenyls	81
20	Super Clean	80
21	Butadiene	76
22	Acetone	75
23	Phosphoric Acid	74
24	Resin Solution	74
25	Nitrogen Dioxide	71
26	Paint or Coating NOS†	71
27	Potassium Hydroxide	70
28	Methanol	69
29	MIX: Carbon Monoxide/Ethylene/Oxides of Nitrogen NOS/Volatile Organic Compounds	67
30	MIX: Carbon Monoxide/Oxides of Nitrogen NOS/Sulfur Dioxide/Volatile Organic Compounds	66
31	Acid NOS†	65
32	Flammable Liquid NOS†	64
33	Isopropyl Alcohol	59
34	MIX: Carbon Monoxide/Hydrogen Sulfide/Oxides of Nitrogen NOS/Sulfur Dioxide	59
35	MIX: Carbon Monoxide/Oxides of Nitrogen NOS/Volatile Organic Compounds	59
36	Sodium Hypochlorite	58
37	Ethyl Alcohol	57
38	Fluorocarbon 22	57
39	Hydraulic Oil	53
40	Adhesive NOS†	52

41	Phosphorus	50
42	Freon	48
43	Pesticide NOS†	47
44	Propane	47
45	Ethylene	46
46	Toluene	46
47	Vinyl Chloride	46
48	Ethyl Ether	43
49	Hydrogen Peroxide	42
50	Xylene	42
51	Ethylene Oxide	40
52	MIX: Hydrogen Sulfide/Sulfur Dioxide	36
53	MIX: Carbon Monoxide/Oxides of Nitrogen NOS†	35
54	Methylene Chloride	33
55	Nitrous Oxide	33
56	Diesel Fuel	32
57	Formaldehyde	32
58	MIX: Acetylene/Carbon Monoxide/Hydrogen Sulfide/Oxides of Nitrogen NOS†	32
59	Acrolein	30
60	Paint Thinner	30
61	Asbestos	29
62	Carbon Dioxide	27
63	Iodine	27
64	Ephedrine	26
65	MIX: Carbon Monoxide/Ethylene/Oxides of Nitrogen NOS†	26
66	Acetic Acid	25
67	Ethylene Dichloride	25
68	Nitric Acid	25
69	Fertilizer NOS†	24
70	Nitrogen Fertilizer	24
71	Resin NOS†	24
72	Cleaning Agent NOS†	23
73	Hydraulic Fluid	23
74	MIX: Oxides of Nitrogen NOS†/Propylene	23
75	Amine NOS†	21
76	Antifreeze	21
77	Ammonium Nitrate	20
78	Caustic NOS†	20
79	Methyl Mercaptan	20
80	MIX: Ammonia/Bleach	20
81	MIX: Carbon Monoxide/Hydrogen Sulfide/Nitrogen Oxide (NO _x)/Sulfur Dioxide	20
82	Styrene	20
83	3M Light Water AFFF	19
84	Alcohol NOS†	19
85	Chloroform	19
86	Flammable Gas	19
87	Ink NOS†	19
88	MIX: Carbon Monoxide/Oxides of Nitrogen NOS†/Propylene	19

89	Transformer Oil	19
90	Methyl Ethyl Ketone	18
91	Tetrachloroethylene	18
92	Battery Acid	17
93	EPA F039*: Multi-Code Treatment, Storage, or Disposal Leachate	17
94	Fertilizer	17
95	Hydrofluoric Acid	17
96	Lithium	17
97	MIX: Carbon Monoxide/Methanol/Oxides of Nitrogen NOS†/Sulfur Dioxide	17
98	MIX: Oxides of Nitrogen NOS†/Sulfur Dioxide	17
99	Trichloroethylene	17
100	Urea Ammonium Nitrate	17

† Not otherwise specified

‡ Common Chemicals Used in Methamphetamine Manufacturing include the following: Acetaldehyde, Acetic Acid, Acetic Anhydride, Acetone, Allyl Chloride, Allylbenzene, Aluminum, Ammonia, Ammonium Acetate, Ammonium Formate, Ammonium Hydroxide, Benzaldehyde, Benzene, Benzyl Chloride, Chloroform, Ephedrine, Ethyl Ether, Freon, Hexane, Hydriodic acid, Hydrochloric acid, Iodine, Isopropanol, Lead Acetate, Lithium Aluminum Hydride, Magnesium, Mercuric chloride, Methanol, Methylamine, Monomethylamine, N-Methylformamide, Nitroethane, Norpseudoephedrine, Palladium, Phenyl-2-propanone, Phenylacetic acid, Phenylpropanolamine, Phosphoric acid, Propiophenone, Raney Nickel, Red Phosphorous, Sodium, Sodium Carbonate, Sodium Cyanide, Sodium Hydroxide, Thionyl Chloride, and Toulene

* Leachate (liquids that have percolated through land disposed wastes) resulting from the disposal of more than one restricted waste classified as hazardous under subpart D of this part. (Leachate resulting from the disposal of one or more of the following EPA Hazardous Wastes and no other Hazardous Wastes retains its EPA Hazardous Waste Number(s): F020, F021, F022, F026, F027, and/or F028.)

Appendix B. — *Hazardous Substances Emergency Events Surveillance-Related Publications.*

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

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

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

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

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

Agency for Toxic Substances and Disease Registry. Hazardous Substances Emergency Events Surveillance annual report, 1996. Atlanta: US Department of Health and Human Services; 1997.

Agency for Toxic Substances and Disease Registry. Hazardous Substances Emergency Events Surveillance annual report, 1997. Atlanta: US Department of Health and Human Services; 1998.

Agency for Toxic Substances and Disease Registry. Hazardous Substances Emergency Events Surveillance annual report, 1998. Atlanta: US Department of Health and Human Services; 1999.

Agency for Toxic Substances and Disease Registry. Hazardous Substances Emergency Events Surveillance five-year cumulative report 1993-1997. Atlanta: US Department of Health and Human Services; 2001.

Agency for Toxic Substances and Disease Registry. Hazardous Substances Emergency Events Surveillance biennial report, 1999-2000. Atlanta: US Department of Health and Human Services; 2002.

Agency for Toxic Substances and Disease Registry. Hazardous Substances Emergency Events Surveillance annual report, 2001. Atlanta: US Department of Health and Human Services; 2003.

Berkowitz Z, Haugh GS, Orr, MF, Kaye WE. Releases of hazardous substances in schools: data from Hazardous Substances Emergency Events Surveillance System, 1993-1998. J Environ Health 2002;65:20-27.

Berkowitz Z, Orr MF, Kaye WE, Haugh GS. Adverse public health effects associated with releases of hazardous substances in the agricultural industry and

related services in four mid-Western states. *J Occup Environ Med* 2002;44:714-723.

Berkowitz Z, Barnhart HX, Kaye WE. Factors associated with severity of injury resulting from acute releases of hazardous substances in the manufacturing industry. *J Occup Environ Med* 2003;45:734-42.

Burgess JL, Kovalchick DF, Harter L, Kyes KB, Thompson JN. Hazardous materials events: an industrial comparison. *J Occup Environ Med* 2000;42:546-53.

Burgess JL, Kovalchick DF, Harter L, Kyes KB, Lymp JF, Brodtkin CA. Hazardous materials events: evaluation of transport to health care facility and evacuation decisions. *Am J Emerg Med* 2001;19:99-105.

Centers for Disease Control and Prevention. Public health consequences among first responders to emergency events associated with illicit methamphetamine laboratories—selected states, 1996-1999. *MMWR* 2000;49:1021-4.

Centers for Disease Control and Prevention. Homemade chemical bomb events and resulting injuries—selected states, January 1996-March 2003. *MMWR* 2003;52:662-4.

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

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

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

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

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

Horton DK, Berkowitz Z, Kaye WE. Surveillance of Hazardous Materials Events in 17 States, 1993–2001: A Report from the Hazardous Substances Emergency Events Surveillance (HSEES) System. *Am J Ind Med* 2004;45:538-548.

Horton DK, Berkowitz Z, Kaye WE. Hydrofluoric acid releases in 17 states and the acute health effects associated, 1993-2001. *J Occup Environ Med* 2004;46:501-508.

Horton DK, Drew J, Nehls-Lowe H, Otto W, Kaye WE. Public health dispatch: acute tearing agent toxicity after exposure to a theft-deterrent device on a safe—Wisconsin, December 2003. *MMWR* 2004;53:176-7.

Horton DK, Ernst K, Kaye WE. Homemade chemical bomb events and resulting injuries—selected states, January 1996–March 2003. *MMWR* 2003;52:662-4.

Horton DK, Berkowitz Z, Kaye WE. The acute consequences to children exposed to hazardous substances used in illicit methamphetamine production, 1996 to 2001. *J Child Health* 2003;1:99-108.

Horton DK, Berkowitz Z, Kaye WE. Secondary contamination of ED personnel from hazardous materials events, 1995-2001. *Am J Emerg Med* 2003;21:199-204.

Horton DK, Berkowitz Z, Haugh GS, Orr MF, Kaye WE. Acute public health consequences associated with hazardous substances released during transit, 1993–2000. *J Hazard Mater* 2003;B98:161-75.

Horton DK, Berkowitz Z, Kaye WE. The public health consequences from acute chlorine releases, 1993-2000. *J Occup Environ Med* 2002;44:906-13.

Horton DK, Haugh GS, Kaye WE. Public health consequences among first responders to emergency events associated with illicit methamphetamine laboratories—selected states, 1996–1999. *MMWR* 2000;49:1021-4.

Manassaram DM, Orr MF, Kaye WE. Counterterrorism planning using the hazardous substances events surveillance system. *Disaster Management and Response* 2003;1:35-40.

Manassaram DM, Orr MF, Kaye WE. Hazardous substances events associated with the manufacturing of chemicals and allied products. *J Hazardous Mater* 2003;104:123-35.

Orr MF, Kaye WE, Zeitz P, Powers ME, Rosenthal L. Public health risks of railroad hazardous substance emergency events. *J Occup Environ Med* 2001;43:94-100.

Orr MF, Kaye WE, Zeitz P, Powers ME, Rosenthal L. Public health risks of railroad hazardous substance emergency events [letter]. *J Occup Environ Med* 2001;43:738-40.

Orr MF, Haugh GS, Kaye WE. Hazardous Substances Emergency Events Surveillance, 1993 to 1997. *Chemical Health and Safety* 2001; [Jan/Feb]:35-41.

Souther L, Small-Johnson J, Messing RB. A description of agricultural releases of anhydrous ammonia in Minnesota. *Chemical Health and Safety*. 2000 [Nov/Dec]: 16-22.

Weisskopf MG, Drew JM, Hanrahan LP, Anderson HA. Hazardous ammonia releases in Wisconsin: trends and risk factors for evacuation and injury. *Wisconsin Medical Journal*. 2000 November:30-46.

Welles WL, Wilburn RE. Hazardous Substances Emergency Events Surveillance (HSEES) in New York State, 1993 to 1997. *Chemical Health and Safety* 2001; [January/February]:42-52.

Wendt RD, Hall HI, Price-Green PA, Dhara VR, Kaye WE. Evaluating the sensitivity of hazardous substances emergency events surveillance: a comparison of three surveillance systems. *J Environ Health* 1996;58:13-7.

Zeitz P, Berkowitz Z, Orr MF, Haugh GS, Kaye WE. Frequency and type of injuries in responders of hazardous substances emergency events, 1996 to 1998. *J Occup Environ Med* 2000;42:1115-20.

Zeitz P, Orr MF, Kaye WE. Public health consequences of mercury spills: Hazardous Substances Emergency Events Surveillance System: 1993-1998. *Environ Health Perspect* 2002;110:129-32.

