HAZARDOUS SUBSTANCES EMERGENCY EVENTS SURVEILLANCE (HSEES)
1993-1997 CUMULATIVE REPORT

INTRODUCTION

Since 1990, the Agency for Toxic Substances and Disease Registry (ATSDR) has maintained an active, state-based Hazardous Substances Emergency Events Surveillance (HSEES) system to describe the public health consequences associated with the release of hazardous substances. Five state health departments participated in the pilot phase of the surveillance system and began data collection on January 1, 1990. Currently 16 states participate in HSEES. During 1993 - 1996, 14 states participated in HSEES. In 1996, New Hampshire left the HSEES program. In 2000, New Jersey, Utah and Louisiana were added to the HSEES program.

The HSEES system is a computerized database used to monitor the acute public health consequences of emergency hazardous substances releases into the environment. The system does not study chronic human health effects or the environmental effects of these releases. HSEES is used to describe the morbidity and mortality experienced by employees, responders, and the general public that result from hazardous substances emergency events. The system documents all reportable hazardous substances releases in the state except for those involving only petroleum products (for example, natural gas, propane, jet fuel, and gasoline). HSEES events can occur at fixed facilities or during transportation.

There are four objectives of the Hazardous Substances Emergency Events Surveillance system. These are:

- To describe the distribution of hazardous substances emergency events within the states.
- To describe the morbidity and mortality experienced by employees, responders, and the general public that result from hazardous emergency releases.
- To analyze and describe risk factors associated with the morbidity and mortality.
- To develop strategies to reduce the subsequent morbidity and mortality.

Emergency events captured by HSEES are classified according to whether they occur at fixed facilities (for example, factories) or during transportation. Events are eligible for inclusion if the releases are uncontrolled or illegal and would require removal, cleanup, or neutralization according to federal, state, or local law. Threatened releases are included in the system if they involve actions such as evacuations which are taken to protect the public health. A substance is considered hazardous if it can be reasonably expected to cause death or injury upon exposure.

This cumulative report summarizes the characteristics of hazardous substances releases and the associated public health consequences of events reported to the during the period between 1993 to 1997.

ALABAMA

RESULTS

Data collection is complete for the five-year period from January 1, 1993 through December 31, 1997. Eight hundred forty-eight events occurred in Alabama in this time period. Of these, about 2% were threatened releases. Approximately 81% occurred at fixed facilities and 19% were transportation related.

Twenty-one percent of fixed-facility events were reported to occur in multiple areas of the facility. Approximately 19% of fixed facility events were releases from above ground storage structures, sixteen percent involved piping and valves, fifteen percent happened during material handling, and fifteen percent occurred in process vessels. The remaining 14% of events involved other areas including transportation within fixed facilities, heating and cooling systems, ancillary processing, or waste processing. Information on the area of the fixed facility where the releases occurred is missing in 8 events. The two most common factors contributing to fixed-facility events were equipment failure and human error. Since contributing factor information was not collected until mid-1995, 331 events are missing this information. Additionally, new categories such as power failure, maintenance, system start-up, deliberate damage, and factors beyond human control have been added. It is expected that the new information will give the data more practical applications.

In transportation events, seventy-five percent were classified as ground or highway, nineteen percent were rail, three percent were during air transportation, and two percent were on water. In 29% of the transportation events, there was a potential for motorists to be exposed to the material released by driving on the road where the release occurred or on an adjacent road, or by being caught in a traffic jam caused by the event. Information was missing for 121 transportation events. Approximately 20% of transportation events happened under adverse weather conditions compared to approximately 16% of fixed-facility events. Information on weather was missing for 8 transportation events and 22 fixed-facility events.

SUBSTANCES

Alabama HSEES data is categorized into eleven substance categories (Table 1). The catch-all category of "Other", which includes substances that could not be placed into any of the other categories, was the most common in both transportation and fixed-facility releases. This category will require further grouping in order to examine the data more completely. Of the remaining groups, "Other Inorganics" were the most common substances in both fixed-facility and transportation releases. Pesticides, which comprised 5.7% of total releases, were represented at a disproportionately higher percentage in transportation releases (11.9%). Ammonia comprised 7.4% of the total releases, but only 1.7% of transportation releases. Chlorine is similarly underrepresented in transportation releases, 1.7% versus 5.6% of total releases. Ammonia was the most frequently released chemical (n = 67) during this period. It was followed by chlorine (n = 51), sodium hydroxide (n = 42), sulfuric acid (n = 40), and sulfur dioxide (n = 37). In ninety-six percent of the events, only one hazardous substance was released. Approximately 3% of the releases involved two substances, and the remaining 1% involved three or more substances.

Chlorine displayed a marked tendency to cause symptoms upon exposure in this data set. While chemical events involving chlorine comprise 17.4% of the total events where injury occurred, chlorine releases were only 5.6% all releases (Table 2). Moreover, approximately thirty-nine percent of all chlorine releases had victims. The tendency for injury to occur during chlorine releases

(39.2%) was over twice that of ammonia (19.3%) and acids (16.8%).

VICTIMS

There was a total of 361 victims in 103 individual events. More than half of the events in which injuries or death occurred involved only one victim (51.5%). However, a total of 191 people were injured or killed in 12 events each of which involved more than six people. Efforts to reduce morbidity and mortality should focus on fixed-facility events since approximately 80% of the victims were injured in fixed-facility events and 71% of the events in which there were victims occurred in fixed facilities.

More employees were injured in both transportation and fixed-facility events than any other population group. Of the 93 responders who were injured, thirty-three percent were injured in transportation events even though only 19.3% of the total events are transportation-related . Responders were twice as likely to be injured compared to the other population groups (36% vs. 20%).

HSEES collected data on 577 injuries during the study period, 1993-1997. This amount does not equal the total number of victims during this period since some victims may have had more than one type of injury, e.g. headache and eye irritation. Respiratory irritation was the most commonly reported type of injury for all events and for each type of event, fixed and transportation. Headache, gastrointestinal symptoms, eye irritation, dizziness and other central nervous system symptoms, and skin irritation were often present as well. Trauma represented 21% of the transportation-related injuries. It should be noted that, in these cases, the trauma is often the result of motor vehicle collisions, not hazardous substance exposure or explosions.

One hundred sixty-four (45%) of the victims were evaluated in hospital emergency rooms, treated, and then released. Seventy (19%) were admitted to the hospital due to their injuries and eighty-one (22%) were treated on the scene. A few victims, ten (3%), were seen by their personal physicians at a later time. There were four deaths in hazardous substances emergency events during this five year period. Information on injury outcome was missing for two victims.

For victims whose sex was known (93%), nearly 80% were male. Sixty-two percent of the victims were employees and 78% of these employees were male. Twenty-eight percent of the victims were responders and 96% of this group was male. The mean age of the victims was 35 years (range: 6-69 years). Of the injured employees, seventy-eight percent wore no personal protective equipment and six percent wore only gloves. The type of personal protective equipment worn was unknown for 10% of the injured employees. Approximately 32% of the victims who were responders wore no personal protective equipment and 52% wore only firefighter turn-out gear.

EVACUATIONS

Evacuations were ordered in 115 events which is 13.6% of the total. The median number of people evacuated was 50. Twenty-nine percent of the evacuations involved 15 people or less and seventy-five percent involved 150 people or less. The maximum number of people evacuated in a single event approached 2000. Information on the number of people evacuated was missing for eight events.

Forty-two percent of the evacuations were of a building or the effected part of a building, thirty-nine percent were of a defined circular area around the release, ten percent were determined by wind or current direction, and six percent had no definite plan. The remainder of the evacuation plans were a combination of some or all of the preceding factors. Information on evacuation type was missing for five evacuations.

CONTINGENCY PLANS

In thirty-six percent of the events, there were no contingency plans followed. The Hazmat/response team's standard operating procedures were followed most frequently in the events that did employee contingency plans (46%). The remaining 54% of contingency plans followed were either the SARA Title III Incidence Command System, incident-specific *ad hoc* plans, or company operating procedures. Information on plan type was missing for 181 events.

SUMMARY

Cumulative data is listed by year in Table 3. Alabama averaged approximately 170 hazardous substance events per year during the five year period of 1993 through 1997. The percentage of events with victims has remained relatively constant during this time. The decrease in total releases in 1997 is suspected to be due to underreporting, but some year-to-year variation is to be expected. Very few deaths occurred due to hazardous substances releases in this time period, and most of the deaths were due to trauma associated with motor vehicle accidents.

The state's two most populous counties, Jefferson and Mobile, had the greatest number of hazardous substance releases with 109 and 184, respectively. The Mobile Metropolitan Area contains the state's only seaport and active state docking facility, as well as being home to a large number of chemical manufacturers and oil and natural gas processing facilities. Birmingham, located in Jefferson County, is the state's largest metropolitan area and is a regional transportation hub. The Huntsville Metropolitan Area in Madison County had relatively few releases during this period. This anomaly is possibly the result of the city's being slightly off the route of any interstate highway. Morgan and Colbert Counties had a disproportionately high frequency of events reflecting the concentration of chemical manufacturing and metallurgical processing facilities there.

These data are distributed to responders, industry, emergency management agencies, and other interested parties with the intent of aiding their emergency planning activities. Information from the project is available to any interested citizens of the state upon request. The HSEES project will begin a prevention outreach plan in the year 2000. The compilation of this five year cumulative analysis was performed to help develop strategies for the prevention outreach plan with the ultimate goal of reducing subsequent morbidity and mortality from hazardous substances emergency events.

Table 1. Distribution of the number of substances releases, by substance category and type of event, AL HSEES, 1993-1997.

Substance Category	Fixed Facility		Transportation		All Events	
	Number of Substances	%	Number of Substances	%	Number of Substances	%
Acids	74	10.0	27	15.3	101	11.0
Ammonia	65	8.8	3	1.7	68	7.4
Bases	44	6.0	44	6.0	63	6.9
Chlorine	48	6.5	3	1.7	51	5.6
Mixture of Categories	8	1.1	5	2.8	13	1.4
Other Inorganics	130	17.6	27	15.3	157	17.2
Paints & Dyes	11	1.5	6	3.4	17	1.9
Pesticides	31	4.2	21	11.9	52	5.7
PCBs *	17	2.3	5	2.8	22	2.4
VOCs **	130	17.6	7	4.0	137	15.0
Other Substances	180	24.4	54	30.5	234	25.6
Total	738	100.0	177	100.0	915	100.0

*polychlorinated biphenyls
**volatile organic compounds

Table 2. Number of substances released in all events and events with victims, by substance category, AL HSEES, 1993-1997.

Substance Category	Number of Releases	%	Number of Releases with Victims	%	Percentage of Releases withVictims
Acids	101	11.0	17	14.8	16.8
Ammonia	68	7.4	11	9.6	16.2
Bases	63	6.9	5	4.3	7.9
Chlorine	51	5.6	20	17.4	39.2

Mixture of Categories	13	1.4	1	1.4	7.7
Other Inorganics	157	17.2	19	16.5	12.1
Paints and Dyes	17	1.9	3	2.6	17.6
Pesticides	52	5.7	7	6.1	13.5
PCBs	22	2.4	0	0.0	0
VOCs	137	15.0	8	7.0	5.8
Other	234	25.6	24	20.9	10.3
Total	**915**	**100.0**	**115**	**100.0**	**12.6**

Table 3. Cumulative data, AL HSEES, 1993-1997.

Year	TYPE OF EVENT Fixed	Transportation	Total	No. of Releases	No. of Deaths	No. of Victims	Events with Victims	%
1993	117	30	147	189	0	80	18	12
1994	136	30	166	234	1	77	18	11
1995	145	38	183	233	1	80	26	14
1996	166	37	203	214	2	81	22	11
1997	121	28	149	173	0	43	10	13
Total	685	163	848	1043	4	361	103	12

COLORADO

During the five-year period 1993-1997, 1,930 hazardous substance events qualified for inclusion in the Colorado HSEES System. 1,335 (69.2%) of the events were at fixed facilities and 595 (30.8%) of the events were transportation related. A summary of all states is as follows:

TABLE 4: Cumulative Data for all States*

State	Type of Event				Total
	Fixed-Facility		Transportation		
Alabama	685	(80.8%)	163	(19.2%)	848

Colorado	1335	(69.2%)	595	(30.8%)	1930
Iowa	1007	(66.3%)	511	(33.7%)	1518
Minnesota	611	(76.9%)	184	(23.1%)	795
Mississippi	241	(68.5%)	111	(31.5%)	352
Missouri	517	(60.3%)	341	(39.7%)	858
New Hampshire	152	(84.0%)	29	(16.0%)	181
New York	1624	(82.8%)	337	(17.2%)	1961
North Carolina	805	(74.5%)	276	(25.5%)	1081
Oregon	673	(72.3%)	258	(27.7%)	931
Rhode Island	199	(87.3%)	29	(12.7%)	228
Texas	8909	(90.8%)	908	(9.2%)	9817
Washington	1624	(75.9%)	516	(24.1%)	2140
Wisconsin	1223	(66.6%)	614	(33.4%)	1837
Total	19605	(80.1%)	4872	(19.9%)	24477

*Not all states participated for the entire 1993-1997 time-frame

The geographic distribution of events by county shows that the five counties with the highest incidence of releases from 1993-1997 were Adams (846), Jefferson (359), Denver (179), El Paso (57) and Boulder (52). These areas, which correspond to the more populated and industrialized areas of Colorado, accounted for 77.4% of the total qualifying events. The large number of events in Adams county is directly related to shipping industries located throughout the county. Many of these events were small quantity releases from loose caps, etc., in packaged materials. No qualifying events were reported in Archuleta, Costilla, Crowley, Custer, Dolores, Gilpin, Hinsdale, Jackson, Mineral or San Juan counties.

Fixed-facility events are defined as those events which occurred within or outside of buildings, but within the facility premises. Also included as fixed-facility events are situations such as offloading of transportation vehicles where an employee of the fixed-facility or transportation company drops a box or punctures a container with a forklift. Examples of fixed-facility events include, but are not limited to: industrial sites, farms, schools, private residences, hospitals, etc.

Transportation events are defined as those events which involve ground, rail, water, air or pipeline transport and occur outside the boundaries of a fixed-facility. Also included as transportation events are the releases which are discovered upon offloading at a fixed-facility, but occurred during transportation. A more specific analysis of the number of transportation and fixed-facility events by county, including the number of events which occurred within 1/4 mile of
a residential area, is shown in Table 5.

Table 5: Reported Events by County

COUNTY	TOTAL NUMBER OF EVENTS & PERCENT OF TOTAL	NUMBER OF TRANSPORTATION EVENTS	NUMBER OF FIXED-FACILITY EVENTS	# OF EVENTS WITHIN 1/4 MILE OF RESIDENTIAL AREAS
ADAMS	846 (43.8%)	265	581	66
ALAMOSA	1 (.05%)	0	1	1

COUNTY	TOTAL NUMBER OF EVENTS & PERCENT OF TOTAL	NUMBER OF TRANSPORTATION EVENTS	NUMBER OF FIXED-FACILITY EVENTS	# OF EVENTS WITHIN 1/4 MILE OF RESIDENTIAL AREAS
ARAPAHOE	48 (2.5%)	16	32	36
BACA	3 (.16%)	1	2	1
BENT	1 (.05%)	1	0	0
BOULDER	52 (2.7%)	10	42	28
CHAFFEE	2 (.10%)	2	0	1
CHEYENNE	9 (.47%)	5	4	0
CLEAR CREEK	3 (.16%)	0	3	0
CONEJOS	1 (.05%)	1	0	0
DELTA	2 (.10%)	1	1	0
DENVER	179 (9.3%)	68	111	89
DOUGLAS	12 (.62%)	1	11	4
EAGLE	15 (.78%)	6	9	5
EL PASO	57 (3.0%)	22	35	39
ELBERT	2 (.10%)	0	2	1
FREMONT	11 (.57%)	4	7	4
GARFIELD	21 (1.1%)	11	10	3
GRAND	2 (.10%)	2	0	1
GUNNISON	2 (.10%)	1	1	1
HUERFANO	2 (.10%)	0	2	0
JEFFERSON	359 (18.6%)	20	339	39
KIOWA	2 (.10%)	0	2	0
KIT CARSON	10 (.52%)	7	3	3
LA PLATA	6 (.31%)	2	4	1
LAKE	2 (.10%)	1	1	0
LARIMER	34 (1.8%)	16	18	11
LAS ANIMAS	7 (.36%)	5	2	2
LINCOLN	30 (1.6%)	25	5	5
LOGAN	10 (.52%)	5	5	8
MESA	33 (1.7%)	18	15	8
MOFFAT	6 (.31%)	3	3	0
MONTEZUMA	4 (.21%)	1	3	1
MONTROSE	3 (.16%)	1	2	1
MORGAN	10 (.52%)	2	8	6
OTERO	7 (.36%)	4	3	0
OURAY	2 (.10%)	2	0	0
PARK	5 (.26%)	2	3	0
PHILLIPS	3 (.16%)	1	2	1
PITKIN	1 (.05%)	0	1	0
PROWERS	5 (.26%)	4	1	3
PUEBLO	44 (2.3%)	22	22	18
RIO BLANCO	5 (.26%)	0	5	0
RIO GRANDE	9 (.47%)	8	1	5
ROUTT	7 (.36%)	1	6	0

COUNTY	TOTAL NUMBER OF EVENTS & PERCENT OF TOTAL	NUMBER OF TRANSPORTATION EVENTS	NUMBER OF FIXED-FACILITY EVENTS	# OF EVENTS WITHIN 1/4 MILE OF RESIDENTIAL AREAS
SAGUACHE	3 (.16%)	2	1	1
SAN MIGUEL	1 (.05%)	0	1	1
SEDGWICK	3 (.16%)	2	1	1
SUMMIT	4 (.21%)	3	1	1
TELLER	2 (.10%)	0	2	0
WASHINGTON	2 (.10%)	2	0	0
WELD	38 (2.0%)	18	20	16
YUMA	2 (.10%)	1	1	0

As stated earlier, 1,335 (69.2%) of the events in Colorado were at fixed facilities. The majority of fixed-facility events occurred during material handling (i.e., loading/offloading), followed second by storage above ground.

Data on factors which contributed to the release (i.e., cause of the release) was not collected until mid 1995, therefore the information is limited. However, it is interesting to note that the most common factor which contributed to the release of substances at fixed-facility events was overwhelmingly operator error (60.4%), followed by equipment failure (32.9%), improper mixing (1.6%), etc.

The majority of transportation-related events in Colorado occur during ground transport (81.34%), followed by rail transport (15.63%) and air transport (2.35%) (Figure 6). Analysis of the daily distribution shows that the majority of transportation events occur Monday-Friday (85.7%), with Wednesday being the peak day for events (19.9%). The peak months for transportation events are April and June, with a gradual increase in incidents beginning in March and declining in October. This appears to be due to the increased transportation and fixed-facility activities in the summer months.

SUMMARY OF DATA ANALYSES 1993-1997

During the five-year period of Colorado's participation in the HSEES project, data collection results have remained fairly consistent. Of the 1,930 hazardous substance events which qualified for inclusion in the Colorado HSEES:

- Most of the events occurred at fixed facilities (69.2%) and most involved a single substance (97.4%). The majority of fixed-facility events occurred during material handling (i.e., loading/offloading), and the most common factor which contributed to the release was operator error;
- The majority of transportation events occurred during ground transport;
- The most common injury to victims was respiratory irritation;
- The substances with the highest percentage of releases with victims were ammonia and chlorine;
- Although eight deaths occurred during this five year period, seven of the deaths were directly attributable to trauma caused by a transportation accident and the other death was caused by operator error on an above ground storage tank at a fixed-facility.

Continued data collection and analysis will provide useful information regarding risk factors related to the occurrence of emergency events and the associated morbidity and mortality. This information can be used to develop training and health education programs for persons involved in hazardous substances emergency response and planning and for manufacturers and transporters of hazardous materials.

Future plans for the Colorado HSEES project include, but are not limited to, design of a web site were information can be easily accessed by interested parties, fact sheets designed to assist private industry in the prevention of hazardous substance emergency events, substance specific fact sheets to assist private industry and first responders in the safe and efficient response to hazardous substance incidents, and coordination with local government emergency planning agencies to ensure plans are adequate to protect public health and the environment.

Iowa

**In Word format-Tables 6-9*

Minnesota

During 1995 to 1997, the Minnesota Hazardous Substances Emergency Events Surveillance (HSEES) recorded 795 events. Of these 795 events, 60 events resulted in injuries to 264 people. These people reported a total of 497 injuries. Of the 60 events with victims, 87% had 3 or fewer victims. There were 99 events with evacuations. These 99 evacuations involved over 5,122 people.

There were 1,010 chemicals released in the 795 events. The most frequently released chemicals were ammonia (anhydrous and aqueous) (10%), sulfuric acid (4%), and PCBs (3%). Most events (92%) involved the release of only one chemical.

Agriculture (27% of all events) uses a large amount of hazardous substances during the spring planting season. There is a corresponding increase in the number of hazardous substances releases during the spring in both fixed-facilities and transportation events.

Non-agriculture events exhibit a typical business cycle both by day of the week and hour of the day. There are twice as many events per day on workdays as on weekends. Most events occur from 6 A.M. to 6 P.M. Transportation events are highest on Tuesday, Wednesday, and Thursday.

Half of the events occurred in the 10 ‘urban’ counties. The other half of the events occurred in the 77 ‘rural’ counties.

METHODS

The data was gathered by a research scientist located within the Minnesota Department of Health using a protocol developed by ATSDR. Information about events was collected on standardized data collection forms. Information about the event, substance(s) released, victims, injuries, and evacuations was collected.

Various data sources were used to obtain information about these events. Reports made to the Minnesota Duty Officer were the primary source of event notification. Other sources, including but not limited to records and oral reports of the Minnesota Pollution Control Agency, Minnesota Department of Agriculture, Minnesota Department of Natural Resources, Minnesota Department of Transportation, police and fire departments, hospitals, and responsible parties, were used to complete the data collection form. Census data were used to estimate the number of residents in the vicinity of the

events. All of the data were computerized using an ATSDR provided data entry system and were sent to ATSDR quarterly.

ATSDR cleaned the data and provided translation of several data fields. The description of the responsible party was converted into standardized 'industry code' and 'industry description' fields. Chemicals released were each assigned a 'standardized name' and 'code.' Chemicals were also assigned to a 'chemical category.'

EVENTS

Table 10 shows the number of events by year and the total for all 3 years. Of the 795 events, 780 (98%) involved the actual release of hazardous substances, 9 (1%) involved the threatened release of hazardous substances, and 6 (1%) involved a combination of threatened and released hazardous substances. Most events occurred in fixed facilities (77%) compared to transportation (23%).

Table 10

EVENTS, BY YEAR AND TYPE OF EVENT , MN HSEES 1995–1997

	TYPE OF EVENT				
	Fixed Facility		Transportation		Total No. of Events
YEAR	No. of Events	%	No. of Events	%	
1995	193	84.3	36	15.7	229
1996	224	74.4	77	25.6	301
1997	194	73.2	71	26.8	265
Total	611	76.9	184	23.1	795

TRANSPORTATION VS FIXED FACILITY

An event was classified as either a transportation event or a fixed-facility event. Transportation events included transportation between fixed facilities, and events at a fixed facility where a transport company was still in possession of the substance released. There were 184 (23%) transportation events and 611 (77%) fixed-facility events.

The number of chemicals (Figure 7) released were in similar proportions; transportation - 213 (21%) chemicals, fixed facility 797 (79%) chemicals. While the percentage of victims is skewed toward fixed facilities (91%), the percentage of events with victims in fixed-facility (77%) and transportation events (23%) (Figure 9) is similar to the overall percentage of fixed-facility (77%) and transportation (23%) events, as shown in Figure 6. The percentage of evacuees is even more skewed toward fixed facilities; transportation 1% - fixed facility 99%. The percentage of events with evacuees is nearly as skewed as the percentage of evacuees; transportation 4% - fixed facility 96%. These ratios make sense given that fixed facilities have more workers near the chemical, while transportation events often occur on open roads with few people near the release.

Comparing fixed-facility and transportation events year to year over the 3 years covered by this report, there does not appear to be any trends. Table 10 shows the 3-year history for fixed-facility and transportation events. Comparisons over the course of a year are discussed below.

The most common areas involved in hazardous substances releases were piping, pumps and valves (25%), above ground storage areas (22%), material handling (21%), and process vessels (15%).

Equipment failure (41%) and operator error (23%) accounted for the majority of contributing factors of fixed-facility events. There were 161 fixed-facility events (26%) for which the primary contributing factor was unknown or was not reported, partly because data for factors was not collected until July 1995.

Ground transportation, including trucks and cars, accounted for 88% of the transportation events.

Removing agriculture events from fixed facilities shows that fixed facility, non-agriculture events show little variation in the number of events per month throughout the year. Similar to all agriculture events, fixed facility agriculture events show a strong spring increase.

There is a strong spring increase in the transportation events. Transportation, non-agriculture events do not have a discernable pattern over the course of a year. Transportation, agriculture events do show a strong spring increase.

Both fixed-facility and transportation events show a significant increase in the number of events during the spring planting season due to the increased use of agricultural products during this time. There is not a monthly pattern in non-agriculture events over the course of a year.

The average number of events in each day of the workweek (135) is 2.3 times larger than the average number of events in each day of the weekend (60). For fixed facilities, the average daily number of events on weekdays (103) is 2.2 times the average daily number of events on weekends (47). Likewise, for transportation events, the average daily number of events on weekdays (32) is 2.5 times the average daily number of events on weekends (13). Furthermore, Fixed Facility Events by Day of the Week shows minor variation in weekday events (range 100 to 107), but Transportation Events by Day of the Week shows an increase on Tuesday, Wednesday, and Thursday (range 34 to 41) compared to Monday and Friday (range 11 to 15).

This increase in transportation events raises the total number of events on Tuesday, Wednesday, and Thursday above Monday and Friday. The cause of the variation in transportation events is most likely related to transportation activity patterns and should be investigated further.

Events were categorized by hour of the day, 00 to 23. Times are rounded down to the whole hour.

For both fixed facility and transportation events, there were few events from 8 P.M. to 6 A.M. There were more events in the morning than in the afternoon.

Assuming the typical business day is from 8 AM to 5 PM, there should be slight variations in the number of fixed-facility events from 8 A.M. to 5 P.M. There should be a drop in the average number of events for the 2nd shift from 6 P.M. to Midnight. The 3rd shift from Midnight to 8 A.M. should have an even lower average number of events.

There is a peak at 8 A.M. tapering off toward lunch time. There is a large sharp peak at 2 P.M. The causes of this curve requires further investigation.

VICTIMS, INJURIES, AND EVACUATIONS

A person is counted as a victim if they suffered an injury(ies) during a hazardous substance emergency event. Because of the difficulty in determining cause and effect, HSEES makes no distinction between injuries sustained because of the emergency event and those sustained

incidentally to the emergency event. The HSEES program counts all injuries to a victim reported within 24 hours of the event.

In the 795 events occurring in 1995 to 1997, there were 264 victims with 497 injuries. Of the 60 events with victims, 60% had only 1 victim, 27% had 2 or 3 victims and 13% had 6 or more victims. Fixed facilities had the majority of events with victims (77%). Fixed facilities also had the majority of the victims (91%). However, most events (735) did not result in injuries. Table 3 lists the distribution of the number events and victims by type of event.

Employees are the most common victims for both fixed facility and transportation events. Respiratory irritation is the most common injury (37%), followed by gastrointestinal problems (17%), headache (14%), and eye irritations (14%). Treatment at a hospital without admission is the most common level of treatment. Only 1 death occurred during 1995-1997 in hazardous substances emergency events.

CHEMICAL CATEGORY

There were 1,010 chemicals released during the three years covered by this report. Table 11 shows the breakdown of these chemicals by category. The HSEES program divides chemicals into 11 categories. The category 'mixture' consisted of mixtures of substances from different categories. The category 'other' consisted of substances that could not be placed in one of the other 10 substance categories. The category 'other inorganic substances' comprised all inorganic substances except for acids, bases, ammonia, and chlorine.

The number of chemicals released by chemical category for the 3-year period and by each year is shown in Table 11. Comparing the number of events by category over the 3-year period shows trends in 5 of the categories. There is an increase in the number of 'Ammonia' releases. There is a decrease in the number of 'Other Inorganic Substances' (OISs) releases. The number of 'Volatile Organic Compounds' (VOCs) releases decreases. 'Other' releases also decrease. And there is an increase in the number of 'Mixtures Across Categories' releases. Analysis was done to determine the cause, if any, for these trends.

One event involved 99 chemicals. Removal of this one event explains some of the trends identified above. Specifically, the decrease in OISs between 1995 and 1996, some of the decrease in VOCs releases, and some of the decrease in 'Other' releases.

The increase in ammonia events is believed to be due to improved reporting of releases and not due to an actual increase in ammonia releases. The increasing use of ammonia for refrigeration may result in increases of ammonia releases. A study of refrigeration ammonia releases should be conducted.

Hydrogen Sulfide (6 in 1995, 17 in 1996, and 6 in 1997), and Sulfur Dioxide (16 in 1995, 7 in 1996, and 4 in 1997) are major contributors to the variation of OISs. The large jump in Hydrogen Sulfide (H2S) releases in 1996 was due to one facility. This facility has since upgraded their pollution control equipment and has fewer releases. This explains about 1/3 of the drop from 1996 to 1997.

A change in reporting requirements (by MPCA) resulted in Petroleum Refining facilities reporting fewer (15 in 1995, 3 in 1996, and 3 in 1997) releases of Sulfur Dioxide. The reduction in releases of these 2 chemicals accounts for most of the reduction in OISs from 1995 to 1997.

There is no obvious reason for the rest of the trends. Further research is needed to determine the cause of these trends.

TABLE 11

CHEMICALS RELEASED, BY CATEGORY AND YEAR , MN HSEES 1995–1997

Substance Category	Year														
	1995				1996				1997				Cumulative		
	Fixed	(%)	Trans	(%)	Fixed	(%)	Trans	(%)	Fixed	(%)	Trans	(%)	Fixed	Trans	Total
Acids	35	10.3	0	0.0	28	11.0	7	8.0	28	13.7	7	8.9	91	14	105
Ammonia	19	5.6	3	6.4	32	12.6	5	5.7	35	17.2	7	8.9	86	15	101
Bases	9	2.7	1	2.1	12	4.7	1	1.1	7	3.4	2	2.5	28	4	32
Chlorine	6	1.8	0	0.0	7	2.8	0	0.0	3	1.5	0	0.0	16	0	16
Mixture across categories	3	0.9	1	2.1	9	3.5	0	0.0	13	6.4	6	7.6	25	7	32
Other	94	27.7	5	10.6	66	26.0	13	14.9	35	17.2	4	5.1	195	22	217
Other Inorganic Substances	89	26.3	3	6.4	52	20.5	7	8.0	26	12.7	9	11.4	167	19	186
Paints and Dyes	4	1.2	0	0.0	6	2.4	3	3.4	2	1.0	0	0.0	12	3	15
Pesticides	42	12.4	33	70.2	16	6.3	51	58.6	31	15.2	40	50.6	89	124	213
Polychlorinated Biphenyls	9	2.7	1	2.1	8	3.1	0	0.0	14	6.9	1	1.3	31	2	33
Volatile Organic Compounds	29	8.6	0	0.0	18	7.1	0	0.0	10	4.9	3	3.8	57	3	60
Total	339	100.0	47	100.0	254	100.0	87	100.0	204	100.0	79	100.0	797	213	1010

MISISSIPPI

Since January 1, 1995, the Mississippi State Department of Health (MSDH) has participated in a project known as the Hazardous Substances Emergency Events Surveillance (HSEES). The project, which currently includes fifteen states, is funded by the Agency for Toxic Substances and Disease Registry (ATSDR) and collects data about emergency spills involving non-petroleum hazardous substances. The goal of the HSEES project is to reduce morbidity (injury) and mortality (death) resulting from hazardous substances emergency events by identifying risk factors using the spill data and by developing risk reduction strategies.

From January 1, 1995 through December 31, 1997, project staff reviewed 2,454 actual and threatened spills/air releases reported in Mississippi and identified 352 events (14.3%) which involved non-petroleum substances and met study criteria. These spills and air releases were investigated through telephone and written inquiries to appropriate sources including state environmental agencies, state emergency management agencies, local fire and police departments, civil defense/emergency planning agencies, hospitals, and the industries involved. Staff collected data using a 68-question survey developed by ATSDR.

The 352 events which met the project criteria were entered into the database. Sixty-eight percent (n = 241) occurred at fixed facilities and the remaining 32% (n = 111) occurred during transport. Of the transportation events, 88 events (79%) involved a motor vehicle (truck, van, tractor or automobile). The chemicals most frequently released in reported events in descending order were ammonia, chlorine, paint or coating NOS, benzene, titanium, and tetrachloride. Most events (n = 326, 93%) involved a single hazardous substance, six percent (n = 22) involved two hazardous substances and only one percent (n = 4) involved three to seven hazardous substances. Evacuations were ordered in 51 events and resulted in 15,181 people leaving their home or work as a direct result of a hazardous substance release. The chemicals most frequently associated with evacuations were ammonia, multi-chemical releases, chlorine, Freon NOS, hydrochloric acid and Malathion.

A total of 327 people were injured in 41 events. The most common injuries were respiratory irritation, nausea or vomiting, headache, dizziness or other central nervous system symptoms, and eye irritation. The chemicals most frequently associated with victims were ammonia, multi-chemical releases, chlorine and formaldehyde. Fifty percent (n = 162) of the injured were employees. Most injured people (88%) were transported to the hospital and released after treatment. Five fatalities were recorded; all were trauma related from transportation events.

Results

In the first three years, the MSDH received information on or identified 2,454 incidents involving releases of potentially hazardous substances. Of these, 1,793 (73%) did not meet the definition for entry into the HSEES system primarily due to the release being a petroleum product; 309 events (13%) met the case definition but occurred in a contiguous state near the border of Mississippi. The remaining 352 events (14%) were documented as hazardous substancs events in the Mississippi HSEES. Two hundred forty-one events (68%) occurred at fixed facilities, while 111 events (32%) were classified as transportation-related events. Events occurred in 59 of Mississippi's 82 counties. The top five counties experiencing events were: Jackson (n=64), Harrison

(n=29), Monroe (n=27), Hinds (n=26), and Rankin (n=22).

Of the 241 fixed-facility events, 29% involved piping; 20% involved storage above ground; 14% involved a process vessel, which is the reaction chamber where chemicals are processed, 9% involved material handling, and 25% involved a type of processing reported as "other" which included ancillary processing equipment, transformers, incinerators, etc.. The remaining events involved a variety of areas or the areas were unknown. Of the 111 transportation-related events, 79% occurred during ground transport (for example, truck, van, or tractor) and 14% involved transport by rail. The remaining transportation-related events involved water, air, or pipeline transport.

One hundred ninety-three of the 241 fixed-facility events identified a contributing factor to fixed-facility events. (Information on contributing factors was not collected until mid-1995.) Of these, 119 (62%) involved equipment failure as a contributing factor to the occurrence of the event and 38 (20%) involved operator error. The remaining factors were identified as improper filling/overfill (3%) and other (15%) including factors such as system/process upset, system start up and shutdown, power failure/electrical problems, etc.

Ninety-three percent of all events involved the release of only one substance. Two substances were released in approximately 6% of the events, and the remaining events involved the release of more than two substances.

Substances

HSEES substances were grouped into 11 categories. Of the 11 categories, "other" (20%), other inorganic substances (19%), ammonia (17%), and VOCs (15%) were the categories of substances most commonly released in fixed-facility events (Table 12). In transportation-related events, "other" (38%), other inorganic substances (15%), acids (12%), and pesticides (10%) were the most frequently released. The top ten chemicals most frequently reported to Mississippi HSEES for the period 1995 - 1997 are listed in Appendix A.

Victims

Forty-one of the 352 events resulted in 327 victims (12% of all events). Of the 41 events, 54% involved only one victim, and 66% involved either one or two victims (Table 13). Eighty-four percent were injured in fixed-facility events. One hundred ninety-two (59%) of the injured were female.

The substances released most often were not necessarily the most likely to result in victims. For example, substances identified in the category "other" were released during 99 events (26% of all events); however, only 15 (15%) of these events resulted in injury. Although pesticides were released in only 19 events (5% of all events) and "mixtures across substance categories" were released in only 10 events (3% of all events), 21% and 20% of these events respectively resulted in injury.

The population groups most often injured were employees (50%) and the general public (43%). In the 41 events with victims, 162 employees, 141 members of the general public (including students) and 24 responders suffered one or more adverse health effects as a result of hazardous substance releases. The 24 responders consisted of 12 police, 7 professional firefighters, 4

emergency medical technicians (EMT), and one responder of unknown affiliation.

The 327 victims sustained a total of 657 injuries. Some victims had more than one injury. The most frequently reported injuries in fixed-facility events were respiratory irritation (25%), headache (23%), nausea (22%) and dizziness or other central nervous system symptoms (16%). In transportation-related events, nausea (23%), trauma (18%), respiratory irritation (14%) and dizziness or other central nervous system symptoms (13%) were reported most frequently. All trauma injuries occurred during transportation events. The trauma might have been caused by the sequence of events (for example, a motor vehicle crash) leading to the release of a hazardous substance and not necessarily by exposure to the hazardous substance itself.

Among the 327 persons injured, 287 (88%) were transported to a hospital for evaluation and treatment, but were not admitted. Of the remaining 40 persons, 15 (5%) were transported to, treated and admitted to a hospital; 8 each (2%) were transported to a hospital for observation, but received no treatment or were seen by private physicians; two each (<1%) were treated on scene or reported injuries to poison control and were advised to seek medical assistance; and five (1.5%) died. The five deaths were all trauma related from transportation events. Among the victims, 22 of 327 (6.7%) were wearing some type of protective equipment.

Evacuations

Evacuations were ordered in 51 events and resulted in 15,181 people leaving their home or work as a direct result of a hazardous substance release. Of the 51 events requiring evacuation, 23 (46%) involved the evacuation of a building or the affected part of a building where the release occurred. Thirteen (26%) involved evacuating a defined circular area around an event, eight (16%) were based on actual or anticipated downwind dispersion, 3 (<1%) were based on a circular area and anticipated downwind dispersion, and 3 (<1%) were ordered without criteria. Information on evacuated area was missing for one event.

Summary of Results, 1995-1997

In the three years of data collection, most events have involved a single substance and have occurred at fixed facilities. Respiratory irritation was the most common injury to victims. All fatalities occurred as a result of trauma from transportation-related events, and all were the result of the accident and not a result of the substance released. Employees were the most commonly reported victims of emergency events.

Findings from HSEES data collection efforts can provide useful information regarding risk factors related to the occurrence of emergency events and the associated morbidity and mortality. This information can be used to develop training and health education programs for persons involved in hazardous substances emergency response and planning and also for manufacturers and transporters of hazardous materials.

Appendix A - Top Chemicals Spilled, Mississippi HSEES

Years 1995 - 1997

HSEES Standard Chemical Name	Frequency	Percent

Ammonia		45		11.6
Chlorine	28		7.2	
Paint or Coating NOS		14		3.6
Benzene NOS		14		3.6
Titanium Tetrachloride		13		3.4
Sulfuric Acid		13		3.4
Hydrochloric Acid		8		2.1
Formaldehyde		7		1.8
Sulfur Dioxide		7		1.8
Hydrogen Sulfide (tie)		6		1.5
Ammonia Nitrate (tie)		6		1.5
Sodium Hydroxide (tie)		6		1.5

Table 12.
Distribution of the number of substances released, by substance category and type of event, Mississippi HSEES, 1995-1997.

Substance Category	Type of Event				All Events	
	Fixed Facility		Transportation			
	No. of Substances	(%)	No. of Substances	(%)	No. of Substances	(%)
Acids	15	5.7	15	12.2	30	7.7
Ammonia	45	17.0	3	2.4	48	12.4
Bases	6	2.3	8	6.5	14	3.6
Chlorine	26	9.8	2	1.6	28	7.2
Other inorganic substances	51	19.2	19	15.4	70	18.0
Paints/Dyes	12	4.5	4	3.3	16	4.1
Pesticides	7	2.6	12	9.8	19	4.9
Polychlorinated biphenyls	5	1.9	0	0.0	5	1.3
Volatile organic compounds	40	15.1	9	7.3	49	12.6
Other substances	52	19.6	47	38.2	99	25.5
Mix between chemical categories	6	2.3	4	3.3	10	2.6
Total*	265	100	123	100	388	99.9
* Percentages may not equal 100% due to rounding.						

Table 13.

Distribution of the number of victims by type of event, Mississippi HSEES, 1995-1997.

Number of Victims	Type of Event						All Events		
	Fixed Facility			Transportation					
	No. of events	(%)	Total Victims	No. of events	(%)	Total Victims	No. of events	(%)	Total Victims
1	12	57.1	12	10	50.0	10	22	53.7	22
2	1	4.8	2	4	20.0	8	5	12.2	10
3	0	0.0	0	2	10.0	6	2	4.9	6
4	2	9.5	8	0	0.0	0	2	4.9	8
5	1	4.8	5	0	0.0	0	1	2.4	5
>= 6	5	23.8	248	4	20.0	28	9	22.0	276
Total*	21	100.0	275	20	100.0	52	41	100.1	327
* Percentages may not total 100% due to rounding.									

MISSOURI

**No report received*

NEW YORK

Since January 1, 1992, the New York State Department of Health (NYSDOH) has participated in a project known as the Hazardous Substances Emergency Events Surveillance (HSEES). The project, which includes thirteen states, is funded by the Agency for Toxic Substances and Disease Registry (ATSDR) and collects data about emergency spills involving non-petroleum hazardous substances. The goal of the HSEES project is to reduce morbidity (injury) and mortality (death) resulting from hazardous substances emergency events by identifying risk factors using the spill data and by developing risk reduction strategies.

From January 1, 1993, through December 31, 1997, project staff reviewed approximately 85,000 actual and threatened spills/air releases reported in New York State and identified discrete events which involved non-petroleum compounds. These spills were investigated through telephone and written inquiries to appropriate sources including local, county and state emergency response personnel such as firefighters, emergency medical technicians and hazardous materials (HazMat) staff; law enforcement; county health departments; industrial health and safety personnel; hospital staff; plant managers and employees; and private citizens. The 1,956 spills (2.3%) which met the project criteria were entered into the database.

For the 1,956 events, project staff collected data using a 68-question survey developed by ATSDR. Eighty-three percent of the HSEES events (1,620 events) occurred at fixed facilities and the remaining 17% (336 events) occurred during transport. Of the transportation events, 296 (88%) involved a motor vehicle (truck, van, tractor or automobile). Most events (1,768 events, 90%) involved a single hazardous substance, nine percent of the events involved two or three hazardous substances, and one percent of the events involved four to eleven hazardous substances. HSEES events were associated with 297 ordered evacuations of 19,489 people.

The ten chemicals most frequently released in reported events in descending order were: ethylene glycol, sulfuric acid, oils (heat transfer fluids) containing low levels of polychlorinated biphenyls (PCBs), hydrochloric acid, ammonia, chlorine, mercury, chlorodifluoro-methane, sodium hydroxide and sodium hypo-chlorite. The chemicals most frequently associated with injuries were hydrochloric acid, sodium hypochlorite, chlorine and ammonia. The chemicals most frequently associated with evacuations were ammonia, chlorine, hydrochloric acid and sulfuric acid.

A total of 718 people were injured in 274 events. The most common injuries were respiratory irritation, dizziness and other central nervous system symptoms, and nausea or vomiting. Most injured people (70%) were transported to the hospital and released after treatment, but ten fatalities were recorded. No personal protective equipment was worn by 72% of the injured employees, 35% of the injured responders, and 89% of the injured public. There were 1,282 decontaminations, the majority of them (91%) on-scene.

A summary of the injury data shows that the ten chemicals most frequently associated with injuries accounted for 58% of the injured people. Most of the injured were employees (60%). The most frequent injury was respiratory irritation. One quarter of the events with injury involved ordered evacuations, the majority (54%) with thirty or fewer people. Many of the events with injury occurred in industrial (48%) or commercial areas (31%), and a high percentage (62%) were also near residences. For the ten chemicals most frequently involved in injuries, the most frequent sites for the spills/releases were “piping” (34%) and “storage above ground” (22%).

To conduct outreach and education for the HSEES project, staff prepared thirteen articles for professional organizations and made 30 presentations to more than 5,200 participants at professional

meetings, workshops and conferences. Staff also prepared chemical-specific factsheets with in-depth analysis for four of the chemicals reported most frequently in HSEES events: ammonia, sulfuric acid, hydrochloric acid and mercury. Most recently, staff created a NYHSEES web site on the NYSDOH Internet home page which includes a description of the project and copies of the project's written materials, and has hotlinks to related federal, state and local government agencies. The address is: ***www.health.state.ny.us/nysdoh/environ/hsees/hsees.htm***

During the five-year period of 1993-1997, project staff reviewed approximately 85,000 spills reported in New York State and identified events involving non-petroleum compounds. Investigation of these actual or threatened releases indicated that 1,956 (2.3%) met the criteria of an eligible event, and these were entered into the project database. The remaining spills were determined to be non-events 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 re-routing traffic.

The 1,956 events (Table 1) involved 2,236 chemicals, 718 injured people, 297 ordered evacuations and 1,282 decontaminations.

The geographic distribution of events 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 (597/1,620), 26% of the transportation events (88/336) and 35% of the total reported events (685/1,956).

A more detailed summary of reported events for all counties in the State is presented in Appendix A. Since New York City was added to the study October 1, 1994, the spill data for those five counties (Bronx, Kings, New York, Queens and Richmond) correspond to a shorter collection period (three and one-quarter years). 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 or 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. Many events occurred in industrial (1,018 events, 52%) or commercial (532 events, 27%) areas but that a large number of these releases were also near residences (1,134 events, 58%). A total of 1,464 events (75%) occurred within one-quarter mile of a residence (Appendix A, last column). 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."

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 (4 barges), air (2 cargo planes), pipeline (2) and other (crash of

airplane and truck, 1).

Temporal Distribution of Events

The quarterly event data indicate that in four of the five years (all but 1995), the highest number of events occurred in the third calendar quarter (July - September). The weekly and daily event cycles for fixed facility events indicate the expected patterns with the highest number of reported events occurring Monday through Friday (86%; 1390/1,620) during the typical business hours of 7 AM (8^{th} hour of the day) and 4 PM (16^{th} hour of the day) (67%; 1,081/1,620). The data indicate that most transportation events occurred Monday through Friday (88%, 295/336) usually between 7 AM (8^{th} hour of the day) and 4 PM (16^{th} hour of the day) (66%; 221/336).

Evacuations

The 1,956 reported events from 1993 to 1997 caused people to leave their homes or workplaces on 302 (21%) occasions, 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 (175/297, 59%) involved 30 or fewer people.

Most ordered evacuations occurred during the work week which coincides with peak business operation. More evacuations were reported on Sundays (27 events, 9%) than on Saturdays (16 events, 5%), predominantly at fixed facilities. The percentage of daily events which resulted in evacuations ranged from a low of five percent at transportation events on Sundays or Fridays, to a high of 23% at fixed facilities on Sundays.

Chemicals Involved in Spills and Injuries

Most events (1,768 events, 90%) involved a single hazardous substance. 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 (four to eleven).

The ten chemicals most frequently released in reported events 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 ten chemicals were involved in 936 events, 48% of the total of 1,956 events.

The ten chemicals most frequently associated with injury accounted for 59% of the injured people (421/718). All are corrosive or caustic materials except for trichloroethene (also known as trichloroethylene). Forty-nine of the 50 trichlorethene injuries occurred during one event when solvent fumes spread throughout a three-story manufacturing building. The highest number of reported injuries occurred following exposure to hydrochloric acid (137), sodium hypochlorite (127), chlorine (64) or ammonia (59). Over half (51%, 198/388) of the injuries sustained by employees were caused by three chemicals

: hydrochloric acid, sodium hypochlorite and trichloroethene. Over two-thirds (67%, 146/217) of the injuries sustained by the general public were caused by four chemicals: ammonia, chlorine, hydrochloric acid and sodium hypochlorite. Four of the ten chemicals most frequently associated with injuries were not among the ten chemicals most frequently involved in reported events (cresylic acid, formaldehyde, phosphoric acid and trichloroethene).

Analysis of the ten chemicals most frequently involved in an evacuation ordered by an official (Figure 8) 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%).

Injury Information

Injuries were reported in 13% (210/1,620) of the fixed facility events, 19% (64/336) of the transportation events, and 14% (274/1,956) of the total reported emergency events. Of the 607 people injured at fixed facilities, the majority were employees (346 people, 57%). One hundred and 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 in transportation events (79% versus 18%). These numbers vary considerably from the composition of the New York State workforce during 1993-1997 which was 53% male and 47% female during 1993-95, and 54% male and 46% female in 1996 and 1997 (Mr. R. Fortran, New York State Department of Labor, April 1999).

The five counties with the highest number of injuries are Monroe (114), Erie (71), Chautauqua (56), Albany (53) and Columbia (48). 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 CNS (central nervous system) 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 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 hospital (4%). One percent of the injuries resulted in fatalities.

**Add Table 1 from NY report*

NORTH CAROLINA

RESULTS

Fixed-Facility and Transportation-Related Events

A total of 1,081 events were reported to the North Carolina HSEES Program from 1993 through 1997; of these events, 53 (4.9%) were threatened releases. There were 805 (74.5%) fixed-

facility events and 276 (25.5%) transportation events.

The areas most often involved in fixed-facility events included storage above ground (N = 212, 23.7%), process vessel (N = 174, 19.4%), piping (N=132, 14.7%), material handling (N = 118, 13.2%), and transportation within the fixed facility (N = 79, 8.8%). The remaining areas were storage below ground, dump waste area, ancillary process equipment, other, and unknown. In transportation events, 252 or 91.3% occurred during ground transport, and 19 or 6.9% involved transport by rail. The remaining transportation events involved water, air, or other (N = 5, 1.8%).

Factors that most frequently contributed to the fixed-facility events were equipment failure (N = 148, 34.4%), operator error (N = 91, 21.2%), and unknown (N = 162, 37.7%). This information was not collected in 1993, 1994, and part of 1995.

The majority of events (N = 1019, 94.3%) involved the release of only one substance. Two substances were released in 3.4% of the events, and the remainder involved the release of more than two substances. Most of the releases were either liquid spills (N = 773) or air emissions (N = 219). The remaining releases resulted from fires (N = 135) or other types of releases (N = 28). An event may have one or two release types, therefore the number of releases can exceed the total number of events. Additionally, a release type was not coded for threatened events. Information on type of release was missing for two events.

Events occurred primarily in July (N = 121, 11.2%), March (N = 111, 10.3%), or June (N = 109, 10.1%). Fixed-facility events occurred most in July (N = 85, 10.6%) or March (N = 81, 10.1%); transportation events occurred most in April (N = 39, 14.1%). Events typically took place on weekdays (~84%) compared to weekends (~16%). The majority of events took place between 12:00 noon and 6:00 pm (N = 386, 36.7%) or from 6:00 am to 12:00 noon (N = 382, 36.3%), which are typical work hours. Information on time of event was missing for 28 events.

The counties with the highest number of events were Mecklenburg (N = 115, 10.6%), followed by Guilford (N = 83, 7.7%), Wake (N = 68, 6.3%), and Cumberland (N = 54, 5.0%). See Appendices 1 and 2 for maps of distribution of fixed-facility and transportation events, respectively, across North Carolina. See Appendix 3 for the total number of events by county.

Substances

Of the 11 categories into which HSEES substances were grouped, the most commonly released were "other" substances which consisted of substances that could not be placed in one of the other ten substance categories (N = 310, 25.4%); "other inorganic substances" which comprised all inorganic substances except for acids, bases, ammonia, and chlorine (N = 186, 15.2%); acids (N = 168, 13.6%); pesticides (N = 128, 10.5%); and volatile organic compounds (N = 121, 9.9%). Specific examples of "other" included ethylene glycol, creosote, formaldehyde, etc.; "other inorganic substances" included ammonium nitrate, sulfur dioxide, carbon disulfide, aluminum, chromium, etc.; and volatile organic compounds included acetone, toluene, trichloroethylene, etc. The top two chemicals released were ammonia (N = 70) and chlorine (N = 61).

Victims

A total of 575 victims were involved in 182 events, which is 16.8% of all events (Table 8). Most victims (N = 458, 79.7%) were injured in fixed-facility events, which is similar to the proportion of fixed-facility events to total events. The average number of victims per fixed-facility event is 3.47 compared to 2.34 for transportation events. Of the events with victims, 81 events (44.5%) involved only one victim, and 115 events (63.2%) involved either one or two victims. Chlorine had the highest percentage of releases with victims (34.4%), followed by other inorganic

substances (29.0%) (Table 9).

The population groups most often injured were employees (N = 433, 75.3%) and the general public (N = 63, 10.9%). Information on responder type was not collected until 1996. Of the responders who were injured in fixed-facility events, the majority were firefighters, unknown type, (N = 22, 37.3%); for transportation events, police officers were most often injured (N = 17, 28.8%).

The victims sustained a total of 987 injuries. Some victims had more than one injury. The most commonly reported injuries in fixed-facility events were respiratory irritation (39.2%), nausea and vomiting (16.3%), dizziness (11.5%), and headache (11.2%). In transportation events, trauma (42.3%), respiratory irritation (21.1%), and nausea and vomiting (10.6%) were reported most often. Trauma was reported in 42.3% of all transportation events compared to 0.6% of fixed-facility events. The trauma was typically a result of a motor vehicle crash and not necessarily by exposure to the hazardous chemical.

The sex of 75% of the victims was known. Of these victims, 325 (75.4%) were male and 106 (24.6%) were female. Age information was only available for 217 (37.7%) victims; the age range was between 1 and 74 years. The majority of the victims (N = 393, 70.9%) were not wearing personal protective equipment. The personal protective equipment most frequently worn was eye protection (N = 49, 8.8%), gloves (N = 47, 8.5%), steel-toed shoes (N = 30, 5.4%), firefighter turnout gear (N = 29, 5.2%), and hard hats (N = 26, 4.7%). Over half of the victims

(N = 306, 53.2%) were transported to the hospital for treatment and released. There were 118 (20.5%) victims treated at the scene with first aid; 76 (13.2%) were transported to the hospital for observation; 49 (8.5%) were transported and admitted to the hospital; 13 (2.3%) were seen by a health care provider within 24 hours of the event; and 8 victims (1.4%) died.

Responders at the scene were decontaminated most often (N = 536, 80.1%) followed by employees at the scene (N = 108, 16.1%). Few individuals, whether employees, responders, or general public were decontaminated at a medical facility or at another location. Since victims could be decontaminated at both the scene and a medical facility, the numbers may be over-estimated.

Evacuations

Evacuations were ordered in 241 (22.3%) of the events. The majority of the evacuations were the building itself or the affected part of the building (N = 167, 69.3%). The remaining evacuations were downwind/downstream (N = 33, 13.7%) or a circle or radius of the event site (N = 25, 10.4%). There were a total of 18,600 people evacuated; however, the majority of people were evacuated due to fixed facility events (N = 15,984 or 85.9%).

Contingency Plans

A contingency plan was followed by the incident commander in 98% (N = 1060) of the events. The types of contingency or preparedness plans used during an event varied. The HAZMAT or response team's standard operating procedures were used most often

(N = 623, 58.8%) followed by the company's operating procedures (N = 194, 18.3%). The type of plan was unknown in 16.4% of events.

SUMMARY

Most events during 1993 to 1997 involved a single substance and occurred at fixed facilities (Table 14). Respiratory irritation has consistently been reported as the most common injury to victims. The percentage of events with victims has fluctuated over the years; for the five

year period overall, 16.8% of all events have victims. Employees continue to be the most commonly reported victim in emergency events. Victims were usually transported to the hospital for treatment and released. Less than one-fourth of the events resulted in an evacuation. The HAZMAT or response team's standard operating procedures were followed for clean-up.

Table 8
Distribution of the Number of Victims by Type of Event, NC HSEES, 1993-1997

Number of Victims	Total								
	Fixed			Transport			All Events		
	No. of Events		No. of Victims	No. of Events		No. of Victims	No. of Events	%	No. of Victims
1	54	40.9	54	27	54.0	27	81	14.1	81
2	23	17.4	46	11	22.0	22	34	11.8	68
3	23	17.4	69	7	14.0	31	30	15.6	90
4	7	5.3	28	2	4.0	8	9	6.3	36
5	7	5.3	35	1	2.0	5	8	7.0	40
≥ 6	18	3.6	226	2	4.0	34	20	45.2	260
Total*	**132**	**99.9**	**458**	**50**	**100**	**117**	**182**	**100**	**575**

* Percentages may not equal 100% due to rounding.

Table 9
Number of Chemicals Released in All Events and Events with Victims, by Substance Category, NC HSEES, 1993-1997

Chemicals Released	Releases		Releases with Victims		Percent of Releases with Victims
	No.		No.	%	
Acids	166	13.6	32	14.0	19.3
Ammonia	82	6.7	10	4.4	12.2
Bases	49	4.0	11	4.8	22.4
Chlorine	61	5.0	21	9.2	34.4
Mixtures*	39	3.2	9	3.9	23.1
Other	310	25.4	38	16.6	12.3
Other inorganic substances	186	15.2	54	23.6	29.0
Paints and dyes	55	4.5	4	1.7	7.3
Pesticides	128	10.5	20	8.7	15.6
Polychlorinated biphenyls	24	2.0	0	0	0
Volatile organic compounds	121	9.9	30	13.1	24.8
Total	**1221**	**100**	**229**	**100**	**18.8**

* Mixtures across compounds.

Table 14

Cumulative Data for NC HSEES Events, 1993-1997

Year	Event Type			No. Substances Released	No. Deaths	No. Victims	Events with Victims		No. Evacuations	No. People Evacuated
	Fixed	Transport	Total				No.	%		
1993	185	77	262	307	2	151	58	22.1	54	1631
1994	190	54	244	272	1	111	36	14.8	60	3320
1995	186	58	244	285	0	107	30	12.3	53	5430
1996	128	45	173	185	1	126	32	18.5	38	3473
1997	116	42	158	172	4	80	26	16.5	36	4746
Total	**805**	**276**	**1081**	**1221**	**8**	**575**	**182**	**16.8**	**241**	**18600**

OREGON

In Oregon, the HSEES system seemed ideal for evaluating the completeness of the OERS system and to propose any needed improvements, as well as defining the public health impact of hazardous materials events in Oregon. The magnitude of the potential and actual public health threat from hazardous material incidents in the state had not been characterized previously. This program provides an opportunity to evaluate whether public health resources should be targeted to address these hazards. The standardized nature of data collected by multiple states in the HSEES system also allows a comparison of differences in patterns of hazardous material incidents in Oregon relative to other states.

RESULTS

Geographical Distribution of Events in Oregon

Between January 1, 1993 and December 31, 1997, a total of 931 emergency events involving hazardous substances were identified in Oregon that met the HSEES definition. These events occurred in nearly all parts of the state.

Events occurred in 35 of the 36 counties in the state. In general, the number of events occurring in an area is correlated with population. For the state, there were 2.9 HSEES events per 10,000 population between 1993 and 1997. The very high rate in Gilliam county is attributable to the fact that the county contains a major regional hazardous waste disposal facility (the only such facility in the state) and a very small total population (1,700). The events in that county were primarily periodic, minor releases, meeting the HSEES definition, that occurred during the disposal process.

Characteristics of Events

Although transportation events may have attracted much of the media and public attention, they accounted for only 27.7% of total events, and the remaining 72.3% occurred at fixed facilities. Over the five year period, the percent of transportation and fixed-facility events remained relatively constant.

Of the transportation events that occurred between 1993 – 1997, most were ground transportation (81.2%). The other events were rail (14.1%), air (3.5%), water (0.8%) and pipeline (0.4%). Information on the type of transportation was missing for 2 (<1%) events.

For both fixed-facility and transportation events from 1993 – 1997, 90% involved the release of only a single chemical. For fixed-facility events, 89.6% were single chemical releases; for transportation events, 91.1% were single chemical releases.

Although most events involved only one substance, the substances released were distributed over a wide variety of categories (Table 4). This classification is used by all 15 HSEES states to standardize chemical categories for comparisons. Excluding the "Other" category, chemicals most often released at fixed facilities in Oregon included other inorganic substances, volatile organic

compounds, acids, ammonia and chlorine. For transportation events in Oregon, the most commonly reported chemicals, excluding the "Other" category, were pesticides, acids, paints and dyes, other inorganic substances, and volatile organic compounds. The "Other"category includes substances that do not fit into any of the other categories. The "Other Inorganic Substances" category includes substances such as arsenic and mercury or inorganic compounds not included in the other categories. For purposes of analysis of Oregon events, the two "Other" categories make up a large proportion of all events (37%) and thus, this categorization is not as useful as it might be for other states.

Table 4
Classification of chemicals released by type of event
Oregon HSEES 1993-1997

Chemical Category	Fixed Facility	Transportation	All Events
	No. of Events (%)	No. of Events (%)	No. of Events (%)
Acids	(9.9 1)	(14 4 .6)	(11.2 25)
Ammonia	(9.9 1)	(2.6)	(7.9 9)
Bases	(3.8 1)	(6.3 9)	(4.5 0)
Chlorine	(9.8 0)	(0.7)	(7.3 2)
Other Inorganic Substances	(17 41 .2)	(10 3 .9)	(15.5 74)
Paints and Dyes	(4.6 8)	(11 5 .6)	(6.5 3)
Pesticides	(8.3 8)	(15 7 .6)	(10.3 15)
PCBs	(2.9 4)	(0.3)	(2.2 5)
Volatile Organic Compounds	(10 3 .1)	(9.6 9)	(10.0 12)
Mixtures	(3.3 7)	(1.7)	(2.9 2)
Other	(20 65 .1)	(26 9 .2)	(21.8 44)
Total	(100 19 .0)	(100 02 .0)	(100 121 .0)

Injuries/illnesses

Most events during the 5 year period did not result in injuries or illnesses. Only 173 (18%) of the 931 events involved an injury/illness. Fixed-facility events accounted for 76% of the 173 injury/illness events reported and 88% of the total of 563 victims in
events involving injuries or illnesses.

Table 6 presents the distribution of victims by category and type of event; a total of 563 victims were reported to Oregon HSEES. Employees are defined as only employees of the company where the event occurred. The general public is defined as any person who is not an employee of the company where the event occurred and is not a responder. A responder is a person whose job it is to bring the release under control, provide medical assistance to victims, or conduct crowd control. For both fixed facility and transportation events the group with the largest proportion of injuries was employees (56.7% and 49.3%, respectively). The general public accounted for 34.1% of fixed-facility and 43.3% of transportation event victims. Students are included in the general public category. Although responders were least likely to be injured in Oregon HSEES events, they still accounted for 9.1% of victims reported.

Table 6:Distribution of victims by victim category and type of event
Oregon HSEES, 1993-1997

Victim Category	Fixed Facility Events		Transportation Events		All Events	
	No. Victims	%	No. Victims	%	No. Victims	%
Employee	81	(56.7)	33	(49.3)	114	(55.8)
General Public	69	(34.1)	29	(43.3)	98	(35.2)
Responder	46	(9.3)	5	(7.5)	51	(9.1)
Total	196	(100.0)	67	(100.0)	263	(100.0)

When we examine the number of victims and victim-events by chemical category in Table 7, we see that the numbers of victims and victim-events counted by category total 777 victims in 228 victim-events. In actuality, there were 173 victim- events and 563 victims within the 5 year period. This discrepancy exists because one person may have been exposed to chemicals in more than one category, and an event may have involved a release of chemicals from more than one category.

There were 40 victim-events with 152 victims counted where the spill/release involved substances in the "Other" category. When we examine these events individually, nearly half (71) of these victims were exposed in only 6 incidents to pepper mace, mace, or tear gas. Within the "Other Inorganic substances"

category there are 40 victim-events with 167 victims counted. Of these, 13 victim-events and 62 victims were counted for spills/releases of compounds of chlorine, that were not counted in the chlorine chemical category. Five victim-events and 21 victims resulted from releases of carbon monoxide. As a result of these findings, we see that it is sometimes necessary to look beyond general categories for information that can be useful for prevention activities. Events involving chlorine and compounds of chlorine should be targeted to determine risk factors so that the numbers of injuries can be reduced and releases prevented.

There were a total of 228 victim-events counted by chemical category (see Table 7). Of these, 147 involved the release of a single chemical and 81 events involved the release of more than one chemical. For single chemical victim-events, there were a total of 475 (61%) victims counted. For multiple chemical events 302 victims (39%) were counted by chemical category. Table 7 shows that single chemical events affected more victims than multiple chemical events for 6 out of 10 chemical categories.

Table 7. Classification of Chemicals Released: Number of Victims and Events Counted For Each Chemical Category

Chemical Category	Victim-Events	Victims	Single Chemical Victim-Events	Victims	Multiple Chemical Victim-Events	Victims
Acids	30	87	19	34	11	53
Ammonia	13	59	13	59	0	0
Bases	7	21	5	6	2	15
Chlorine	28	104	27	87	1	17
Other Inorganic Substances	40	167	23	68	17	99
Paints and Dyes	9	16	7	12	2	4
Pesticides	34	101	15	35	19	66
Volatile Organic Compounds	22	54	13	35	9	19
Mixtures across Categories	5	16	3	14	2	2
Other	40	152	22	125	18	27
Total Counted By Category	228	777	147	475	81	302

Actual Total	1 73 V ictim- Events	5 63 V ictims	–	–	–	–

Severity of Injuries

The largest proportion of victims (42.1%) were transported to a hospital for treatment but not admitted. Between 1993 and 1997, two deaths were reported; both victims were killed when the crop duster plane/helicopter they were piloting crashed. In both fatal injury events, the victim died on scene and due to trauma rather than exposure to chemicals. Otherwise, the severity of injury was mild in 95% of cases.

The 563 victims reported a total of 879 injuries. [Note: The number of injuries is greater than the number of victims because a victim can have more than one injury.] Respiratory irritation was the injury most often reported for both types of events and by all victim categories, accounting for 47.8% of all injuries reported. Eye irritation and nausea were the next most frequently reported injuries, 18.1% and 10.4%, respectively. A transportation event was more likely to result in trauma than an event at a fixed facility.

During the five year period 51 responders were injured. Of these, 12 had at least 2 injuries, and 2 responders experienced 3 injuries during an incident.

Forty two of the responders experienced respiratory irritation, accounting for 64.6% of all reported injuries. This finding was not expected because responders typically have much better respiratory protection available than the other categories of victims. Thirteen responders wearing "turnouts" experienced respiratory irritation, 2 experienced eye irritation, 3 skin irritation, and 4 suffered chemical burns. It appears that "turnouts" may not always provide adequate protection to prevent these kinds of injuries. However, 8 of these responders were wearing no personal protective equipment (PPE), 13 were wearing turnouts, 4 were wearing level B protection, and 2 were wearing level D protection. For 10 of the 42 responders with respiratory irritation, it is not known whether or what kind of PPE was worn. We can conclude from this information that 23 (62%) of these injured responders were not wearing respiratory protective equipment. Of additional concern is the apparent inadequacy of Level B protection to prevent respiratory irritation in 4 of these responders.

Three hundred and fourteen employees were injured during the 5 year period. For 129 (41.4%) of these, the type of PPE worn, if any, was unknown. Two hundred and fourteen employees experienced respiratory irritation. Again, respiratory irritation was the most common type of injury among employees. This is unexpected because employees, like responders, should have the equipment and training to protect themselves against inhalation exposures. At least 136 (63.6%) of employees with respiratory irritation were reportedly not wearing respiratory protective equipment.

Respiratory irritation and eye irritation were the most common injuries reported among the general public. There is, however, no protection from airborne exposures for the general public other than removal from the area.

Most Frequently Released Chemicals

The ten chemicals most often released between 1993 – 1997 are listed in Table 11. Together, they account for 37.5% of all chemicals released. Ammonia and chlorine were the two chemicals most often involved in a release.

Table 11. Top Ten Chemicals Released
Oregon HSEES 1993-1997

HSEES Standard Chemical Name	Frequency of Releases %
Ammonia	(74.5)
Chlorine	(72.3)
Paint or Coating NOS	(61.3)
Hydrochloric Acid	(40.5)
Sodium Hydroxide	(20.7)
Sulfuric Acid	(27.4)
Polychlorinated Biphenyls	(25.2)
Ethylene Glycol	(11.9)
Solvent NOS	(17.5)
Pesticide NOS	(13.2)

An evacuation was ordered for 245 (26.3%) of the events reported during the five year reporting period. The two chemicals most often associated with evacuations were chlorine and ammonia. Chlorine was most often associated with injuries; ammonia was ranked fourth in victim-events.

Rhode Island

In Word format

TEXAS

Executive Summary

Since January 1, 1993, the Texas Department of Health has participated in the Hazardous Substances Emergency Events Surveillance (HSEES) System. This surveillance system is currently funded in fifteen states by the Agency for Toxic Substances and Disease Registry (ATSDR) and collects data about emergency releases of non-petroleum hazardous substances. The goal of HSEES is to reduce morbidity (illness) and mortality (death) resulting from hazardous substances emergency events by identifying risk factors and developing risk reduction strategies.

From January 1, 1993, through December 31, 1997, project staff reviewed approximately 17,557 notifications of actual and threatened chemical spills and air releases reported in Texas and identified 9,817 events (56%) which involved non-petroleum compounds that met the HSEES case definition. These events were investigated through telephone, fax, and written inquiries to appropriate sources including local, county, and state emergency response personnel such as firefighters and HAZMAT staff; county health departments; industrial health and safety personnel; plant managers and employees; and private citizens. The 9,817 spills which met the case criteria were entered into the HSEES project database, edited, and then transmitted electronically to ATSDR.

For the 9,817 events, project staff collected data using a 68-question survey developed by ATSDR. Approximately 91% of the HSEES events (n=8,909) occurred at fixed facilities and the remaining 9% (n=908) occurred during transport. Of the transportation events, 580 (63.8%) involved a motor vehicle (truck, van, tractor or automobile).

In most events only one hazardous substance was involved (n=9294, 94.7%). Events involving two or three separate hazardous chemicals numbered 419 (4.3%). Events involving four to 44 separate hazardous chemicals numbered 104 (1.0%). A total of 10,876 substances were released during this time period. Evacuations were ordered in 421 events involving more than 52,068 people. Seventy seven events were missing information or number of people evacuated.

The ten chemicals most frequently released were: sulfur dioxide (n=935, 8.6%), benzene (n=414, 3.8%), ammonia (n=345, 3.2%), butadiene (n=314, 2.9%), sulfuric acid (n=302, 2.8%), sodium hydroxide (n=239, 2.2%), mixture of hydrogen sulfide and sulfur dioxide (n=210, 1.9%), ethylene (n=203, 1.9%), hydrogen sulfide (n=200, 1.8%), and ethylene glycol (n=183, 1.7%). The single chemicals most frequently associated with events with victims were ammonia (n=20), chlorine (n=17), sulfuric acid (n=16), hydrochloric acid (n=12), and sodium hydroxide (n=10). The chemicals associated with the largest number of people injured in a single event include ammonia (583 people), sodium hydroxide (251 people), and aldicarb (136 people). The single chemicals most frequently associated with ordered evacuations were ammonia (n=62), chlorine (n=21), sulfuric acid (n=16), and hydrochloric acid (n=14).

A total of 2,507 persons were injured in 312 events. Injured persons included employees (n=712, 28.4%), responders (n=153, 6.1%), and general public (n=1627, 65.0%). In 15 cases, the victim category information was missing. The most common injuries were respiratory irritation, eye irritation, and nausea or vomiting. Most injured persons were transported to a hospital and released after treatment

(n=1894, 75.6%). Forty-three fatalities (1.7%) were recorded. Twenty fatalities were associated with trauma injuries due to transportation-related accidents, and 23 occurred in fixed facilities. No personal protective equipment was worn by 274 of the injured employees, 69 injured responders, and 1553 injured general public.

The type of chemical-specific analysis available from the database is provided using ammonia as an example. There were 311 events where ammonia was the only chemical released. In 20 of these events, 726 persons were injured, and 87.1% (n=632) of the injured were members of the general public. The most common injuries suffered were respiratory irritation, eye irritation, and headache. These releases involving victims occurred at food processing or storage facilities (n=9), in industrial/chemical facilities (n=5), and in agricultural chemical, crop production, or farm supplies (n=4). An evacuation was ordered during 62 events. Evacuation time totaled 257 hours.

HSEES project staff have prepared many prevention and education materials from this data including an article for a professional organization, yearly submissions to the Texas Department of Health's *Epidemiology Annual Report*, presentations at 10 professional meetings, workshops, and conferences, and a brochure covering the Texas HSEES 1993-1995 data. An Internet web page is available at http://www.tdh.state.tx.us/epidemiology/hsees.html.

Figure 7. Distribution of events by calendar quarter and type of event, Texas HSEES, 1993 - 1997

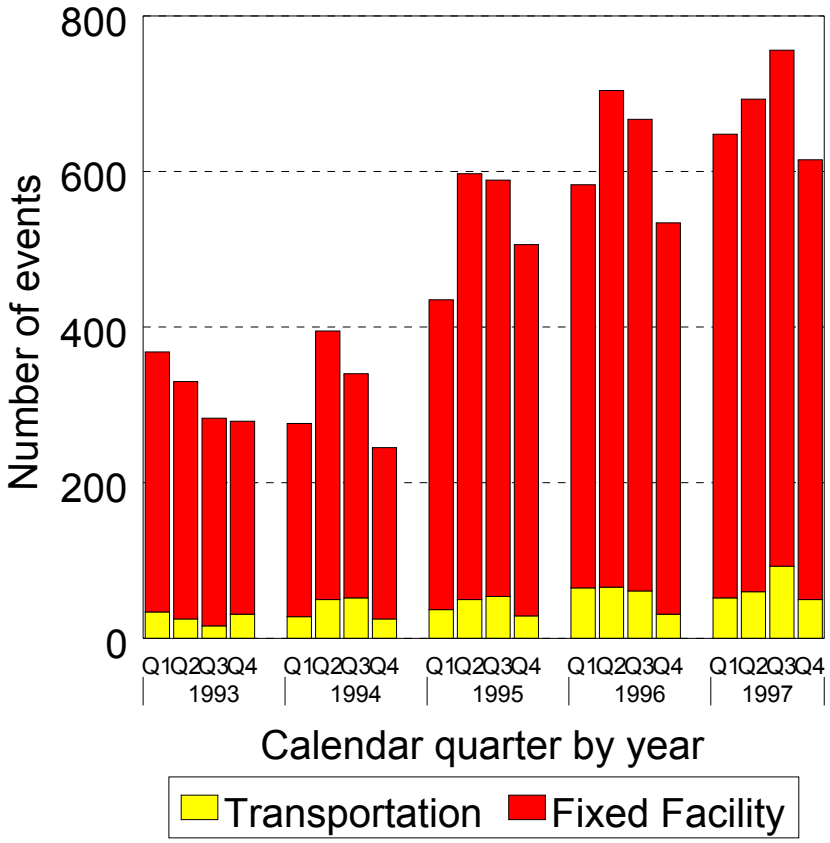

Table 1
Distribution of type of event by year for Texas HSEES, 1993 - 1997

YEAR	FIXED FACILITY NO. OF EVENTS (%)	TRANSPORTATION NO. OF EVENTS (%)	TOTAL NO. OF EVENTS (%)
1993	1145 (91.5)	106 (8.5)	1251 (100.0)
1994	1099 (87.6)	155 (12.4)	1254 (100.0)
1995	1945 (91.9)	170 (8.0)	2115 (99.9)
1996	2265 (91.0)	223 (9.0)	2488 (100.0)
1997	2455 (90.6)	254 (9.4)	2709 (100.0)
Total*	8909 (90.8)	908 (9.2)	9817 (100.0)

*Percentages may not add to 100% due to rounding.

Table 2
Distribution of the number of victims by type of event, Texas HSEES, 1993 - 1997

	TYPE OF EVENT				ALL EVENTS	
	FIXED FACILITY		TRANSPORTATION			
NO. OF VICTIMS	NO. OF EVENTS (%)	NO. OF VICTIMS	NO. OF EVENTS (%)	NO. OF VICTIMS	NO. OF EVENTS (%)	NO. OF VICTIMS
1	105 (48.2)	105	69 (73.4)	69	174 (55.8)	174
2	33 (15.1)	66	15 (15.9)	30	48 (15.4)	96
3	18 (8.3)	54	1 (1.1)	3	19 (6.1)	57
4	13 (6.0)	52	1 (1.1)	4	14 (4.5)	56
5	4 (1.8)	20	1 (1.1)	5	5 (1.6)	25
> 6	45 (20.6)	1801	7 (7.4)	298	52 (16.7)	2099
Total*	218 (100.0)	2098	94 (100.0)	409	312 (100.1)	2507

*Percentages may not add to 100% due to rounding.

Table 5
Distribution of substances released by substance category and type of event, Texas HSEES, 1993 - 1997

SUBSTANCE CATEGORY	TYPE OF EVENT				ALL EVENTS	
	FIXED FACILITY		TRANSPORTATION			
	NO. OF SUBSTANCES	(%)	NO. OF SUBSTANCES	(%)	NO. OF SUBSTANCES	(%)
Acids	597	(6.1)	128	(12.5)	725	(6.7)
Ammonia	331	(3.4)	23	(2.3)	354	(3.3)
Bases	260	(2.6)	66	(6.8)	326	(3.0)
Chlorine	106	(1.1)	5	(0.5)	111	(1.0)
Mixtures*	1227	(12.4)	76	(7.5)	1303	(12.0)
Other inorganic substances	2442	(24.8)	130	(12.7)	2572	(23.6)
Other substances	1759	(17.8)	319	(31.3)	2078	(19.1)
Paints and dyes	41	(0.4)	35	(3.4)	76	(0.7)
Pesticides	173	(1.8)	57	(5.6)	230	(2.1)
Polychlorinated biphenyls	134	(1.4)	8	(0.8)	142	(1.3)
Volatile organic compounds	2786	(28.3)	173	(17.0)	2959	(27.2)
Total**	9856	(100.1)	1020	(100.4)	10876	(100.0)

*Mixtures of substances from different categories.

**Percentages may not add to 100% due to rounding.

WASHINGTON

Executive Summary

Washington State Department of Health (DOH) has collected Hazardous Substances Emergency Events Surveillance (HSEES) data since 1992. Washington is one of fifteen states currently participating in the project funded by the Agency for Toxic Substances and Disease Registry (ATSDR). The goal of the HSEES project is to reduce morbidity (injury) and mortality (death) resulting from hazardous substances emergency events by identifying risk factors leading to their occurrence and developing strategies for risk reduction.

HSEES staff investigate releases of non-petroleum substances reported by state and local emergency managers, including state regulatory agencies, police and fire departments, local health departments and health care providers. These agencies and industry management, health and safety personnel and HazMat teams cooperate in providing detailed information on the nature of releases, substances released, and number and types injuries experienced by victims and evacuations.

Of the more than 50,000 reports received by DOH, HSEES staff identified 2,022 events that met the case definition for inclusion in the study. Data were collected using the project survey questionnaire, entered into the database and sent to ATSDR quarterly. Of the 2,022 events, 1,974 were actual releases and 48 were threatened releases. One of the actual releases included both an actual and threatened release of hazardous substances. Seventy-five percent of the actual releases occurred at fixed facilities and 25% occurred during transport. Most transportation related events involved ground transport (75.4%). Rail (15.0%), water (7.1%) and air (2.2%) accounted for the remaining events. Releases were most apt to occur in industrial or commercial settings.

Analyses were conducted on the individual victims in events (victims) and on events involving victims (victim events). There were 2,654 victims associated with 457 victim events. Employees (1,656) were the most frequent victims. There were 809 general public victims and 189 responder victims. There were 486 events where evacuations were ordered. There were 37,673 people evacuated in 397 of the events; the number of people evacuated was unknown for 89 events. The industries with the highest numbers of releases did not have the highest number of victims, except for the industry category 'Manufacture of non-durable goods' which had 24.5% of the incidents and was ranked fifth for number of victims (230).

The injuries most frequently experienced by victims were, in order, respiratory irritation, eye irritation, headache and nausea or vomiting. Most victims (1,660) were transported to the hospital for treatment. Five hundred-eighty victims were treated on scene. There were 15 male fatalities; including one from a threatened release. There were 48 threatened releases with 15 evacuations of 774 people. There were six victims in five threatened events; all transportation related.

Ninety-four percent of events (1,847) involved the release of a single substance, 4.7% of events (93) involved two or three substances and 1.7% of events (34) involved four or more substances. The top three chemicals released were ammonia, PCBs in oil and sulfur dioxide. The three chemicals most often associated with victim events and evacuations were ammonia, chlorine and o-chlorobenzylidene malononitrile (pepper gas). Ammonia, pepper gas and carbon monoxide were most often associated with victims.

Members of the general public were more often the victims of ammonia and pepper gas releases. Employees, including students, were more often the victims of chlorine releases.

Appendix G. Annual data
Distribution of victims by category by year, WA HSEES, 1993-1997

Year	Victim category			All Victims
	Employee*	Responder**	General Public	
1993	499	27	81	607
1994	239	42	70	351
1995	312	77	110	499
1996	299	21	259	579
1997	307	22	289	618
Total	1656	189	809	2654

* Employee includes students
** Responder includes firefighters, police, EMT personnel and hospital personnel.

Distribution of annual data by type of event, number of substances released, victims, deaths and victim events, WA HSEES, 1993-1997

Year	Fixed facility events	Transport events	Total no. of events	No. of substances released	No. of victims	No. of deaths	No. of victim events	Percent of victim events
1993	379	79	458	509	607	4	124	27.1
1994	265	108	373	408	351	3	82	22.0
1995	315	97	412	467	499	5	92	22.3
1996	273	101	374	467	579	1	86	23.0
1997	250	107	357	448	618	1	73	20.4
Total	1482	492	1974	2299	2654	14	457	23.2

Table 10. Distribution of events and victims by industry category, WA HSEES, 1993-1997

Industry Category	No. of events	(%)	No. of victims	(%)
Agriculture, forestry and fisheries	70	(3.6)	68	(2.6)
Mining	3	(0.2)	0	(0.0)
Construction	45	(2.3)	37	(1.4)
Manufacturing/Non-durable goods	481	(24.4)	230	(8.7)
Manufacturing/Durable goods	145	(7.4)	334	(12.6)
Transportation	363	(18.4)	113	(4.3)
Communication/Public Utilities	226	(11.5)	85	(3.2)
Wholesale trade	56	(2.8)	294	(11.1)
Retail trade	87	(4.4)	258	(9.7)
Finance/Insurance/Real estate	9	(0.5)	70	(2.6)
Business and repair services	36	(1.8)	47	(1.8)
Private households	77	(3.9)	73	(2.8)
Personal services	31	(1.1)	65	(2.4)
Entertainment and recreation services	20	(1.0)	111	(4.2)
Professional and related services	119	(6.0)	582	(21.9)
Public administration	25	(1.3)	70	(2.6)
Active duty military	42	(2.1)	188	(7.1)
Industry Unknown	139	(7.1)	29	(1.1)
Total	1974	(100.0)	2654	(100.0)

Table 21. Distribution of substances released by event type, WA HSEES, 1993-1997

Substance category	Event type		All events		
	Fixed facility	Transportation			
	No. of substances (%)	No. of substances (%)	No. of releases (%)	No. of releases with victims (%)	Percent releases with victims
Acids	163 (9.2)	72 (13.6)	235 (10.2)	71 (12.7)	28.9
Ammonia	151 (8.5)	35 (6.6)	186 (8.1)	43 (7.7)	23.1
Bases	57 (3.2)	39 (7.4)	96 (4.2)	21 (3.7)	21.9
Chlorine	98 (5.5)	6 (1.1)	104 (4.5)	37 (6.6)	35.6
Other inorganic substances	392 (22.2)	86 (16.3)	478 (20.8)	103 (18.4)	19.9
Paints and dyes	75 (4.3)	39 (7.4)	114 (5.0)	8 (1.4)	7.0
Pesticides	92 (5.2)	49 (9.3)	141 (6.1)	41 (7.3)	29.1
PCBs	103 (5.8)	3 (0.5)	106 (4.6)	3 (0.5)	2.8
Volatile organic compounds	184 (10.4)	61 (11.5)	245 (10.7)	73 (13.0)	26.5
Other	369 (20.8)	100 (18.9)	469 (20.4)	122 (21.7)	23.5
Mixtures across categories	86 (4.9)	39 (7.4)	125 (5.4)	28 (5.0)	20.8
Totals*	1770 (100.0)	529 (100.0)	2299 (100.0)	561 (100.0)	22.5

* Total exceeds total number of events (1974) because events at which more than one substance was released were counted more than once.

WISCONSIN

Over the 5 year period, a total of 1,837 qualifying HazMat events were reported to the WI HSEES Program (Table 1). Among these events, 8 (< .005%) were threatened releases. Approximately 67% (n=1223) of the events occurred at fixed facilities; 33% (n=614) were transportation related.

Spills in approximately 25% of fixed-facility events were reported as involving piping; process vessels (approximately 24%); above ground storage (approximately 20%); and material handling, 11.2%. It is noteworthy that the two areas designated as piping and process vessel, account for almost 49% of areas in which spills occurred (n=789). The remaining fixed-facility events involved a variety of areas including below ground storage, dump areas, and ancillary processes. For transportation-related events, 94.7% occurred during ground transport (i.e., truck, van, or tractor), while 2.6% involved transport by rail. The remaining transportation-related events involved transport via water, air or pipeline. We note that information concerning transportation type was not available for 33 of the total 614 transportation events reported for the period.

The collection of information regarding which factors contributed to fixed-facility events began during 1995. Of the 573 events for which information was collected, equipment failure was mentioned as a causal factor in 47.5% (n=272) of the events; operator error 103 times (18%); and improper filling/overfilling 29 times (5.1%). The causal factor was listed as unknown in 110 instances (19.2%). The remaining fixed-facility events occurred as the result of other causal factors such as deliberate damage, improper mixing and unauthorized dumping.

Almost 97% of the releases involved the release of a single substance, with mixtures being treated as a single substance. Two distinct and separate substances were released in approximately 2% of the events. The remaining events involved the release of more than 2 distinct and separate substances.

Substances

Among the 11 categories into which HSEES substances are grouped, Other substances (20.8%), Ammonia (19.1%), Other inorganic substances (15.2%), Volatile organic compounds (9.5%), and Acids (9.2%) were the categories of substances most commonly reported in fixed-facility events (Table 6). In transportation-related events, Other substances (26.7%), Pesticides (25%), Other inorganic substances (10.6%), Volatile Organic Compounds (9.3%), Acids (8.4%), and Bases (7.8%) were the most frequently reported categories.

Victims

Of the total 1,837 events occurring during the 5-year period, 133 events, or 7.2%, resulted in a total of 426 victims (Table 7). Among the 133 events with victims, 51.1% involved a single victim, 23.3% involved 2 victims, and 12% involved 6 or more victims. Most (94.6%) victims were injured in fixed-

facility events. Of the 133 total events with victims, 116 (87.2%) were fixed-facility events; 17 (12.8%) were transportation-related events. Among events with victims, the average number of victims per event was 3.47 for fixed-facility events and 1.35 for transportation-related events.

For the period, there were 1,929 substances released during 1,837 events (Table 8). Though Acids, Ammonia, and Chlorine combined accounted for only 500 of the releases (less than 26% of the total releases), the releases in these three categories resulted in 38.4% of the total releases with victims. Of the 62 Chlorine releases, 21 of the releases (33.9%) resulted in victims. In comparison, the category Pesticides were released 235 times with only 7 releases (3%) resulting in victims. The substance category referred to as Other, (which includes substances/compounds such as fertilizers, cyanide, formaldehyde, and phenol) accounted for 440 releases; this category represented almost 23% of total releases, and 21.2% of the total releases with victims.

The population groups most often injured were employees (71.4%) and the general public (11.5%). Among the 51 responders who were injured in fixed-facility events, their affiliation was categorized as responder (unknown type) for 73%; of the remaining responder victims, 11.8% were police officers; 9.8% were EMT personnel; and 5.9% volunteer firefighters. When combining responder categories, responder victims (n=51) account for almost 12% of the total victims. For the period, there were no responder victims involved in transportation-related events. [Note: Collection of information about responder victims was not begun until mid-1995.] Table 10 presents the distribution of victims by event type, victim category, and event year (responder victims have been combined into a single victim category, responder all).

It was not uncommon for victims to experience multiple injuries. The 426 total victims sustained a total of 728 injuries. In fixed-facility events, the most commonly reported injuries were respiratory irritation (38.4%), skin irritation (15.6%), eye irritation (13.3%), central nervous system (CNS) symptoms (10.9%), and headache (11%). In transportation-related events, skin irritation (28.6%), respiratory irritation (21.4%), trauma (21.4%), and eye irritation (10.7%) were reported most frequently. Of the total 728 reported injuries, respiratory irritation was reported almost 38% of the time, skin irritation 16.1%, and eye irritation 13.2%.

In the area of injury outcome (or victim disposition), most victims (62%) were transported to a hospital and not admitted. Dispositions among the remaining victims included being treated on scene (15.3%); transported to a hospital for observation (12%); transported to a hospital and admitted (5.6%); injuries reported by an official within 24 hours of the event (2.8%); and seen by a private physician within 24 hours of the event (1.4%). The victims also included one fatality. Victim disposition could not be established for 3 victims (<1.0% of total victims).

Table 13 presents cumulative data by event year for event type, number of substances released and number of victims.

Table 1. - Wisconsin HSEES (1993-1997)
Number of events meeting the surveillance definition by calendar year and event type

	Event Type				
	Fixed		Transportation		Total
Event Year	No. of Events	(%)	No. of Events	(%)	No. of Events
1993	290	82.9%	60	17.1%	350
1994	223	56.0%	175	44.0%	398
1995	283	69.4%	125	30.6%	408
1996	211	63.8%	120	36.3%	331
1997	216	61.7%	134	38.3%	350
Total	1223	66.6%	614	33.4%	1837

Table 6. - Wisconsin HSEES (1993-1997)
*Distribution of the number of substances released by substance category and type of event**

	Event Type					
	Fixed		Transportation		Total	
Chemical Category	No. of Substances	%	No. of Substances	%	No. of Substances	%
Acids	118	9.2%	54	8.4%	172	8.9%
Ammonia	245	19.1%	21	3.3%	266	13.8%
Bases	40	3.1%	50	7.8%	90	4.7%
Chlorine	58	4.5%	4	0.6%	62	3.2%
Mixtures (across categories)	52	4.0%	13	2.0%	65	3.4%
Other inorganic substances	196	15.2%	68	10.6%	264	13.7%
Paints and dyes	55	4.3%	36	5.6%	91	4.7%
Pesticides	74	5.8%	161	25.0%	235	12.2%
Polychlorinated biphenyls	58	4.5%	4	0.6%	62	3.2%
Volatile organic compounds	122	9.5%	60	9.3%	182	9.4%
Other	268	20.8%	172	26.7%	440	22.8%
Total[1]	1286	100.0%	643	100.0%	1929	100.0%

* During some events, multiple substances were released; therefore, total substances released exceeds the total number of events (n=1837).

[1] Percentages may not total 100% due to rounding.

Table 7. - Wisconsin HSEES (1993-1997)

Distribution of the number of victims by type of event (events with victims only)

Number of Victims	Event Type						Total		
	Fixed			Transportation					
	No. of Events	(%)	No. of Victims	No. of Events	(%)	No. of Victims	No. of Events	(%)	No. of Victims
1	56	48.3%	56	12	70.6%	12	68	51.1%	68
2	27	23.3%	54	4	23.5%	8	31	23.3%	62
3	9	7.8%	27	1	5.9%	3	10	7.5%	30
4	5	4.3%	20	0	0.0%	0	5	3.8%	20
5	3	2.6%	15	0	0.0%	0	3	2.3%	15
>=6	16	13.8%	231	0	0.0%	0	16	12.0%	231
Total*	116	100.1%	403	17	100.0%	23	133	100.0%	426

* Percentages may not total 100% due to rounding.

Table 8. - Wisconsin HSEES (1993-1997)

*Number of substances released in all events and events with victims by substance category**

Substance Category	Releases		Releases with Victims		Percentage of Releases with Victims
	Number	(%)	Number	(%)	
Acids	172	8.9%	14	9.6%	8.1%
Ammonia	266	13.8%	21	14.4%	7.9%
Bases	90	4.7%	6	4.1%	6.7%
Chlorine	62	3.2%	21	14.4%	33.9%
Mixtures (across categories)	65	3.4%	10	6.8%	15.4%
Other inorganic substances	264	13.7%	28	19.2%	10.6%
Paints and dyes	91	4.7%	3	2.0%	3.3%
Pesticides	235	12.2%	7	4.8%	3.0%
Polychlorinated biphenyls	62	3.2%	0	0.0%	0.0%
Volatile organic compounds	182	9.4%	5	3.4%	2.7%
Other	440	22.8%	31	21.2%	7.0%
Total[1]	1929	100.0%	146	99.9%	7.6%

* During some events, multiple substances are released; therefore, total substances released exceed the total number of events (n=1837).

[1] Percentages may not total 100% due to rounding.

Table 10. - Wisconsin HSEES (1993-1997)

Distribution of victims by event type, victim category, and event year

		Event Year										Total	
		1993		1994		1995		1996		1997			
Event Type	Victim Category	No. of Victim	(%)	No. of Victims	(%)	No. of Victims	(%)	No. of Victims	(%)	No. of Victims	(%)	No. of Victims	(%)
Fixed	Employee	39	72.2%	35	50.0%	45	65.2%	67	75.3%	98	81.0%	284	70.5%
	General public*	4	7.4%	24	34.3%	6	8.7%	14	15.7%	15	12.4%	63	15.6%
	Responder (all)	11	20.4%	6	8.6%	18	26.1%	8	9.0%	8	6.6%	51	12.7%
	Unknown	0	0.0%	5	7.1%	0	0.0%	0	0.0%	0	0.0%	5	1.2%
	Total	54	100.0%	70	100.0%	69	100.0%	89	100.0%	121	100.0%	403	100.0%
Transportation	Employee	6	85.7%	6	85.7%	2	100.0%	2	66.7%	4	100.0%	20	87.0%
	General public*	1	14.3%	1	14.3%	0	0.0%	1	33.3%	0	0.0%	3	13.0%
	Total	7	100.0%	7	100.0%	2	100.0%	3	100.0%	4	100.0%	23	100.0%

* Includes students.

Table 13. - Wisconsin HSEES (1993-1997)

Cumulative data

	Event Type				
Event Year	Fixed	Transport	Total	No. of Substances released*	No. of Victims
1993	290	60	350	359	61
1994	223	175	398	466	77
1995	283	125	408	420	71
1996	211	120	331	334	92
1997	216	134	350	350	125
Total	1223	614	1837	1929	426

* During some events, multiple substances were released; therefore, total substances released exceeds the total number of events.