COLORADO HAZARDOUS SUBSTANCES EMERGENCY EVENT SURVEILLANCE SYSTEM

ADAMS COUNTY ANALYSIS 1993-1997

Colorado Department of Public Health and Environment

ATSDR

AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY

U.S. PUBLIC HEALTH SERVICE

BACKGROUND

In 1990, the Agency for Toxic Substances and Disease Registry (ATSDR) implemented 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 (Colorado included) participated in the pilot phase of the surveillance system and began data collection on January 1, 1990. Since 1990, the number of participating state health departments has gradually increased to include Alabama, Colorado, Iowa, Minnesota, Mississippi, Missouri, New Jersey, New York, North Carolina, Oregon, Rhode Island, Texas, Utah, Washington and Wisconsin.

Information on acute hazardous substances emergency events was collected on data collection forms designed by ATSDR. The types of items collected included general information on the event, substance(s) released, victims, injuries, and evacuations. Estimates have been made of the number of people at risk of exposure from a particular event. Several data sources were used to obtain the maximum amount of information about these events. These sources included, but were not limited to, records of federal, state and local agencies, first responder reports, hospital reports and communications with responsible parties. The data obtained were computerized using an ATSDR-provided data entry system and were sent to ATSDR quarterly.

As a result of the Colorado Department of Public Health & Environment's (CDPHE) participation in HSEES for the past nine years, the CDPHE has become much more proactive in acquiring detailed information from other state, local and private entities regarding hazardous substance emergencies. Participation in HSEES has resulted in the acquisition of data on the distribution, frequency and cause of events within Colorado and on the types and causes of injuries to employees, responders and the general public associated with these events. In addition, this process of acquiring information has resulted in increased interaction between the CDPHE, other emergency planning and response agencies, private industry and the general public and has also led to the CDPHE playing a more productive and active role in hazardous materials training and incident response.

OBJECTIVES

The Colorado Department of Public Health and Environment, Hazardous Materials and Waste Management Division (CDPHE, HMWMD) has been gathering information on hazardous substance events occurring in Colorado for inclusion in the HSEES system since January 1990. The goals of this project are to:

- Describe the distribution of hazardous substance emergencies within Colorado;
- Describe the type and cause of morbidity and mortality experienced by employees, first responders and the general public as a result of selected hazardous substance emergencies;
- Analyze and describe risk factors associated with the morbidity and mortality; and
- Work with federal, state and local agencies and private industry to develop and propose strategies to reduce subsequent morbidity and mortality when comparable events occur in the future.

METHODS

When the CDPHE is notified of a release, or a threatened release, of a hazardous substance, one of the first steps taken by the HSEES Manager is determining whether the event meets surveillance criteria for inclusion in the HSEES System. Events that would be captured for inclusion in the HSEES System are predefined by the following ATSDR guidelines:

- The incident must be an uncontrolled or illegal release, or threatened release of one or more hazardous substances, and
- The hazardous substances include ALL hazardous substances except petroleum products, and

- The quantity of the hazardous substances which are released, or threatened to be released, need (or would need) to be removed, cleaned up, or neutralized according to federal, state or local law; or

- There is only a threatened release of hazardous substances, but this threat leads to an action (e.g., evacuation) that can potentially impact the health of employees, responders or the general public.

A review of federal, state and local databases of events is also conducted, and media reports are investigated in an effort to identify which events the CDPHE has not been notified of.

Due to the fact that, by state statute, virtually any release of a hazardous substance in Colorado is required to be cleaned up, almost all hazardous substance releases qualify for inclusion. Guidance from ATSDR excludes some of these events based on quantity (i.e., stained packages) and specific substances and/or situations.

When the HSEES Manager determines that an event qualifies for inclusion, the HSEES Manager begins collecting the following detailed information on the event:

- Name and address of the notification contact;
- Date and time of the call and event occurrence;
- Location of the event and type of area where the event occurred (industrial, residential, rural, etc.);
- Source of the event (i.e., type of transportation or fixed-facility event);
- Quantities of any substances released as a spill, vapor or consumed in a fire or explosion;
- Detailed information on number of employees, responders and general public injured or killed as a result of the event, the type and severity of injuries, any personal protective equipment used by victims, the sex and age of the victims, and the distance of the victims from the source of the event;
- Information on the number of people living and working within one mile of the event;
- The extent of any evacuation that was ordered as a result of the event;
- Information on agencies that responded to the site of the event and

control actions taken to mitigate the event;

- Information on any environmental sampling that was performed in the vicinity of the event;
- Information on health actions taken as a result of the event;
- The type of response plan followed by responding agencies, if any; and
- When the emergency action was terminated.

Depending on the severity and/or importance of the event, other information may also be requested.

After the information on the event is gathered, it is compiled and entered into the HSEES online data entry system designed by ATSDR.

RESULTS

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:

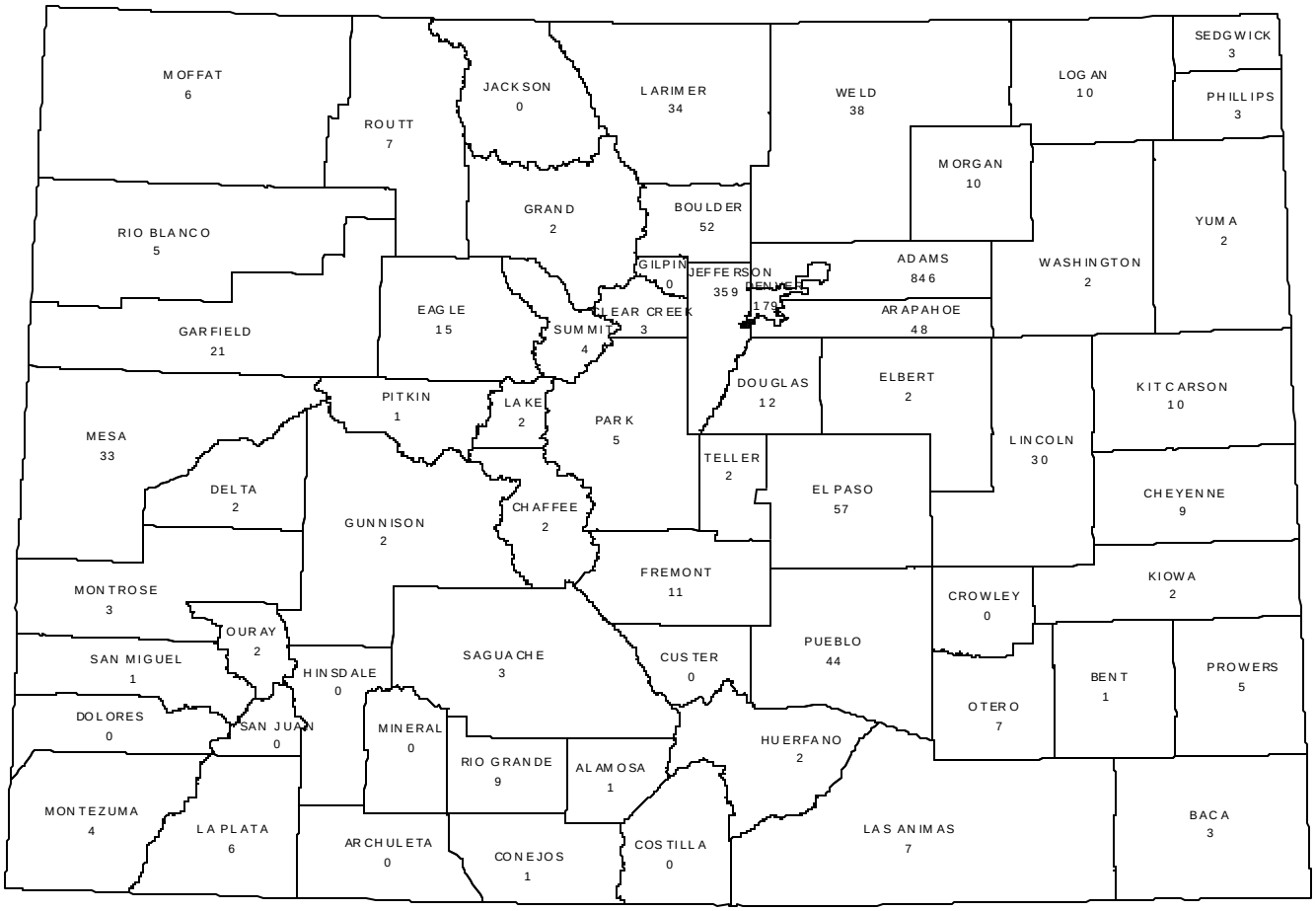
TABLE 1: Cumulative Data for all States*

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 (Figure 1) 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. No qualifying events were reported in Archuleta, Costilla, Crowley, Custer, Dolores, Gilpin, Hinsdale, Jackson, Mineral or San Juan counties. Due to the large number of events in Adams county, it was determined that as part of the ongoing HSEES prevention outreach activities, an Adams county specific analysis should be conducted to determine the underlying factors for such a large number of incidents within this county.

Figure 1: Geographic Distribution of Events by County



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 2.

Table 2: 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
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

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
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
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

ADAMS COUNTY ANALYSIS

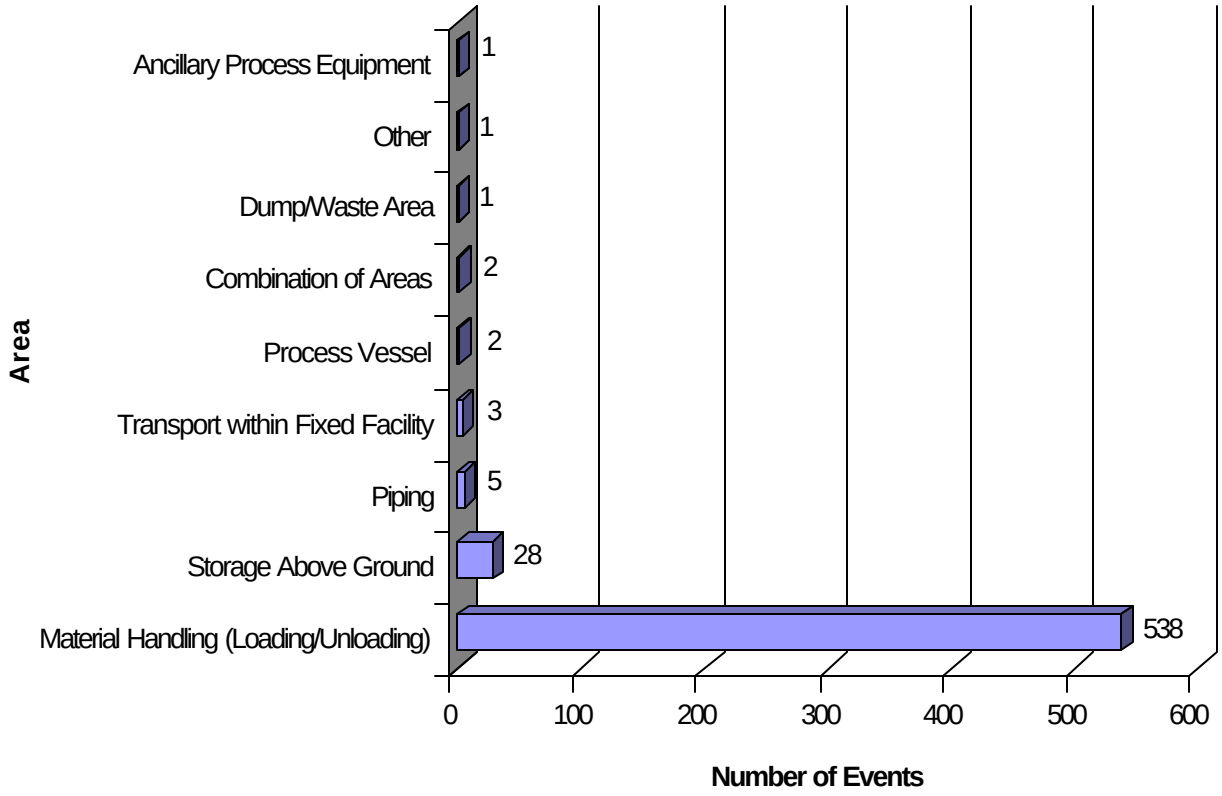
During the five-year period 1993-1997, 846 hazardous substance events in Adams county qualified for inclusion in the Colorado HSEES System. 581(68.7%) of the events were at fixed facilities and 265 (31.3%) of the events were transportation related. A summary by cities is as follows:

TABLE 3: Cumulative Data for Adams County

CITY	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
ARVADA	2 (.24%)	1	1	1
AURORA	286 (33.8%)	104	182	29
BENNETT	2 (.24%)	2	0	0
BRIGHTON	4 (.47%)	1	3	3
BROOMFIELD	1 (.12%)	1	0	0
COMMERCE CITY	408 (48.2%)	122	286	15
DEERTRAIL	1 (.12%)	1	0	0
DENVER	103 (12.2%)	21	82	12
FEDERAL HEIGHTS	1 (.12%)	0	1	1
HENDERSON	23 (2.7%)	9	14	0
THORNTON	4 (.47%)	1	3	2
UNINCOR-PORATED	6 (.71%)	2	4	0
WESTMINSTER	5 (.59%)	0	5	3

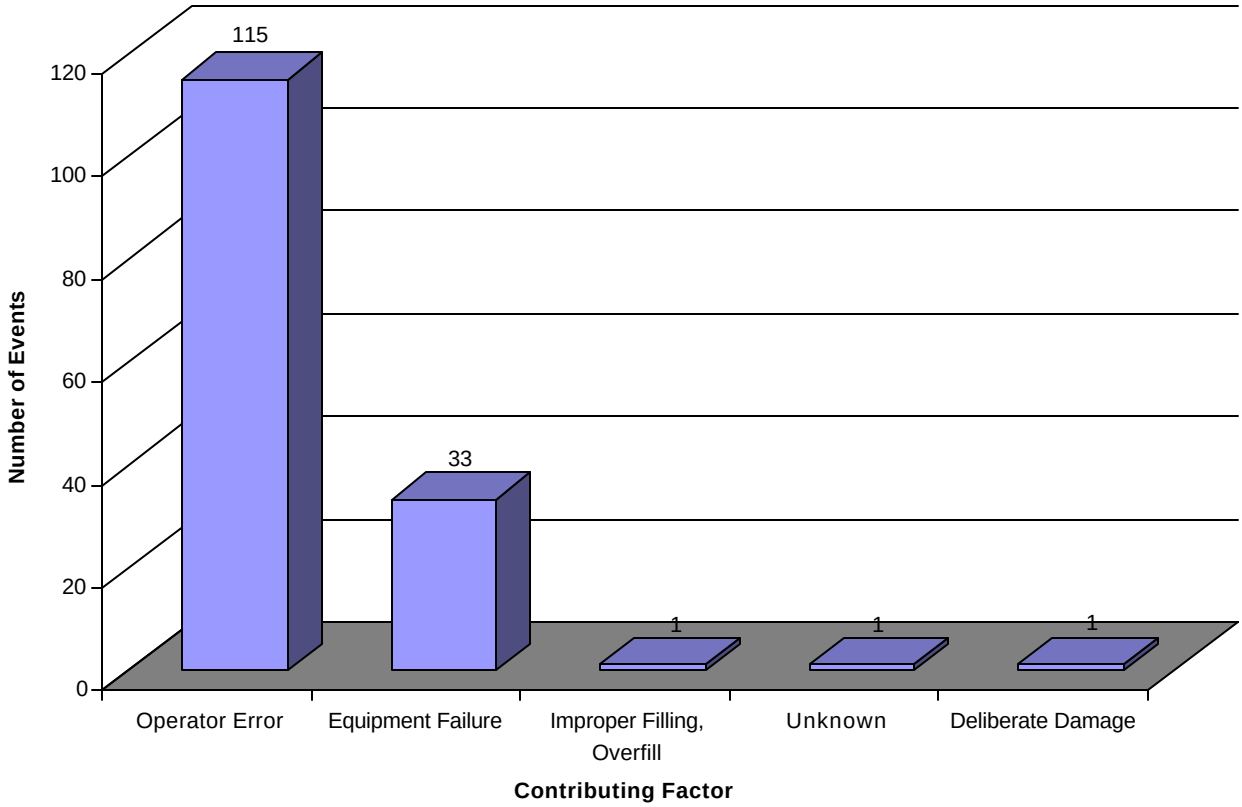
The majority of fixed-facility events occurred during material handling (i.e., loading/offloading), followed second by storage above ground (Figure 2).

Figure 2: Areas of Fixed Facilities Involved in Events



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 (76.2%), followed by equipment failure (21.9%), improper mixing (.67%), etc., as shown in Figure 3.

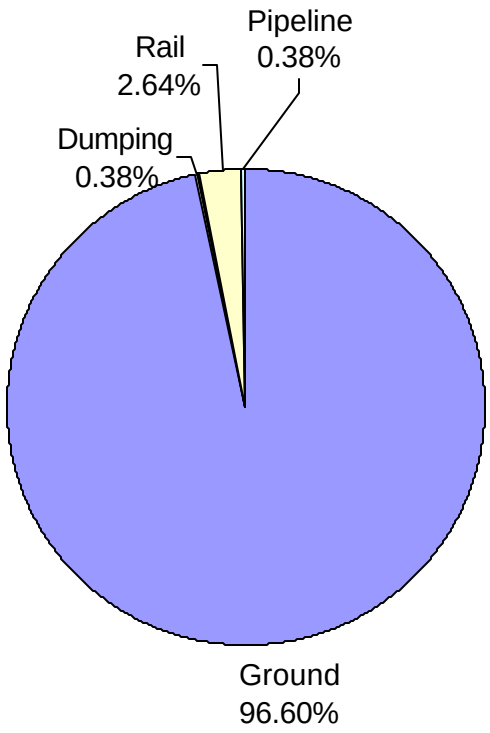
Figure 3: Factors Contributing to the Occurrence of Fixed Facility Events



A more detailed analysis of specific types of industries involved in the releases shows the majority of releases at fixed facilities in Adams county involved trucking services (91.9%). Trucking service facilities in Aurora, Commerce City and Denver accounted for 98.3% of these releases. The high numbers of material handling incidents caused by operator error are directly related to improper loading and unloading of materials. A large number of these incidents are small quantity releases.

The majority of transportation-related events in Adams county occur during ground transport (96.6%), followed by rail transport (2.6%) (Figure 4). As with fixed facilities in Adams county, the majority of transportation releases are directly related to the trucking industry. A review of the majority of these cases shows that most incidents occur due to improper loading techniques which cause loads to shift during transit.

Figure 4: Distribution of Transportation Events, by Type of Transport



SUBSTANCES

Ninety-nine percent of the events in Adams County involved the release of only one substance. Three events involved the release of two chemicals, one event involved three chemicals, one event involved four chemicals and one event involved 63 chemicals. The 63 chemical event was caused by an illegal drug lab.

The majority of the releases were liquid spills (90.2%), followed by threatened releases (6.9%), air releases (1.97%), combinations of releases (.87%), and fires (0.11%).

The substances released are categorized into eleven groups. The category "mixtures" consists of mixtures of substances from different categories, and the category "other" consists of substances that could not be placed in one of the other ten substance categories. The category "other inorganic substances" comprised all inorganic substances except for acids, bases, ammonia and chlorine. Of the eleven categories into which HSEES substances were grouped, the category of substances most commonly released in fixed-facility and transportation events was "other substances" (26.7% and 30.6% , respectively). These substances usually consist of chemicals such as ethylene glycol, corrosives (not otherwise specified), adhesives (not otherwise specified), asbestos, fertilizers, flammable liquids (not otherwise specified), formaldehyde, methyl methacrylate, and resins. The second most commonly released substances were "volatile organic compounds" for fixed-facility (25.8%) and transportation (23.9%) events (Table 4).

Table 4: Distribution of the Number of Substances Released, by Substance Category and Type of Event

Substance Category	Type of Event		All Events	
	Fixed-Facility		Transportation	
	Number of Substances		Number of Substances	
Acids	107	(16.5%)	35	(13.1%)	142	(15.5%)
Ammonia	11	(1.7%)	4	(1.5%)	15	(1.6%)
Bases	60	(9.3%)	36	(13.4%)	96	(10.5%)
Chlorine	2	(.31%)	0	(0.0%)	2	(.22%)
Other inorganic substances	77	(11.9%)	30	(11.2%)	107	(11.7%)
Paints & Dyes	22	(3.4%)	6	(2.2%)	28	(3.1%)
Pesticides	17	(2.6%)	6	(2.2%)	23	(2.5%)
Polychlorinated biphenyls	5	(.77%)	1	(.37%)	6	(.66%)
Volatile organic compounds	167	(25.8%)	64	(23.9%)	231	(25.2%)
Mixtures of substance categories	7	(1.1%)	4	(1.5%)	11	(1.2%)
Other substances	173	(26.7%)	82	(30.6%)	255	(27.8%)
Total	648		268		916	

The top ten substances spilled are as follows:

Table 5: The Top Ten Substances Spilled in Adams County

HSEES Standard Substance Name	Number of Events	Percent
Corrosive, NOS	48	5.2%
Sodium hydroxide	47	5.1%
Ethanol	38	4.1%
Hydrochloric acid	34	3.7%
Potassium hydroxide	34	3.7%
Sulfuric acid	33	3.6%
Phosphoric acid	31	3.4%
Adhesive, NOS	28	3.1%
Isopropanol	28	3.1%
Methanol	28	3.1%

The large number of corrosive, not otherwise specified, events is directly attributable to small quantity spills from the trucking industry as specified previously. The other most commonly released substance is sodium hydroxide, which is one of the most commonly used substances in industry.

VICTIMS

Victims were defined as those individuals who suffered at least one injury, or died, as a consequence of the event. In counting injuries, victims may have been counted more than once if they had more than one injury. Of the 846 events, a total of 14 victims were involved in 11 events (1.3% of all events). All of the events with victims involved only one victim, except for one event which had four victims. The four victim event was due to the release of 30 gallons of methylcyclohexanone at a trucking service facility. Four employees were overcome by fumes when unloading a truck containing leaking drums. 63.6% of the victims were injured in fixed-facility events, compared with 36.4% in transportation events (Table 6). All victims were employees, except for one, which was a member of the general public.

Table 6: Distribution of the Number of Victims by Type of Event

Number of Victims	Event Type				All Events	
	Fixed-Facility		Transportation			
	Number of Events	Number of Victims	Number of Events	Number of Victims	Number of Events	Number of Victims
1	7 (63.6%)	7	3 (27.3%)	3	10 (90.9%)	10
4	0 (0.0%)	0	1 (9.1%)	4	1 (9.1%)	4
Total	7	7	4	7	11	14

Analysis was conducted on which substances caused the most injuries, however, due to the low number of victims within Adams county, conclusions could not be drawn (Table 7).

Table 7: Number of Substances Released in all Events and Events with Victims, by Substance Category

Substance Category	Total Number of Releases		Total Number of Releases with Victims	
Acids	142	(15.5%)	1	(9.1%)
Ammonia	15	(1.6%)	0	(0.0%)
Bases	96	(10.5%)	1	(9.1%)
Chlorine	2	(0.22%)	0	(0.0%)
Other inorganic substances	107	(11.7%)	0	(0.0%)
Paints & Dyes	28	(3.1%)	2	(18.2%)
Pesticides	23	(2.5%)	0	(0.0%)
Polychlorinated biphenyls	6	(.66%)	1[	(9.1%)
Volatile organic compounds	231	(25.2%)	0	(0.0%)
Mixtures of substance categories	11	(1.2%)	1	(9.1%)
Other substances	255	(27.8%)	5	(45.5%)
Total	916*		11	

*Total exceeds total number of events (846) because events at which more than one substance was released were counted more than once.

[Injury due to trauma received during a collision into a transformer

INJURIES

Victims in events sustained a total of 19 injuries, 10 in fixed-facility events and 9 in transportation events. Some victims had more than one injury. The most commonly reported injuries in fixed-facility events were respiratory irritation (40.0%), dizziness or other central nervous system symptoms (30.0%), chemical burns (20.0%), and skin irritation (10.0%). In transportation events the most commonly reported injuries were respiratory irritation (44.4%), dizziness or other central nervous system symptoms (22.2%), skin irritation (22.2%) and trauma (11.1%). (Table 8)

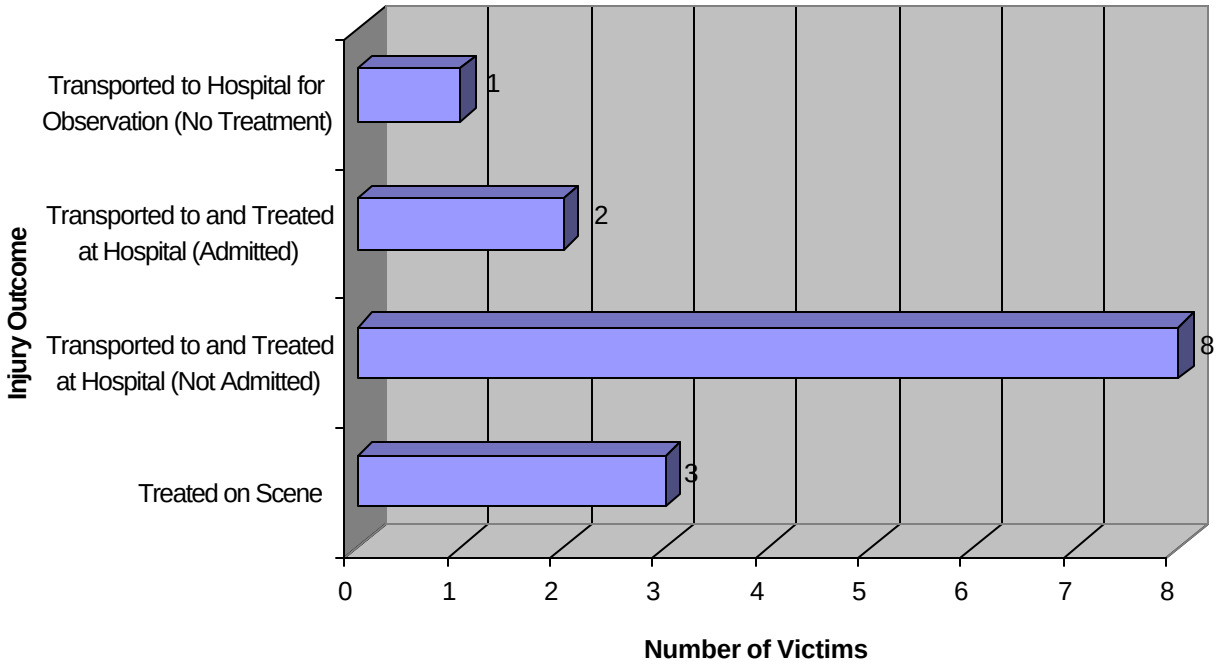
Table 8: Distribution of Type of Injury by Type of Event*

Type of Injury	Type of Event		All Events
	Fixed-facility	Transportation	
	Number of Injuries	Number of Injuries	Number of Injuries
Respiratory irritation	4 (40.0%)	4 (44.4%)	8 (42.1%)
Dizziness/CNS^	3 (30.0%)	2 (22.2%)	5 (26.3%)
Skin irritation	1 (10.0%)	2 (22.2%)	3 (15.8%)
Chemical burns	2 (20.0%)	0 (0.0%)	2 (10.5%)
Trauma	0 (0.0%)	1 (11.1%)	1 (5.3%)
Total	10	9	19

*The number of injuries is greater than the number of victims because a victim could have had more than one injury.
^Central Nervous System.

The majority of victims (57.1%) were transported to and treated at a hospital, but not admitted, 21.4% were treated on scene, 14.3% were transported, admitted and treated at a hospital, and 7.1% were transported to a hospital for observation but did not receive any treatment (Figure 5).

Figure 5: Injury Outcome



EVACUATIONS

Evacuations were ordered in 72 events. Eighty-nine percent of the evacuations were of a building or the affected part of a building. Eight percent were of a defined circle or radius around an event, 1.5 percent were based on potential downwind or downstream dispersion and 1.5 percent were based on a circle and downwind or downstream dispersion. The number of people evacuated ranged from 1 to 77. The 77 person evacuation was the evacuation of a chemical distributor and surrounding businesses due to an above ground storage tank failure which caused the release of over 600 gallons of sulfuric acid. Sodium hydroxide and phosphoric acid are the top two substances released where an evacuation was ordered (Table 9).

Table 9: Top Ten Substances Spilled for Events Where an Evacuation was Ordered

HSEES Standard Substance Name	Number of Events	Percent
Sodium hydroxide	8	11.1%
Phosphoric acid	7	9.7%
Isopropanol	5	6.9%
Xylene	4	5.6%
Acetone	4	5.6%
Toluene	3	4.2%
Ethanol	3	4.2%
Ammonia	3	4.2%
Hydrochloric acid	3	4.2%
Mercury	3	4.2%

SUMMARY OF ADAMS COUNTY DATA ANALYSES 1993-1997

Of the 846 Adams county hazardous substance events which qualified for inclusion in the Colorado HSEES:

- Most of the events occurred at fixed facilities (68.7%) and most involved a single substance (99.0%). 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 large number of events in Adams county is directly related to shipping industries located throughout the county;

- The cities with the highest number of incidents are Aurora, Commerce City and Denver;

- The majority of transportation events occurred during ground transport and are due to improper loading techniques;

- The most common injury to victims was respiratory irritation;

- The most commonly released substances are corrosives and sodium hydroxide.

- Sodium hydroxide and phosphoric acid are the top two substances released where an evacuation was ordered.

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.

Recommendations to the hazardous materials staff of Adams county include: Emphasis on training for response to acid/base type chemical releases for first responders; communication, training and information sharing with shipping industries; and, if possible, assisting private industry in the prevention and/or planning for hazardous substance emergencies.

The Colorado HSEES is interested in receiving any information on hazardous materials events in Colorado to ensure data accuracy and completeness. If you or your agency has information that would be helpful to this project, please contact the project manager at the number below.

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