Hazardous Substances Emergency Events Surveillance (HSEES) in New York State, 1993 to 1997

By Wanda Lizak Welles and Rebecca E. Wilburn

The Hazardous Substances Emergency Events Surveillance (HSEES) is an ongoing state-based project funded by the Agency for Toxic Substances and Disease Registry (ATSDR) to describe and evaluate the public health consequences of spills involving nonpetroleum hazardous substances. In 1992, the New York State Department of Health joined the project that now includes 15 states. (Other states participating in the study are Alabama, Colorado, Iowa, Minnesota, Mississippi, Missouri, New Jersey, North Carolina, Oregon, Rhode Island, Texas, Utah, Washington, and Wisconsin.)

__Wanda Lizak Welles, Ph.D.__, is a Research Scientist at the New York State Department of Health in the Bureau of Toxic Substance Assessment. Dr. Welles manages the Hazardous Substance Emergency Events Surveillance project and has expertise in the areas of drinking water quality, indoor air quality, risk assessment, and risk communication. __Rebecca E. Wilburn__ works at the New York State Department of Health as a Public Health Specialist II investigating releases of Hazardous Substances for the Hazardous Substances Emergency Events Surveillance project. The data collected are then used for training and education throughout the states in an effort to plan for and prevent future releases.

The goal of this project is to reduce morbidity (injury) and mortality (death) resulting from hazardous substance emergency events by identifying risk factors in the spill data and providing the information to appropriate audiences such as health and safety officers or emergency responders. Measures to reduce morbidity and mortality may include improved employee training, improved use of appropriate personal protective equipment, improvements in equipment maintenance or, in some cases, a process change. The surveillance objectives are to:

- describe the distribution and characteristics of hazardous substance emergencies in New York State,
- describe the morbidity and mortality experienced by employees, responders, and the general public that result from hazardous substance emergency events,
- identify risk factors associated with morbidity and mortality from the release of hazardous substances,
- identify or develop prevention strategies that might reduce future morbidity and mortality associated with hazardous substance releases.

This report summarizes all project data collected in New York State and released by ATSDR for the period of January 1, 1993, through December 31, 1997.

Table 1. Summary Information

Number of events	1956
Fixed facility	1620 (83%)
Transportation	336 (17%)
Number of chemicals released	2236
Number of events with injuries	274
Number of injured people	718
Employees	388 (54%)
Responders	100 (14%)
General public	217 (30%)
Unknown	13 (2%)
Number of events with ordered evacuations	297
Fixed facility	261 (88%)
Transportation	36 (12%)
Number of people evacuated	>19,489[a]
Number of people decontaminated	1282

[a] Number indicates known number of evacuees. When large areas were evacuated, not all evacuees could be counted.

 © Division of Chemical Health and Safety of the American Chemical Society
Published by Elsevier Science Inc.
1074-9098/01/$20.00
PII S1074-9098(00)00163-5

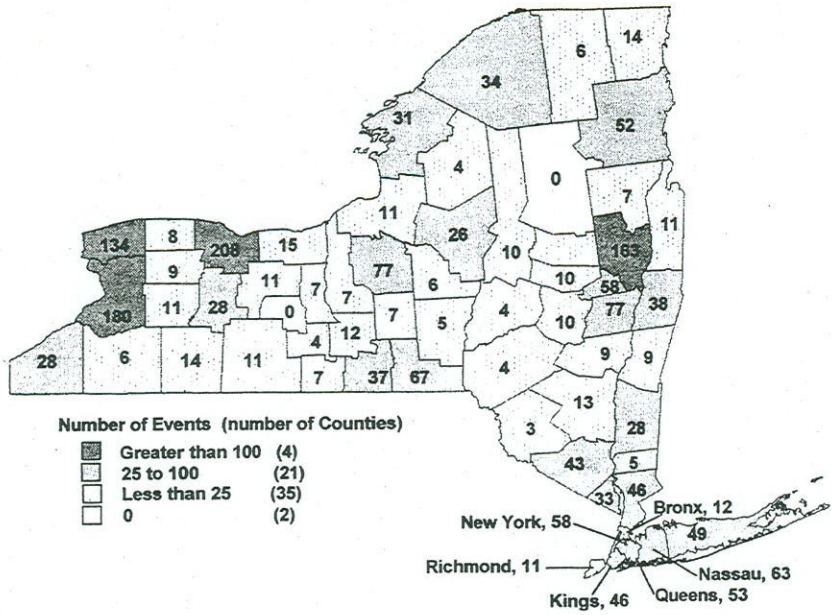


Figure 1. Reported Events by County.

The maintenance staff at an elementary school used a sulfuric acid cleaner to unclog a drain in a classroom. The cleaner reacted with the clog in the drain releasing fumes throughout the building. Eight teachers, 35 students, and two visiting parents reported symptoms including dizziness, nausea or vomiting, headache, chest pain, and asthmatic reaction. Twenty-three were treated at the scene, 21 were treated at hospitals and released, and one child was kept overnight. Four hundred people were evacuated at 9 A.M. for the remainder of the day. After the incident, an investigation revealed that the ventilation system recirculated the contaminated air rather than venting it to the rooftop.

METHODS

Definition of a Reportable Event

For the HSEES project, a reportable event is defined as an uncontrolled or illegal release or threatened release of hazardous substances (excluding petroleum products) that need to be removed, cleaned up or neutralized according to federal, state, or local law.

A threatened release that leads to a public health action such as an emergency response, an evacuation, or traffic rerouting also qualifies for inclusion in the study. If a spill includes petroleum products with other hazardous substances that meet event criteria, the spill is a reportable event.

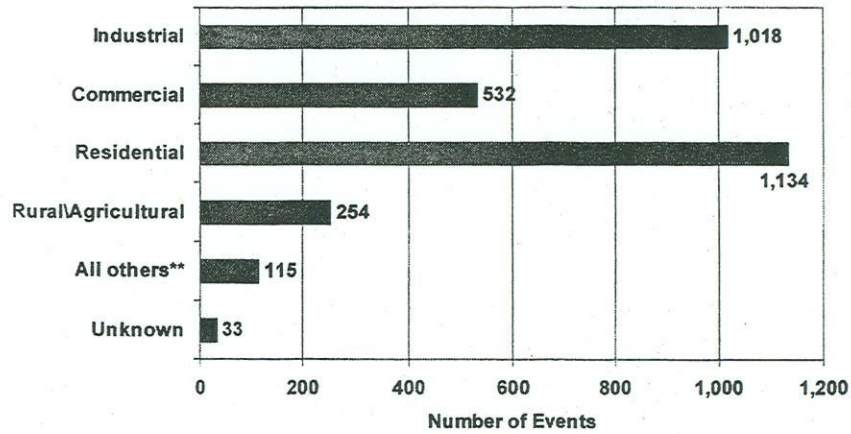
Definition of Fixed-Facility and Transportation Events

Fixed-facility events are those which occur outdoors or inside a building on the premises of a facility or site. Some examples of fixed facilities are industrial sites, manufacturing plants, businesses, farms, schools, hospitals, and private residences. Transportation events involve ground, rail, water, air, or pipeline transport and occur outside the boundaries of a fixed facility.

Data Collection Methods

Data are collected on a 68-question survey form developed and provided by ATSDR. The categories of information collected during an investigation include the following:

- chemical name and quantity released,
- time, date, and location of spill,
- type of release (e.g., spill, explosion, air emission) and factors contributing to the release (e.g., equipment failure, operator error, improper mixing),
- weather information,
- injury information including victim category (employee, responder, or general public), injury type, and treatment sought,
- information on use of personal protective equipment and on number of persons (employees, responders, or members of the general public) decontaminated,
- estimated size of the potentially exposed residential population near the event,
- evacuation and in-place sheltering activities, and
- control actions and type of emergency response (emergency preparedness plan).



*Each event may involve up to two area types.

**This category includes vacant plain, forest, wetlands or coastal, surface water and the category "other".

Figure 2. Type of Area.*

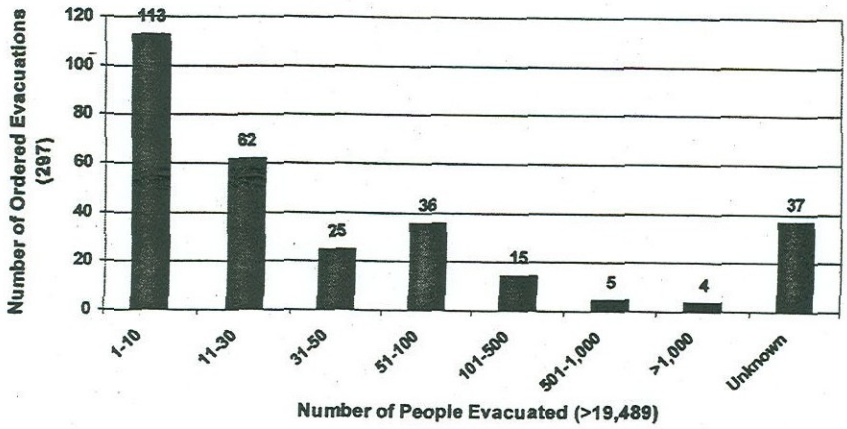


Figure 3. Size of Evacuated Populations.

Table 2. Chemical Frequency in Reported Events

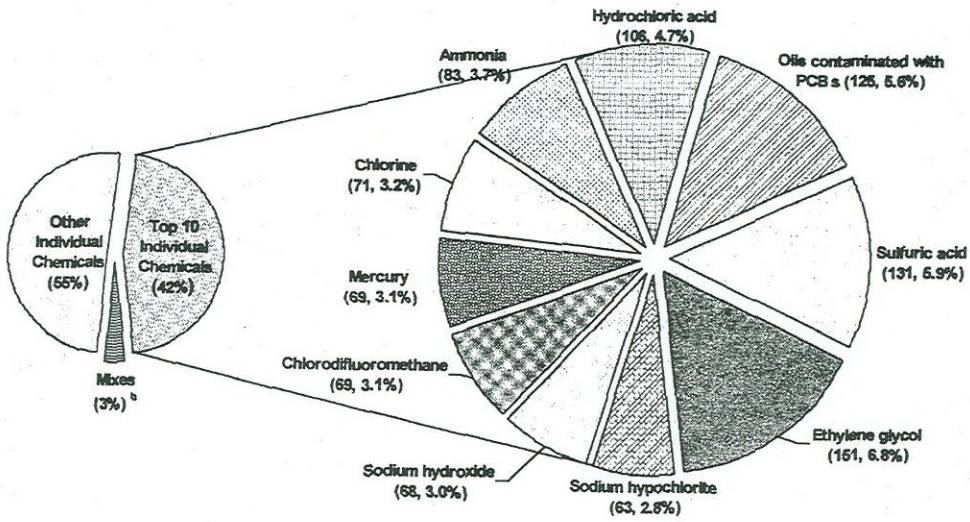
Chemicals per Event	Number of Events	Total
1	1768	1768
2	127	254
3	45	135
4	10	40
5	3	15
6	1	6
7	1	7
11	1	11
Total	1956	2236

Each spill is given a unique record identification code for tracking purposes.

ATSDR stipulates that initial identification of spills or releases must be through state or local information sources. In New York State, spills were identified through two main sources: the New York State Department of Environmental Conservation Spill Hotline and the New York City Department of Environmental Protection. Additional spill identification was obtained from the Bureau of Environmental Radiation Protection at the NYSDOH, and other state organizations such as the New York State Emergency Management Office (SEMO), the New York State Office of Fire Prevention and Control, the New York State Department of Transportation, and the New York State Department of Motor Vehicles. New York State Police must report hazardous substance spills to the Spill Hotline and are thus also included as a source. These agency sources of information are supplemented by spill reports from county health departments and the news media. A newspaper clipping service, used as a supplemental source of accident reports from 1993 to 1995, was discontinued as the network of sources contributing to the project increased.

Each spill was investigated thoroughly and as quickly as possible by telephone and written inquiries to appropriate sources including local, county, and state emergency response personnel such as firefighters, emergency medical technicians, and HazMat staff; county health departments; industrial health and safety or environmental personnel; hospital staff; plant managers and employees; and private citizens.

During the early stages of this project, limited staff and resources prevented data collection in the five counties of New York City. As the project became established and an additional position was funded, data collection in New York City began October 1, 1994.



[a] These ten chemicals total 936 (42%) of all chemicals (2,236) involved in 1,956 accidental chemical releases.

[b] Mixes of chemicals resulted in 67 events.

Figure 4. Ten Chemicals Most Frequently Involved in Reported Events.[a]

Table 3. Chemicals Frequently Associated With Injuries

Chemical (number of events with injuries)	Number of Injured People				Total (%)[a]
	Employees	Responders	General Public	Unknown	
Ammonia (20)	25	9	25	0	59 (8%)
Chlorine (26)	22	10	32	0	64 (9%)
Cresylic acid (1)	20	1	0	0	21 (3%)
Hydrochloric acid (22)	71	7	47	12	137 (19%)
Formaldehyde (4)	24	1	4	0	29 (4%)
Phosphoric acid (1)	25	0	1	0	26 (4%)
Sodium hydroxide (6)	20	0	7	0	27 (4%)
Sodium hypochlorite (19)	77	7	42	1	127 (18%)
Sulfuric acid (19)	22	13	7	0	42 (6%)
Trichloroethene (2)	50	0	0	0	50 (7%)
Total for 10 chemicals	356	48	165	13	582[b]
Total for all 1993–1997 HSEES events	388	100	217	13	718

[a] Percentage of all injured people (718).
[b] If a person is injured by more than one chemical, she or he is counted under each chemical. The total of 582 injuries corresponds to 421 injured people.

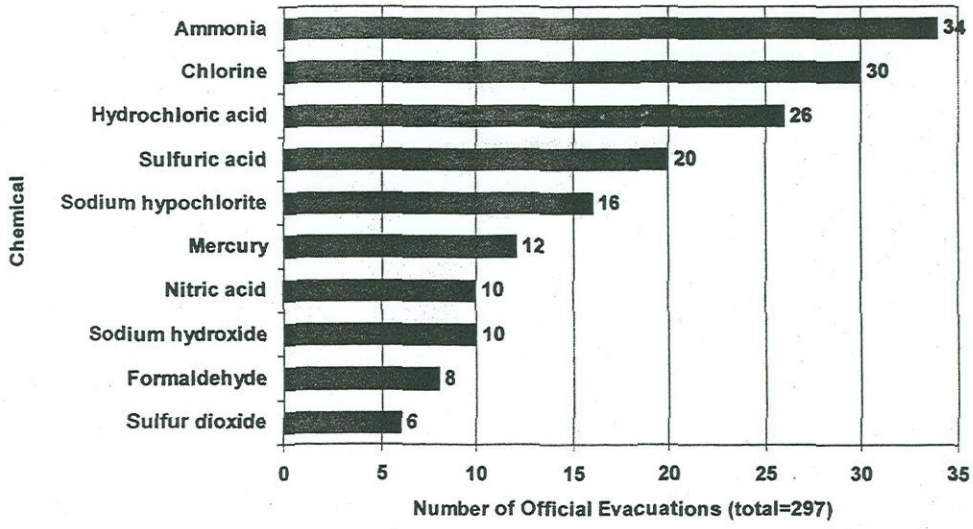
A dentist dropped a bottle containing cresol and formaldehyde. Fumes filled the office and spread through the ventilation system into the building. The fire department evacuated 80 people for 2.5 hours. Twenty-one people were transported to the hospital with eye irritation, headache, nausea, and dizziness. Ten additional people were transported for observation only. All were released the same day.

RESULTS

During the 5-year period of 1993–1997, project staff reviewed approximately 85,000 spills reported in New York State and identified events involving nonpetroleum compounds. Investigation of these actual or threatened releases indicated that 1956 (2.3%) met the criteria of an eligible event, and these were entered into the project database. The remaining spills were determined to be nonevents for any of several reasons: the chemicals involved were excluded by case definition, the amounts released were trace quantities, the spill was not a recent accident but rather a discovery of substances such as waste barrels discarded in the past, or the threatened incident did not involve any public health action such as rerouting traffic.

The 1956 events (Table 1) involved 2236 chemicals, 718 injured people, 297 ordered evacuations, and 1282 decontaminations.

The sprinkler system at a pool chemical packaging facility malfunctioned, spraying water on calcium hypochlorite and sodium dichloroisocyanuric acid. The release of heat started a fire. At the start of



[a] For this analysis, if two chemicals were involved in the same event with an evacuation, the event is counted separately for each chemical. Chemical mixes are omitted from the chart but resulted in 15 events requiring evacuation.

Figure 5. Chemicals Most Frequently Associated With an Official Evacuation Order.[a]

Table 4. Information on Injured People

	Fixed Facility (%)	Transportation (%)	Total (%)
Number of events	1620 (100)	336 (100)	1956 (100)
Events with injuries	210 (13)	64 (19)	274 (14)
Number of victims	607 (100)	111 (100)	718 (100)
Employees	346 (57)	42 (38)	388 (54)
Responders	73 (12)	27 (23)	100 (14)
General public	175 (29)	42 (38)	217 (30)
Unknown	13 (2)	0 (0)	13 (2)
Gender			
Male	341 (56)	88 (80)	429 (60)
Female	229 (38)	20 (17)	249 (35)
Not available	37 (6)	3 (3)	40 (5)

the incident, 140 people were evacuated from nearby homes. The fire was believed to be out and the evacuated persons were allowed to return home. Before they returned, the fire flared up again and a second evacuation was ordered; an additional 660 people were evacuated. The total evacuation time was 14 hours. Two people were injured: one responder and a nearby resident. The responder was taken to the hospital, treated, and released; the resident was seen by a private physician. Thirty-four responders were decontaminated at the scene.

Geographic Distribution

The geographic distribution of events (Figure 1) shows that the four counties with more than 100 qualifying spills from 1993 to 1997 were Monroe (208), Erie (180), Saratoga (163), and Niagara (134). These four counties, which correspond to some of the more populated and industrialized areas of New York State, accounted for 37% of the fixed-facility events (597 of 1620), 26% of the transportation events (88 of 336) and 35% of the total reported events (685 of 1956). Reported events occurred in 60 of the 62 counties; no reportable events occurred in Hamilton County (a sparsely populated area within Adirondack Park) or in Yates County (an area of vineyards and agricultural lands in the Finger Lakes region).

Reported events can occur in a variety of land areas defined by the survey protocol as vacant, industrial (manufacturing), commercial (retail), residential, rural/agricultural, forested, wetlands or coastal, surface water, or other (e.g., airport, hospital, jail, university). According to the project's design, each event is identified by one or two area types, and thus, land areas associated with an event are not mutually exclusive. The data in Figure 2 indicate that many events occurred in industrial (1018 events, 52%) or commercial (532 events, 27%) areas but that a large number of these releases were also near residences (1134 events, 58%). Geocoding of the spill data indicated that a total of 1464 events (75%) occurred within one-quarter mile of a residence. The category termed "all others" is a consolidation of areas with few events, namely, vacant lands, forests, wetlands/coastal areas, surface waters, and the category "other."

A tractor-trailer accident caused by a split tank released 3553 gallons of sodium hydroxide onto a major highway. The road was closed but no evacuations were required. One employee, two responders, and three passersby were decontaminated at the scene. Six people were injured. One employee and four passersby sustained chemical burns, and one passerby had respiratory irritation. All were treated at a hospital and released the same day.

Vehicle Distribution in Transportation Events

The vast majority of the 336 reported events which occurred during transportation involved motor vehicles (296, 88%). Forty-one events involved transport by rail. Only nine events involved other modes of transportation: water (four barges), air (two cargo planes), pipeline (two), and other (crash of airplane and truck, one).

Evacuations

The 1956 reported events from 1993 to 1997 caused people to leave their homes or workplaces on 302 occasions (15%), 264 at fixed facilities, and 38 during transportation events. An official evacuation order was given in 297 of these 302 events (261 fixed-facility and 36 transportation) and more than half of the evacuations (175 of 297, 59%) involved 30 or fewer people (Figure 3).

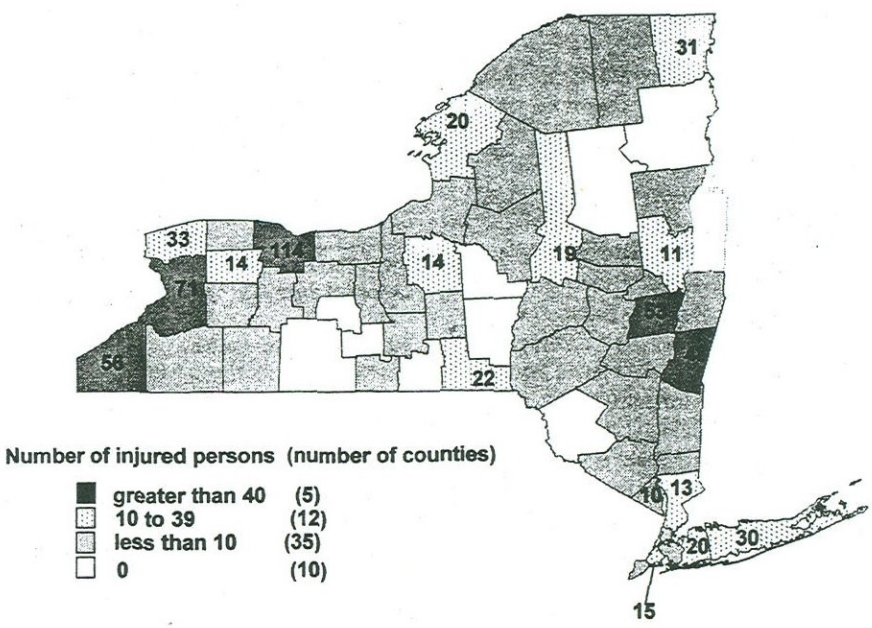


Figure 6. Reported Injuries by County, NYHSEES, 1993–1997.

Table 5. Injuries Following Reported Events

Type of Injury[a]	Fixed Facility (%)[b]	Transport (%)[b]	Total (%)[b]
Chemical burns	34 (6)	17 (16)	51 (7)
Dizziness or other CNS symptoms	124 (20)	8 (7)	132 (18)
Eye irritation	102 (17)	16 (15)	118 (16)
Headache	116 (19)	1 (1)	117 (16)
Heat stress	10 (2)	5 (5)	15 (2)
Nausea or vomiting	113 (19)	9 (8)	122 (17)
Respiratory irritation	328 (54)	34 (30)	362 (50)
Skin irritation	40 (7)	13 (12)	53 (7)
Thermal burns	5 (1)	2 (2)	7 (1)
Other	76 (13)	9 (8)	85 (12)
Trauma	13 (2)	34 (31)	47 (7)
Total	961	148	1109

[a] A total of 718 people were injured (607 in fixed facility events and 111 during transportation events). Some people sustained more than one type of injury.
[b] Indicates the percentage of al injured people with that injury type. For example, 2% of the 607 people injured at a fixed facility suffered a trauma type injury.
CNS = [c] Central nervous system.

A substitute teacher was teaching an eighth-grade science laboratory when a student broke a thermometer. Some of the 25 students "flicked" minute amounts of the mercury around the room. The next day the regular teacher learned of the incident from the students. The classroom was closed for cleanup. Two hundred twenty-five students were evacuated for 60 hours while the laboratory and janitor's supply closet were decontaminated.

Chemicals Involved in Spills and Injuries

Most events (1768 events, 90%) involved a single hazardous substance (Table 2). In 127 events (6%), two hazardous substances were involved, and 45 events (2%) involved three substances. Only one percent of events involved a greater number of chemicals (4 to 11).

The 10 chemicals most frequently released in reported events (Figure 4) included a coolant and antifreeze (ethylene glycol), oils (heat transfer fluids) that contain low concentrations (typically 50 to 500 parts per million) of polychlorinated biphenyls (PCBs), six corrosive substances (sulfuric acid, hydrochloric acid, ammonia, chlorine, sodium hydroxide, and sodium hypochlorite), a heavy metal (mercury), and a refrigerant (chlorodifluoromethane). These 10 chemicals were involved in 936 events, 48% of the total of 1956 events.

The 10 chemicals most frequently associated with injury (Table 3) accounted for 59% of the injured people (421 of 718). All are corrosive or caustic materials except for trichloroethene (also known as trichloroethylene). The highest number of reported injuries occurred after exposure to hydrochloric acid (137), sodium hypochlorite (127), chlorine (64), or ammonia (59). Over half (198 of 388, 51%) of the injuries sustained by employees were caused by three chemicals: hydrochloric acid, sodium hypochlorite, and trichloroethene. The trichloroethene injuries occurred during two events; in one event, 49 employees were injured when fumes from 10 to 15 gallons of spilled solvent spread throughout a three-story manufacturing building. Over two-thirds (146 of 217, 67%) of the injuries sustained by the general public were caused by four chemicals: ammonia, chlorine, hydrochloric acid, and sodium hypochlorite. Four of the 10 chemicals most frequently associated with injuries (cresylic acid, formaldehyde, phosphoric acid, and trichloroethene) were not among the 10 chemicals most frequently involved in reported events.

Analysis of the 10 chemicals most frequently involved in an evacuation ordered by an official (Figure 5) shows that 110 of the 297 evacuations (37%) were associated with four hazardous substances: ammonia (11%), chlorine (10%), hydrochloric acid (9%), and sulfuric acid (7%).

On a winter Sunday afternoon, five boys were playing with a small unlabeled bottle of malathion pesticide which they found in a field near their trailer park. One of the boys kicked the bottle, spilling its contents on all five youngsters. When the parents of two brothers, ages 5 and 8, noticed that the material was burning their children's skin, they reported the incident to state police. Twenty-five nearby residents were evacuated for 5 hours. An ambulance then transported the children, the parents, and the container of material to the hospital where the emergency area was evacuated as a precaution (15 people for 6 hours). The father and both sons experienced respiratory and skin irritation, and nausea or vomiting. Two nurses treating the family

Table 6. Medical Outcomes for Injured People

Medical Outcome[a]	Fixed Facility (%)	Transport (%)	Total (%)
Seen by a private MD	7 (1)	1 (0.1)	8 (1)
Delayed symptoms reported later	2 (0.2)	0	2 (0.2)
Treated at the scene	121 (17)	8 (1)	129 (18)
Transported to the hospital for observation	31 (4)	2 (0.2)	33 (5)
Transported to the hospital, treated, and released	419 (58)	83 (12)	502 (70)
Transported to the hospital and admitted	23 (3)	9 (1)	32 (4)
Fatality	2 (0.2)[b]	8 (1)[c]	10 (1)
Unknown	2 (0.2)	0	2 (0.2)

[a] A total of 718 people were injured: 607 in fixed facility events and 111 during transportation events.
[b] Fixed facility fatalities: ammonia inhalation, one; explosion, one.
[c] Transportation fatalities: chemical exposure (HCI, HF), two; collision, four; fire, two.

Table 7. Personal Protective Equipment Worn by Injured People

Personal Protective Equipment[a,c]	Employees (%)[b]	Responders (%)[b]	General Public (%)[b]	Unknown (%)[b]	Total
None	280 (72)	35 (35)	195 (89)	11 (85)	521
Gloves	25 (6)	3 (3)	2 (1)	0	30
Eye protection	20 (5)	4 (4)	0	0	24
Hard hat	19 (5)	0	0	0	19
Steel-toed shoes	18 (4)	11 (11)	0	0	29
Firefighter turnout gear	0	30 (30)	0	0	30
Level D	3 (1)	0	0	0	3
Level C	4 (1)	0	0	0	4
Level B	4 (1)	8 (8)	0	0	12
Level A	2 (0.5)	8 (8)	0	0	10
Unknown	38 (10)	19 (19)	8 (4)	1 (8)	66

[a] The total number of PPE exceeds the number of injured people because some people wore more than one item of PPE.
[b] The injured people (718) belong to the following categories: employees, 388; responders, 100; general public, 218; and unknown, 13.
[c] HSEES did not collect PPE information for 31 people in 1993. They belong to the following categories: employees, 17; general public, 13; and unknown, one.

became contaminated with the pesticide and experienced respiratory, eye and skin irritation, and chemical burns. Nine people were decontaminated at the hospital.

Injury Information

Injuries were reported in 13% (210 of 1620) of the fixed-facility events, 19% (64 of 336) of the transportation events, and 14% (274 of 1956) of the total reported emergency events (Table 4). Of the 607 people injured at fixed facilities, the majority were employees (346 people, 57%). One hundred eleven people were injured during transportation events with equal numbers (42, 38%) in the employee and general public categories. Males were more frequently injured than females in both fixed-facility events (56% versus 38%) and transportation events (79% versus 18%). These numbers vary considerably from the composition of the New York State workforce during 1993 to 1997, which was 53% male and 47% female during 1993 to 1995, and 54% male and 46% female in 1996 and 1997 (R. Fortran, New York State Department of Labor, April 1999).

Figure 6 provides the distribution of injuries in reported events across the state. The injury data (Table 5) indicate that the majority of people injured at fixed facilities reported respiratory irritation (54%) and that several symptoms were reported with similar frequency: dizziness or other central nervous system (CNS) effects (20%), nausea or vomiting (19%), headache (19%), and eye irritation (17%). During transportation events, the most common injuries related to reportable events were respiratory irritation (31%), chemical burns (16%), and eye irritation (15%). Trauma injuries were most prevalent in transportation events and were reported for 34 people (31%), but these were related to the vehicular accident and not to the release of hazardous substances.

Review of the medical outcomes for injured people (Table 6) indicates that some injured people were treated on the scene (18%) but most injured people (70%) were transported to the hospital and released after treatment. Relatively small numbers of injured people were seen by a private physician (1%), kept at the hospital for observation (5%), or admitted to the

Table 8. Injuries Sustained by Employees and Responders Wearing Level A Protection, Level B Protection, or Firefighter Turnout Gear

Category of victim	Employees		Responders			
Type of PPE worn	Level A	Level B	Level A	Level B	FFTOG	Total
Number of injured persons	2	4	8	8	30	52
Type of injury[a]						
Chemical burns		2		5	9	16
Dizziness or other CNS symptoms	2	1			2	5
Eye irritation					5	5
Headache	1				1	2
Heat stress			3	1	1	5
Nausea or vomiting	2	1				3
Respiratory irritation	2	2		2	15	21
Skin irritation		1	3		2	6
Trauma					2	2
Other[b]			2		3	5

[a] Some people sustained more than one type of injury.
[b] Other = heart palpitations (two) and high blood pressure (three).
FFTOG = firefighter turnout gear; CNS = central nervous system.

Table 9. Decontamination by Victim Category

Victim Category	Location of Decontamination: Scene	Location of Decontamination: Medical Facility	Total Persons Decontaminated
Employee	118	31	149
Responder	1044	69	1113
General public	10	10	20
Total	1172	110	1282

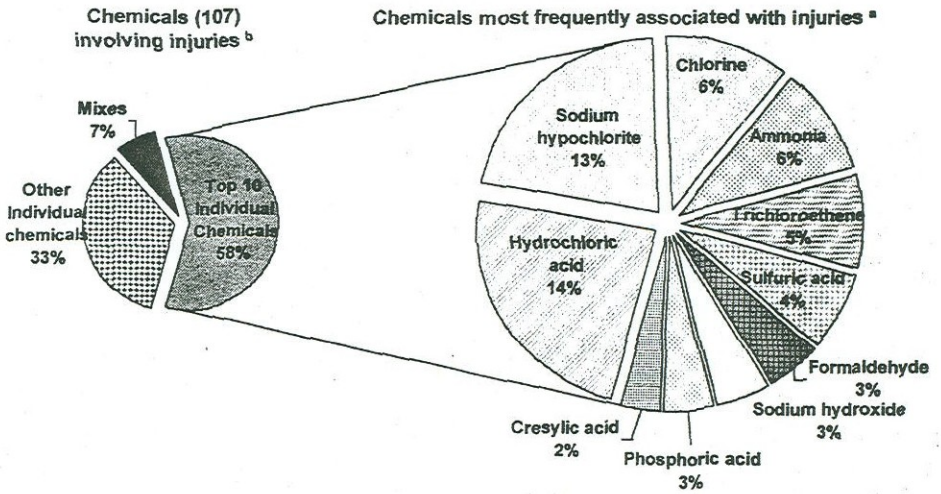
hospital (4%). One percent of the injuries resulted in fatalities.

A truck carrying 120 golf cart batteries was involved in a traffic accident on a rural road. Many of the batteries broke open, spilling sulfuric acid inside the trailer and into a ditch. The driver and two responders were injured. The driver was transported to the emergency room where he was treated for trauma and released. Two firefighters were released after being transported and treated for respiratory irritation and high blood pressure. Both firefighters were trained in hazardous materials response and were wearing firefighter turnout gear when they were injured. Approximately 50 people were evacuated from nearby residences for 12 hours. Six responders were decontaminated at the scene and the two injured responders were decontaminated at the hospital.

Personal Protective Equipment

In presenting the data on personal protective equipment (PPE), some limitations in the design of the HSEES study must be noted. First, information on PPE is collected only for people who were injured during the event, and does not include people who wore PPE and were protected from injury or who wore PPE and were not exposed. Also, a reported injury does not necessarily indicate a causal relationship between the injury and a deficiency in the PPE or in the level of PPE. For example, injury may have occurred because an inappropriate level of PPE was used, but also because the PPE was misused, because it failed, or because the person was injured during decontamination. Data on PPE worn by people injured during HSEES events (Table 7) show that the majority of injured people wore no personal protective equipment (521 of 718, 72%). In specific categories, no PPE was worn by 72% of injured employees, 35% of injured responders, and 89% of injured general public. It is unclear why such a large percentage of injured employees wore no personal protective equipment, but it is possible that some of these injuries were sustained by employees who worked away from the spill location but were caught up in the event and injured. Items of PPE most frequently worn by employees who reported injuries were gloves (6%), eye protection (5%), hard hat (5%), and steel-toed shoes (4%). A large number of injured responders wore no PPE (35%) or wore firefighter turnout gear (30%); the remaining injured responders wore steel-toed shoes (11%), level A (8%), level B (8%), eye protection (4%), and gloves (3%). (Level A protection: totally encapsulating vapor-tight suit with full facepiece, self-contained breathing apparatus (SCBA) or supplied air respirator. Level B protection: encapsulating suit which does not have to be vapor tight; same level of respiratory protection as level A. Firefighter turnout gear: fire-resistant outerwear including coat, boots, gloves, and helmet with face shield. SCBA or a supplied-air respirator is used as needed.)

Because the highest levels of personal protection are afforded by levels A and B and by firefighter turnout gear, it is



[a] The ten chemicals in the right pie chart account for 59% (421/718) of the injured people. A person that is injured during the release of more than one chemical is counted with each chemical. Because some people were injured by exposure to multiple chemicals, the sum of people injured when adding injured people by chemicals is 998 but the actual number of people injured is 718.
[b] One hundred seven different chemicals caused 718 injured people in 274 events.

Figure 7. Ten Chemicals Most Frequently Associated With Injuries.

Table 10. Summary Information on Events Involving the 10 Chemicals Most Frequently Associated With Injuries

Number of events	533
Fixed facility	436 (82%)
Transportation	97 (18%)
Number of chemicals released	559
Number of events with injuries	122
Number of injured people	421
Employees	252 (60%)
Responders	41 (10%)
General public	116 (28%)
Unknown	12 (3%)
Number of events with ordered evacuations	134
Fixed facility	119 (89%)
Transportation	15 (11%)
Number of people evacuated	>8881
Number of people decontaminated	447

interesting to examine the types of injuries sustained by people wearing this apparel (Table 8). Respiratory irritation was reported in two employees wearing level A, in four people (two employees and two responders) wearing level B, and in 15 responders wearing firefighter turnout gear. Chemical burns were reported by seven people in level B protection (two employees and five responders) and by nine responders in firefighter turnout gear. Skin irritation was reported by one employee in level B, by three responders in level A, and by two responders in firefighter turnout gear. The available data do not indicate whether the sustained injuries occurred from equipment failure or during decontamination procedures. Firefighters responding in turnout gear reported numerous health effects including respiratory irritation (15), chemical burns (nine), and eye irritation (five).

A broken pipeline on a refrigeration unit released approximately 4000 lb of ammonia in a fruit cold storage facility. No one was injured but eight residents of two nearby homes were evacuated for 18 hours. Three employees and 10 responders were decontaminated at the scene.

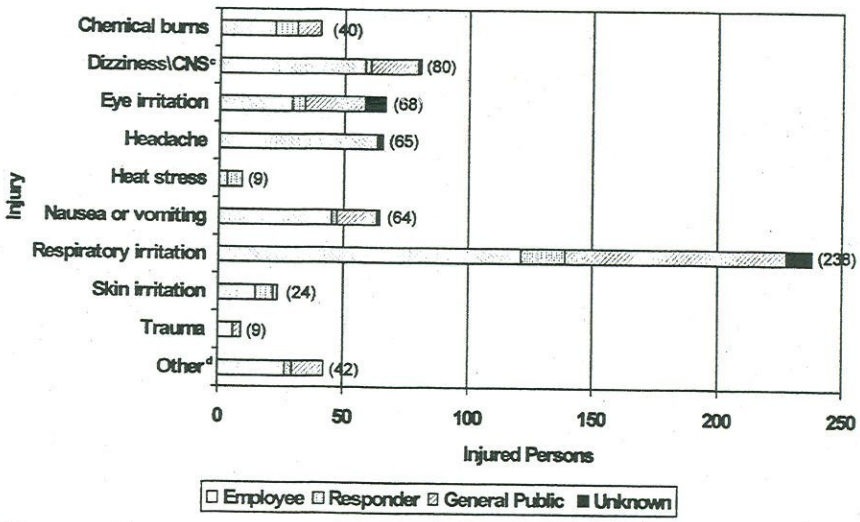
Decontamination

According to spill reports during the 5 years of 1993 to 1997, 1282 persons, the majority of them responders (1113, 87%), and a smaller number of employees (149, 12%) were decontaminated after exposure to hazardous substances (Table 9). The majority of people (1172, 91%) were decontaminated at the scene after an event.

During the delivery of hydrochloric acid to a chemical plant, the storage tank ruptured releasing 4900 gallons of acid. The tank rupture caused a nearby pipe to break and released a second chemical, sodium hypochlorite. A two-block area was evacuated for 4 hours. Forty-three people were treated at nearby hospitals: 20 employees, 18 members of the general public, four Emergency Medical Technicians, and one police officer. Three people were admitted to the hospital, and 40 were treated and released. Eight responders were decontaminated on the scene. Two responders, two employees, and one member of the general public were decontaminated at the hospital.

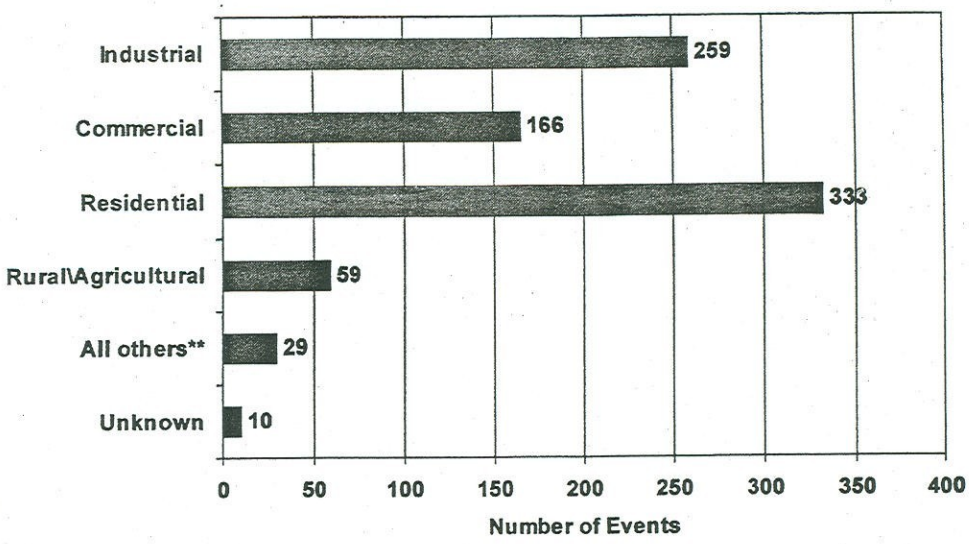
Data Summary for the 10 Chemicals Most Frequently Associated With Injuries

The 10 chemicals most frequently associated with injuries in reported events from 1993 to 1997 (Figure 7)



[a] A total of 421 persons were injured during releases involving the top ten chemicals responsible for injuries: 252 were employees, 41 were responders, 116 were members of the general public, and 12 were unknown.
[b] The total number of injury types exceeds the total number of injured persons because some people had more than one injury.
[c] Central nervous system
[d] Other = Sore throat, shortness of breath, respiratory failure, chest pain, hyperventilation, coughing, asthma, light headedness, heart palpitations, chest tightness.

Figure 8. Injuries Following Events Involving the 10 Chemicals Most Frequently Associated With Injuries.[a,b]



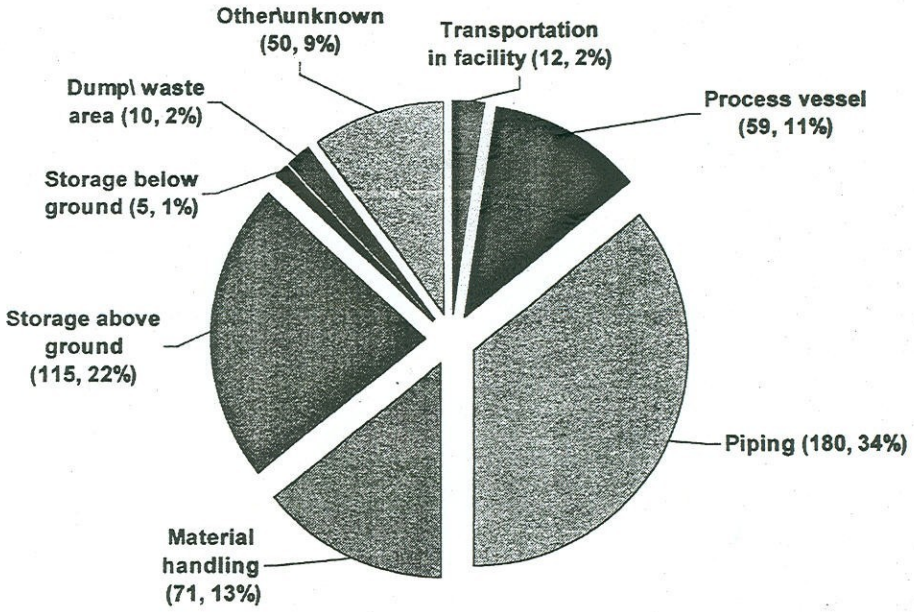
* Each event may involve up to two area types.

**This category includes vacant plain, forest, wetlands or coastal, surface water and the category "other".

Figure 9. Type of Area for Events Involving the 10 Chemicals Most Frequently Associated With Injuries.*

accounted for 59% of the injured people (421 of 718). The events involving these 10 chemicals (Table 10) occurred predominantly at fixed facilities (82%), and most injured people were employees (60%). One quarter of these events (134 of 533) involved ordered evacuations, the large majority (89%) at fixed facilities.

The most frequent injuries caused by the 10 chemicals (Figure 8) were respiratory irritation (38%), dizziness/CNS symptoms (13%), headache (10%), eye irritation (10%), and nausea or vomiting (10%). Respiratory irritation was the most frequently reported symptom for employees (121 of 252, 48%), responders (18 of 41,



[a] Study design allows the choice of one or two locations for each event.
[b] These data were collected for 533 events.

Figure 10. Location of Fixed-Facility Events Involving the 10 Chemicals Most Frequently Associated With Injuries.[a,b]

44%) and members of the general public (89 of 116, 77%). The majority of injured people (73%) were taken to the hospital, treated, and released. Many of these events (Figure 9) occurred in industrial (259 of 533, 48%) or commercial areas (166 of 533, 31%), but a large percentage (333 of 533, 62%) were also near residences.

For the 10 chemicals most frequently involved in injuries, the most frequent sites for the spills/releases (Figure 10) were "piping" (180 of 533, 34%) and "storage above ground" (116 of 533, 22%).

Employees at a medical facility cleaned up a spill after a bottle of phenol was dropped on the carpet. The next day when they reported to work, they experienced eye and respiratory irritation. Eight were transported to the emergency room, treated, and released. A HazMat team responded and the building was evacuated for 5.5 hours.

OUTREACH/EDUCATION ACTIVITIES

Staff continuously strives to use HSEES data to meet the project's goal. Since the project's inception, staff have prepared chemical-specific factsheets for four of the chemicals that were most frequently involved in NYHSEES events: ammonia, sulfuric acid, hydrochloric acid, and mercury. Each factsheet was mailed to about 1000 individuals and organizations involved in activities such as emergency response, emergency planning, chemical manufacture, occupational safety and health, medical care, and worker training. Additional copies have been distributed during presentations at national, state, and local conferences. The fact sheets have also been reproduced and used for training statewide by individual fire departments and occupational safety and health educators. The NYHSEES Web site on the NYSDOH Internet home page includes a description of the project, copies of the project's written materials, and hotlinks to related federal, state, and local government agencies. The address is: www.health.state.ny.us/nysdoh/environ/hsees/hsees.htm.

A New York City sanitation crew picked up garbage not knowing that it contained a bottle of hydrofluoric acid. When the hopper of garbage was crushed, the two employees suffered chemical burns and the employee nearest the release was killed. The second employee was transported to the hospital and admitted. Two responders sustained respiratory and skin irritation. Both were transported to the hospital, treated and released. A total of 14 responders and one employee were decontaminated.

Acknowledgment

This journal article was supported by Cooperative Agreement Number 296968 from the Agency for Toxic Substances and Disease Registry (ATSDR), Public Health Service, U.S. Department of Health and Human Services. Its contents are solely the responsibility of the authors and do not necessarily represent the official views of ATSDR.

References

1. Agency for Toxic Substances and Disease Registry. Hazardous Substances Emergency Events Surveillance (HSEES) Annual Report 1998. U.S. Department of Health and Human Services, Atlanta, GA, 1998.
2. Hall, H. I.; Haugh, G. S.; Price-Green, P. A.; Dhara, V. R.; Kaye, W. E. *Am. J. Public Health* **1996**, *86*, 855–857.
3. Hall, H. I.; Dhara, V. R.; Kaye, W. E.; Price-Green, P. *Toxicol. Indust. Health* **1996**, *12*, 289–293.