NATIONAL TOXIC SUBSTANCE INCIDENTS PROGRAM (NTSIP) BIENNIAL REPORT 2013-2014

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES

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In 1980, Congress created the Agency for Toxic Substances and Disease Registry (ATSDR) to implement health-related sections of laws that protect the public from hazardous wastes and environmental spills of hazardous substances. The Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), commonly known as the Superfund Act, designated ATSDR as the lead agency within the U.S. Public Health Service to help prevent or reduce further exposure to hazardous substances and the adverse health effects that might result from such exposures and to expand the knowledge base about such effects.

In accordance with this legislative mandate, this publication reports results and findings of health studies, registries, or other health-related activities supported by ATSDR.

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Definition of Acronyms

ACE	Assessment of Chemical Exposures
ATSDR	Agency for Toxic Substances and Disease Registry
CDC	Centers for Disease Control and Prevention
CNS	Central nervous system
CO	Carbon monoxide
DOT	Department of Transportation
EMS	Emergency medical services
EPA	Environmental Protection Agency
HAZMAT	Hazardous materials
HIP	HAZMAT Intelligence Portal
HSEES	Hazardous Substances Emergency Events Surveillance
MMWR	Morbidity and Mortality Weekly Report
NAICS	North American Industry Classification System
NIOSH	National Institute of Occupational Safety and Health
NRC	National Response Center
NTSIP	National Toxic Substance Incidents Program
PHAP	Public Health Associate Program

1.0 Executive Summary

This National Toxic Substance Incidents Program (NTSIP) is a preeminent chemical surveillance system that collects information on many aspects of acute hazardous chemical incidents. This report details descriptive data from the three parts of the 2013-2014 NTSIP program: state surveillance, national database, and incident investigations. The NTSIP annual report summarizes stories illustrating the program's positive impacts in states and shows both the specificity and the variety of NTSIP's outreach activities.

The following are key 2013-2014 findings:

- During 2013, an estimated 14,175 total NTSIP qualifying incidents occurred across the United States: 9,118 incidents in fixed facilities and 5,057 incidents in transportation.
- In the 8 surveillance states, 430 NTSIP incidents resulted in 1,527 injured persons, 37 of whom were fatalities.
- Incidents were approximately 1½ times more likely to occur in fixed facilities (n=2,575) than during transportation-related events (n=1,709). Injured persons were disproportionately more likely (10 times) to be associated with fixed-facility incidents (n=1,389) than transportation-related incidents (n=138).
- The same chemicals have been involved in the largest number of incidents in fixed facilities since 2010: natural gas, carbon monoxide, methamphetamine production chemicals, and ammonia. However, the top chemicals in transportation-related incidents have changed from previous years—from alkaline (potassium and sodium) hydroxides, sulfuric acid, and hydrochloric acid to alkaline hydroxide, natural gas, and sulfuric acid.
- Although the transportation and warehousing sector had the largest number of incidents, the educational services sector accounted for the largest number of injured persons.
- The most injuries (n = 616, 40.3%) occurred among members of the public.
- When people had only one adverse health effect (57.3% of time), the most common symptom was related to the respiratory system (18.0%).
- In 22.2% of incidents, an evacuation was ordered, and 1.8% of incidents resulted in a sheltering-in-place order.
- An ACE team investigation of a 10,000-gallon chemical spill into the Elk River in West Virginia revealed that a majority of the spill was 4-methylcyclohexanemethanol. Of the 369 patients who met the inclusion criteria for an ACE investigation, 96% received treatment at the hospital and were released. The most frequently reported symptoms were nausea (38%), skin rash (28%), and vomiting (28%).

2.0 Introduction

Recent large-scale chemical events continue to garner attention in the media, for example the 2013 explosion of a petrochemical plant in Geismar, Louisiana, which injured over 70 individuals and resulted in one fatality [Daily Mail 2014]. Events such as this highlight the importance of chemical surveillance activities in the United States—not only to keep a record of these incidents, but also to prevent similar events from occurring in the future.

To increase the accuracy of chemical release information and proactively use these data to prevent related adverse health effects, the Agency for Toxic Substances and Disease Registry (ATSDR) introduced the National Toxic Substance Incidents Program (NTSIP) in January 2010. NTSIP is an acute chemical incident surveillance program that collects and combines information from many sources to protect populations from harm caused by acute toxic substance releases.

From 2013-2014, eight states participated in the program. During 1990-2012, ATSDR supported states by a three-year cooperative agreement awarded through a competitive program announcement. However, during 2013-2014, ATSDR collaborated with the Centers for Disease Control and Prevention's (CDC) Public Health Associate Program (PHAP) to provide state assignees to support state surveillance. PHAP is a two-year, paid, competency-based training program. CDC partners with host sites, such as state (in this case), tribal, local, and territorial health departments and non-governmental organizations, to train and provide experiential learning to early career professionals in the public health workforce.

Participating states report acute chemical releases occurring in their states to NTSIP through a web-based data portal. Chemical event information gathered and reported by the states includes the location of the incident, evacuation details, number of injured people, adverse health effects experienced by those injured or exposed, and personal protective equipment (PPE) used by responders. The data are used with other national data on chemical incidents to develop national NTSIP incident estimates. These data are used to prevent or reduce morbidity and mortality caused by chemical releases and to assist NTSIP in proactively planning responses to future chemical incidents.

Previous publications have described the concepts and fundamental principles of NTSIP in detail [ATSDR 2013], but this report reviews specific aspects of the program. NTSIP uses three primary components: (1) state surveillance, (2) a national database, and (3) incident investigation. Table 1 provides a summary description of each component and its core function, as well as the relevant partners.

Table 1. Summary information on the three primary components of NTSIP

Component Description	Partners	Core Functions
State Surveillance		
State health departments collect detailed information on acute chemical spills for a central chemical incident surveillance database and conduct prevention and preparedness activities.	• Cooperative agreement states **2013 / 2014** CA / --- LA / --- MO / MO NC / NC NY / --- TN / TN UT / UT WI / WI	• Gather data from a variety of national (DOT, NRC), state (department of natural resources, department of agriculture, division of emergency management, police, and bureaus of investigation) and local (health departments, emergency planning committees, media, regional epidemiologists) sources • Analyze data to develop prevention outreach programs aimed at decreasing the morbidity and mortality associated with acute chemical exposures, focusing on green chemistry, inherently safer technologies, and vulnerability mapping
National Database		
ATSDR, working with the DOT, has established a data repository that incorporates the states' data with supplemental data from the NRC and the DOT to create national chemical incident estimates.	• DOT • NRC • State health departments	• Federal, state, and local agencies, emergency responders, and researchers use data for research and preparedness planning initiatives • Use data to monitor trends and publish information about exposure prevention
Incident Investigations		
ATSDR supports state and local health departments in conducting large-scale chemical incident investigations through Assessment of Chemical Exposure (ACE) expert teams and the ACE toolkit.	• State health departments • Local health departments • National Institute of Occupational Safety and Health (NIOSH) • Other federal agencies responding to the incident • Emergency response management and personnel teams	• Collect information through interviews with key response personnel and potentially exposed people; collect medical data on treated people • Gather data and information from these investigations to promote emergency response and preparedness activities and to create a cohort of exposed people who can be followed up in a later approved study of long-term health effects

3.0 State Surveillance

Eight states collected NTSIP data in 2013: California, Louisiana, Missouri, North Carolina, New York, Tennessee, Utah, and Wisconsin. Five states collected NTSIP data in 2014: Missouri, North Carolina, Tennessee, Utah, and Wisconsin. States monitor chemical incidents using a variety of sources. Other agencies and organizations also collect information on chemical incidents, including the Chemical Safety Board, the U.S. Coast Guard's NRC, the National Fire Incident Reporting System, the Occupational Safety and Health Administration (OSHA), and the U.S. DOT. However, many of these organizations and agencies collect data only in call logs, making the data unusable for surveillance purposes. Additionally, these data do not include information on the public health impacts of these incidents (e.g., morbidity, mortality).

NTSIP bridges this gap by collecting and combining information from many independent data sources to create a database suitable for public health outreach. Each participating state develops data-sharing agreements with the organizations most responsible for addressing the types of incidents. These are synergistic partnerships; the state develops a network of stakeholders from which to obtain incident data and in turn shares annual incident data with its stakeholders.

Definition of Terms

To facilitate full interpretation of the results discussed in this report, Table 2 provides definitions for NTSIP incidents, toxic substances, and injured people.

Table 2. Important definitions for interpreting 2013-2014 NTSIP results.

Term	Definition
NTSIP incident	Any acute, uncontrolled, or illegal acute release of any toxic substance meeting NTSIP reporting criteria.*
Toxic substance	Any substance that might reasonably be expected to cause adverse human health outcomes.
Injured people	Anyone (e.g., members of the general population, employees, or emergency responders) who experiences at least one documented adverse health effect within 24 hours after an incident or who dies as a consequence of an incident. Injured people may be exposed to more than one chemical and may experience more than one injury or symptom. However, injured people are not necessarily those exposed to a toxic substance. Examples include a HAZMAT truck driver ejected during a vehicle rollover that spills hazardous material or a person injured by falling debris in a factory explosion caused by a chemical reaction. All attempts are made to classify trauma and burn injuries as chemically- or non-chemically related.

*For specific NTSIP reporting criteria see the NTSIP 2010 Final Report [ATSDR 2013].

3.1 Incidents

During 2013-2014, states entered 6,090 incidents into the NTSIP system; of those, 4,284 (70.3%) were eligible for inclusion and 1,806 (29.7%) were ineligible under the definition of NTSIP. Because NTSIP requires states to enter 80% of chemical incidents into the database within 48 hours, many states enter all chemical incidents into the system and later use additional information about the incidents to classify their eligibility. The most common reason for ineligibility was petroleum incidents without public health action (28.9%). The remainder of this section describes the characteristics of the 4,284 eligible incidents.

> **NTSIP promotes preparedness:** Oregon Hazardous Substance Incidents Surveillance Program (HSIS) educates the public about ammonia releases.
>
> Columbia County preparedness officials contacted the Health Security Preparedness and Response (HSPR) program and requested a public education campaign for anhydrous ammonia and sheltering-in-place. HSIS staff analyzed the NTSIP data and found Columbia County has the most ammonia releases in the entire state of Oregon.
>
> HSIS and HSPR collaborated to develop a preparedness fair as well as several basic shelters-in-place. Additionally, HSPR donated $10,000 to local firefighters and police officers to purchase a respirator fit tester from the community fund they created.

Approximately 1.5 as many incidents occurred in fixed facilities (*n* = 2,575) as during transport (*n* = 1,709). Yet injured people were disproportionately (about 10 times) more likely to be associated with a fixed-facility incident (n=1,389) than a transportation incident (n=138); 13.7% of fixed-facility incidents resulted in injuries (n=352), compared with 4.6% (n=78) of transportation incidents. More fatalities (1.6 times as many) occurred in fixed-facility incidents (n=23) than transportation-related incidents (n=14). All reporting states except Utah recorded at least one fatality (Tables 3a & 3b).

A variety of sources can provide initial notification about a chemical incident (Table 1). For fixed-facility incidents, the primary reporting sources were emergency government services (27.7%), the state environmental division (22.1%), and the media (20.9%). The primary notification sources for transportation incidents were the DOT (61.5%) and emergency government services (13.4%). The state must then verify and complete the data using supplemental sources if necessary.

Fixed Facility

Fixed facility incidents are all incidents that occur in stationary structures (e.g., buildings) or through another form of transport within a stationary structure (e.g., a facility rail system for moving chemicals within a chemical manufacturing plant). If a chemical spill occurs while loading a chemical shipment onto a truck for transport before the entire shipment is loaded, NTSIP considers the incident a fixed-facility event. This differs from other databases like the DOT Hazardous Materials Information System (HMIS), which considers such an incident as transportation-related. However, NTSIP's goal is to target prevention initiatives to the party responsible for the substance at the time of release. During 2013-2014, 2,575 fixed-facility incidents occurred (60.1% of all incidents).

NTSIP promotes surveillance: NC NTSIP provides carbon monoxide surveillance data.

During 2013, North Carolina noticed an increased frequency and severity of carbon monoxide incidents. The NC NTSIP developed a statewide carbon monoxide poisoning surveillance program in December 2013. The program uses emergency department and poison center data to generate monthly surveillance reports sent to stakeholders, including local health departments and first responder organizations. NC also posts reports on the program's website: http://epi.publichealth.nc.gov/oee/a_z/co.html .

Specifying the area or equipment involved in an incident is important for understanding fixed-facility incidents. Of the 2,575 fixed-facility incidents for which either an area or equipment was reported as the primary cause of the spill, 66.2% (*n* = 1,171) involved the following 4 areas or types of equipment:

- 423 incidents (23.9%) were associated with pipelines.
- 309 incidents (17.5%) occurred in a material handling area.
- 221 incidents (12.5%) occurred in a storage area above the ground.
- 218 incidents (12.3%) were associated with ancillary process equipment.

Other area or equipment incidents involved heating/cooling for a building (n=58), transportation within the facility (n=35), transformer/capacitor (n=33), process vessel (n=21), dump/waste area (n=21), storage area below ground (n=18), laboratory (n=10), and incinerator (n=3). One hundred and seventeen events involved 2 types of equipment /areas. The remaining were other areas (n=281).

Approximately 30.9% (n= 796) of fixed-facility incidents resulted in an ordered evacuation.

Transportation

Of the 1,709 transportation-related incidents, 45.1% (*n*=772) occurred while unloading a stationary vehicle or vessel, followed by incidents that occurred while a shipment was en route, but not discovered until the vehicle or vessel stopped (n=310, 18.1%), and incidents involving a moving vehicle or vessel (n=273, 16.0%) (Table 4). Although the largest number of incidents occurred while unloading a stationary vehicle or vessel, the largest number of injuries in a transportation incident involved a moving vehicle or vessel (n=78, 56.5%). However, many of these injuries were a result of trauma from vehicle accidents or rollovers and not due to chemical exposure.

Of the various modes of transportation, most incidents occurred during ground transportation (*n* = 1,459, 85.4%). Of the ground transportation incidents, a majority involved non-tanker trucks (n=1,194). Railway transportation also accounted for a large number of incidents (*n* = 106, 6.2%). These were followed by pipeline (n=83, 4.9%), air (n=41, 2.4 %), and water (n=9, <1 %,) incidents.

NTSIP promotes awareness: NTSIP networks raise awareness about pool chemical releases.

During May 2014, NY NTSIP responded to a request from the Durham Regional Health Department in Ontario, Canada, asking for permission to reproduce and distribute the seven New York State pool chemical fact sheets developed by NTSIP. The Durham Regional Health Department, which serves a population of about 700,000 residents, is planning both paper and electronic distributions to private and public pool and spa operators.

Additionally, NY NTSIP prepared bulleted messages about swimming pool chemical safety for CDC's Recreational Water Illness and Injury Prevention Week, May 19-25, 2014. CDC used the messages in "Have You Heard?" bulletins, which displayed activities by state and local partners to promote pool safety and prevent injuries. NY NTSIP focused on the seven pool chemical fact sheets (http://www.health.ny.gov/environmental/chemicals/pool_chems/).

3.2 Chemicals

Of the 2,575 incidents reported in fixed facilities, 2,331 involved single chemical releases. Of these, over half (54.3%) involved the top 10 chemicals recorded in NTSIP incidents. The chemicals accounting for the largest number of incidents were natural gas (14.1%), ammonia (9.3%), chemicals involved in the production of methamphetamine (meth) (7.7%), and carbon monoxide (7.3%) (Table 5).

These four chemicals were also the top chemicals involved in fixed-facility incidents in 2012. However, these events do not include all natural gas incidents, since these incidents must result in a public health action or an injury to qualify. Chemicals involved in the production of meth is the term that describes a variety of chemicals that cannot be individually identified, often the case in this type of illegal incident.

Of the 1,709 transportation-related incidents, 1,658 incidents involved single chemical releases. Of these, the top 10 chemicals accounted for 35.3% of all incidents. Alkaline hydroxide accounted for the most transportation-related incidents (7.7%), followed by natural gas (5.3%), sulfuric acid (4.0%), and hydrogen peroxide (3.8%) (Table 6).

These top released substances have a variety of harmful properties; i.e., they are volatile, caustic, corrosive, and reactive. However, the most frequently released substances did not necessarily cause the most injuries.

Volatilization of a chemical (when a liquid or solid becomes a vapor following exposure to air) and chemical spills (either in liquid or solid form) were the two most common types of releases in both fixed-facility and transportation-related incidents. In fixed-facility incidents, volatilization accounted for 44.5%, spills for 36.2%, and 1 or more release types with multiple chemicals for 9.4% of releases. Fires and explosions accounted for less than 1% each. For transportation incidents, the majority were spills (80.9%), followed by volatilization (10.3%), and 2 different release types with 1 chemical (e.g. chlorine could have been released as a spill and vapor) (4.9%). Transportation incidents included only three fires and two explosions.

Of all types of chemical releases resulting in injured people, volatilization contributed the largest percentage of injuries, accounting for more than half (54.4%, n=831) of releases reported. Approximately 27.0% (n=10) of fatalities were attributable to volatilization. Injuries can occur if the spilled chemical readily volatilizes and exposes a large number of people before they have time to evacuate or shelter in place. Therefore, results show that future response plans should target reducing exposure following a volatile chemical incident.

To examine whether a combination of chemicals is more toxic and detrimental than a single chemical exposure, the analysis includes the total number of chemicals involved in each incident. In 93.1% of all incidents (*n* = 3,989), only 1 chemical was involved, in 2.9% (*n* = 123), 2 chemicals, and in 4.0% (*n* = 172), 3 or more chemicals. The proportion of people injured by a single chemical was 89.0% (n = 1,359 persons), and the proportion of fatalities from exposure to a single chemical was 81.1% (n = 30).

NTSIP alerts promote safe emergency response:
Insecticide release in California

In September 2013, a 10-lb bag of carbaryl (an insecticide) broke while being moved, releasing the substance to the concrete slab. The California Department of Public Health (CDPH) received an alert, and CDPH's duty officer followed up with the affected party. The officer advised affected people to minimize contact with the spilled carbaryl powder, wash all clothing that may have been in contact with it, and wet the powder down on the pavement to prevent dust from blowing. CDPH also advised the company to lock the building to keep workers from the area until a decision was made about how to deal with the substance that remained after fire department clean up. Although the local fire department collected the majority of the spilled carbaryl into bags, clean-up workers left them onsite.

The duty officer also contacted local public health and environmental health officers, who sent staff to the spill site to evaluate the situation and assist with removing the contained material.

Chemical Trends

Fixed Facility

The top four chemicals involved in fixed-facility events were the same each year between 2010 and 2014: natural gas, carbon monoxide, chemicals involved in the production or use of methamphetamine (meth), and ammonia.

Transportation

The top chemicals resulting in transportation incidents in 2013-2014 were different from previous years. From 2010-2012, the top chemicals were alkaline (sodium and potassium) hydroxide, sulfuric acid, and hydrochloric acid. However, from 2013-2014, the top chemicals resulting in transportation incidents were alkaline hydroxide, natural gas, sulfuric acid, and hydrogen peroxide. These chemicals differed from the top fixed-facility chemicals.

Substances Causing the Most Injuries

Almost half (48.3%) of reported injuries were attributed to six substances: carbon monoxide (n=436), meth chemicals not otherwise specified (NOS) (n=90), sulfuric acid (n=80), natural gas (n=71), ammonia (n=46), and sodium hydroxide (n=15). A large number of injuries can result from exposure to these chemicals, because of their toxic properties described below.

- Carbon monoxide is colorless and odorless and is known as the “silent killer” because its victims often succumb to the effects of low blood oxygen levels before knowing they have been exposed [ATSDR 2012].
- Meth chemicals (NOS) are extremely toxic, flammable chemicals involved in meth production.
- Sulfuric acid is a strong, highly corrosive mineral acid that can have a corrosive effect on human tissue, with the potential to damage respiratory organs, eyes, skin, and intestines [NIOSH 2016a].
- Natural gas and propane are extremely volatile and explosive, resulting in injuries from burns, explosions, or irritation of skin and eyes [NIOSH 2016b].
- Ammonia, a highly volatile, caustic chemical, readily vaporizes into the air upon release, and a large number of people can be exposed. Ammonia reacts with mucous membranes, causing respiratory system problems and eye irritation [ATSDR 2015].
- Sodium hydroxide is a colorless to white, odorless chemical, which can irritate the eyes, skin, and mucous membranes; cause eye and skin burns, and lead to temporary hair loss [NIOSH 2016c].

3.3 Incident Specifics

Timing of Incidents

Events were not evenly distributed by month, day of week, or time. For both fixed-facility and transportation incidents, the slowest time (less incidents occurring) was during the winter months (December-February, 21.0%), followed by fall (September through November, 22.2%) with more incidents occurring during spring (March through May, 27.4%) and summer (June through August, 29.4%). Incidents peaked in July and August in fixed facilities and in May and June in transportation (Figure 1). The most injured people were reported in June (n=156) for fixed facilities and February (n=24) for transportation (Figure 2.)

In addition, the majority of incidents occurred (*n* = 3,659, 85.4%) and the majority of injured people (n=1,272, 83.3%) from Monday through Friday, consistent with a standard business schedule and most commercial activity. Approximately 74.9% of persons were injured between 6:00 am and 5:59 pm (n=1,144), but no time was recorded for 77 events, which resulted in 43 injuries.

Figure 1. Distribution of incidents by month

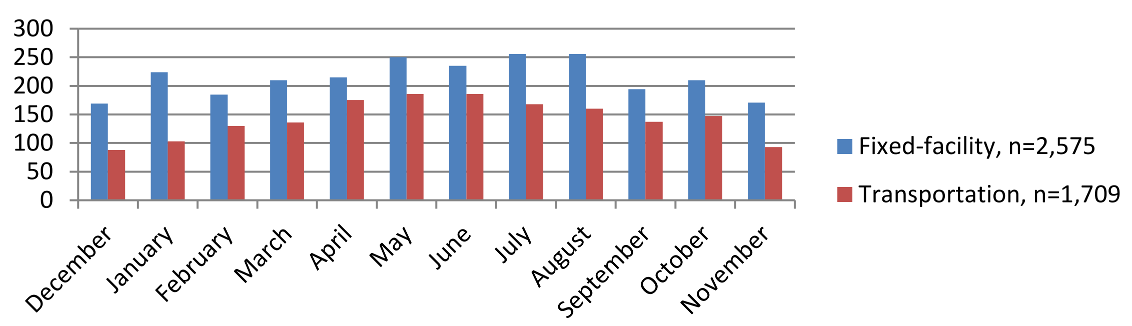
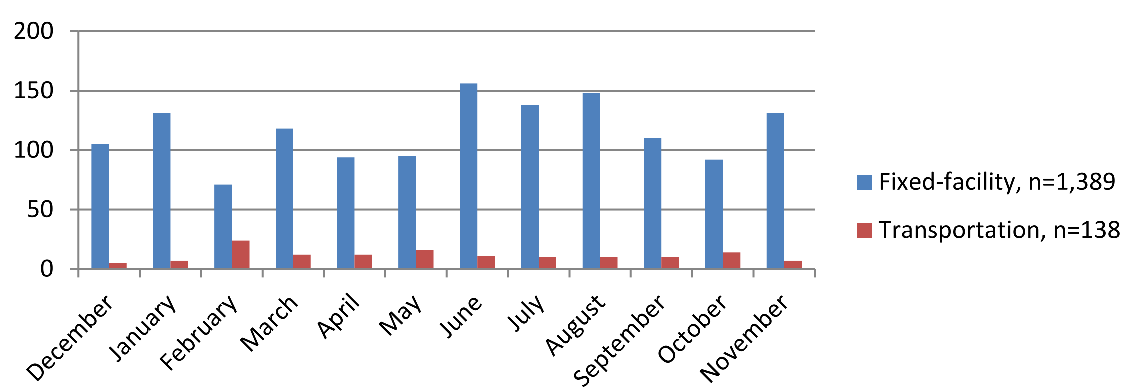


Figure 2. Distribution of injured people by month



Primary/Secondary Contributing Factors

Understanding factors that contribute to a chemical release is the key to reducing chemical spills and the injuries associated with them. Primary contributing factors are the fundamental conditions that may have led to a hazardous release, while secondary contributing factors are any additional factors that may also have played a role; however, secondary factors are not always present. For approximately 42.5% of incidents, the primary factor was human error, and 39.8% were due to equipment failure (Table 7). Equipment failure was the leading factor in fixed-facility incidents (47.1%), compared to human error (62.6%) in transportation incidents. More specific factors cited most often for fixed facilities were illicit drug production (n=294), ruptured pipeline (n=199), system/process upset (n=181), and improper filling, loading, or packing (n=172). More specific factor descriptions cited most often for transportation were improper filling, loading, or packing (n=535); loose closure component or device (n=269); and forklift puncture (n=158). More specific prevention strategies could address these particular factors.

The primary contributing factors of equipment failure and human error also resulted in the majority of injured people (*n* = 634, 41.5% and *n* = 485, 31.8%, respectively). Events caused by human error resulted in the largest number of injuries in transportation-related incidents (n = 84, 60.9%). Equipment failure resulted in the largest number of injures in fixed-facility incidents (n= 615, 44.3%). Other primary factors contributing to the injuries of people were in the categories of "intentional," "other," "bad weather conditions/natural disaster," and "illegal act" (Table 7).

The majority of incidents did not have a secondary contributing factor (*n* = 2,639, 61.6%). In those incidents for which a secondary contributing factor was reported, equipment failure was the most frequent (*n* = 452, 27.5%).

3.4 Injury Characterization

Of the 4,284 NTSIP-eligible incidents, 430 (10.0%) resulted in 1,527 injured people. Sixty fixed-facility and two transportation incidents resulted in six or more people injured (Table 8). Fourteen fixed-facility incidents had a large number of people (>20) injured. The following chemicals were involved:

- 2-chloroacetophenone (n=1)
- Carbon monoxide (n=4)
- Ethylene dichloride (n=1)
- Hydrochloric acid (n=1)
- Hydrogen sulfide (n=1)
- Pepper spray NOS (n=1)
- Perchloroethylene (n=1)
- Sulfuric acid (n=2)
- Vinyl chloride (n=1)
- Chemical not specified (n=1)

These incidents were in areas where a large number of people, some vulnerable populations (e.g. with children and elderly), were located and where a chemical release would be unexpected, including correctional institutions, elementary and secondary schools, outpatient care centers, a grocery store, and a farm. Four occurred in a chemical manufacturing facility. These incidents demonstrate the importance of chemical response plans and drills, especially for use in unexpected incident areas that may affect vulnerable populations, as well as the need for carbon monoxide prevention and detectors.

The most frequently reported disposition of injured people was receiving treatment at a hospital, but their admission status was unknown (30.0%); however, this percentage was higher in transportation incidents (46.4%) than fixed-facility incidents (28.4%). A higher percentage of people died in transportation incidents (10.1%) than in fixed-facility incidents (1.6%), presumably due to the high percentage of trauma from collisions/rollovers (Table 9).

Category, Age, and Gender of Injured People

Injured people were categorized into a victim category; the public, consisting of both the general public and students at school, accounted for almost half of all injured persons (48.3%). Other victim categories included employees (39.3%) and responders, including hospital personnel (6.8%). Fixed-facility incidents involved more injuries to members of the public (49.9%) than transportation incidents (32.6%). However, fixed-facility incidents injured fewer employees (38.4%) than transportation-related incidents (47.8%). (Table 10).

Of the 678 injured persons whose gender was reported, over twice as many were male (n=462) than female (n=216). The breakdown was dependent on the victim category, with more male than female employees injured (n=224 vs. n=96) (Table 11). Male responders and hospital staff were also reported to have the most injuries (n=53) (Table 11). In the public category, however, the number of male and female injuries was similar (185 males vs. 115 females). Of the 967 people injured for whom age category was reported, 205 (21.2%) were children under 18 years of age (Table 11).

Adverse Health Effects in Injured People

Depending on the type of chemical and the circumstances and location of release, a variety of adverse health effects are observable, including trauma, respiratory irritation, eye irritation, burns, headache, and others. The 1,527 injured people could have reported up to 7 adverse health effects, but more than half (n = 875, 57.3%) reported only 1. The most commonly reported adverse health effects were respiratory system problems (18.0%), burns (7.7%), dizziness or other CNS problems (5.9%), and trauma (5.0%). Respiratory system problems (18.9%) were the most common injury in fixed-facility incidents, and trauma was most common in transportation injuries (36.2%). Non-chemical-related traumas (n=61) were notably more frequent than chemical-related traumas (n=2) and may have been caused by the impact of a vehicle accident or debris from an explosion, not by direct exposure to a chemical. Additionally, a number of thermal burns (n=73) may have been due to a fire or explosion rather than direct exposure to a chemical (Table 12).

Personal Protective Equipment (PPE)

The higher the level of personal protective equipment (PPE) worn by a first responder, the more it should help to reduce or mitigate adverse effects from chemical exposure. Therefore, documenting the type of protection that injured emergency responders are wearing during the incident is imperative. These data can help determine the need for changes in the types of PPE for various incidents and possible implementation of changes.

Of the 104 injured responders, only 10.6% (n=11) were reported to have worn PPE; 45 were reported to have no PPE, and for 48, information about PPE status was missing. Of those with PPE, nine were firefighters who were wearing turnout gear with respiratory protection, and two were wearing the most protective Level A equipment. Level A equipment includes positive pressure, full face-piece, self-contained breathing apparatus (SCBA) or positive pressure, supplied air respirator with escape SCBA; totally encapsulated chemical- and vapor-protective suit; inner and outer chemical-resistant gloves; and disposable protective suit, gloves, and boots [EPA 2011]. Of the 600 injured employees, 73.2% (n=439) were reported as having no PPE. Of the types of PPE that were reported, 1 was level A, 1 was level C, and 25 were level D (a basic work uniform). One injured employee had respiratory protection; 9 had other types of protection (like gloves or hardhat), and for 124, PPE information was missing.

Decontamination Status

Decontamination is the process of reducing or removing chemical agents. Detoxification or neutralization are the most common methods of chemical decontamination. Because the decontamination process can be complex, costing both time and money, knowing the number of people decontaminated at a site is important, as well as knowing which chemical exposures resulted in decontamination and where decontamination occurred (i.e., at the scene of the incident, at a medical facility, or both). This information helps first responders as well as hospital staff better prepare for chemical incidents. The decontamination data for all injured people shows that the majority were not decontaminated (n = 921, 60.0%).

Of the total number of injured people, 5.8% (n = 89 injured people) were decontaminated at the scene of the incident and 3.3% (n = 51 injured people) at a medical facility. Additionally, for 9 injured people (0.6%) decontamination occurred at both the scene of the incident and at a medical facility, and decontamination information was missing for 457 injured people (30.0%).

Decontamination in general (injured or uninjured people) did not occur that frequently; for 3,455 (80.6%) incidents, no decontamination occurred at the scene. Twelve incidents reported between 6 and 20 persons decontaminated at the scene. Decontamination occurred at a medical facility for 21 people, and three incidents reported decontamination at a medical facility for between 6 and 20 persons.

3.5 Response and Evacuation

Emergency Response

The majority (n = 3,025, 70.6%) of NTSIP-eligible incidents did not require public health action. Fixed-facility incidents required more public health actions than transportation-related incidents (*n* = 762, 29.6% of fixed-facility incidents and *n* =95, 5.6% of transportation-related incidents). In fixed-facility and transportation incidents, the most frequent public health action was environmental sampling (*n* = 598 and 53 incidents respectively).

Notable health actions included health investigations following six incidents. These investigations are generally necessary following a chemical release that exposes a large number of people. Depending on the severity of the injuries, investigations can include an epidemiological study, medical monitoring of the exposed person(s) over time, or an exposure assessment. Additionally, five chemical release incidents resulted in a health advisory. In one incident, the chemical release affected a drinking water source, resulting in communities being asked to use an alternative water source. In another incident, the chemical spill affected groundwater wells, resulting in a well survey. In still another incident, authorities shut down water intakes to prevent contaminated water from affecting the drinking water source.

An examination of the type of responders aiding in NTSIP-eligible incidents shows that a company response team responded to 42.1% of incidents. Approximately 35.5% of incidents (*n* = 1,520) required multiple types of responders. Only 162 incidents (3.8%) did not require responders (Table 13).

Evacuation and in-place sheltering

Required evacuation occurred when people needed to leave the contaminated area to protect their health following a chemical exposure. When evacuation was not feasible, emergency personnel alerted people in the exposure area to shelter in place, or to remain inside with exterior doors and windows closed and the heating, ventilation, and air conditioning systems turned off, until environmental staff had remediated the threat. During 2013-2014, 952 incidents (22.2%) resulted in an evacuation order, while an additional 48 incidents (1.8%) resulted in a shelter-in-place order.

> **NTSIP protects vulnerable populations:** LA NTSIP assists with an acid leak in the St. Charles Parish
>
> In July 2013, a valve released sulfuric acid at a major petro-chemical plant. Two employees became nauseated. LA NTSIP GIS staff created emergency response maps that showed the spill location in relation to facilities of interest such as hospitals and daycare centers. Employees evacuated and air monitoring was conducted until the site was secure.

In a majority of incidents requiring an evacuation order (*n* = 509 or 53.5%), 50 or fewer people evacuated. Approximately 24.6% of NTSIP-eligible incidents requiring an ordered evacuation (*n* = 234) affected an area with a single general land use. The most common single general land use was residential (*n* = 148 incidents), followed by commercial (n = 40 incidents), industrial (*n* = 38 incidents), agricultural (*n* = 5 incidents), recreational (n = 2 incidents), and an undeveloped area (*n* = 1 incident). For 39 of the incidents, information about land use was missing. When we evaluated mixed land use (any 2 different land uses), we found that over 40.1% of incidents (*n* = 382) occurred in a combination of both commercial and residential areas. This was followed by mixed industrial and residential land use (*n* = 183), undeveloped and residential use (*n* = 44), residential and recreational use (n=19), residential and agricultural land use (n=18), and industrial and commercial use (n=14).

Vulnerable Populations

The proximity of a chemical release to vulnerable populations is a concern because these populations may need additional time or assistance during an evacuation and may be more sensitive to the effects of a chemical. Therefore, identifying vulnerable populations prior to the occurrence of a chemical incident is critical to ensure that they receive additional assistance during an evacuation or following a shelter-in-place order. Examples of places where vulnerable populations may be present include residences, schools, hospitals, nursing homes, licensed day care facilities, or recreational areas (e.g., parks). The most frequently reported location where acute chemical spills could affect vulnerable populations was residences (n=3,480 within .25 mile from the acute chemical incident), followed by day care centers (n=541).

NTSIP planning identifies high-risk facilities: WI conducts a table-top exercise

To help identify vulnerable populations during chemical releases, WI NTSIP staff created and integrated software that maps and provides graphic depiction of multiple data sources supplying information about transportation corridors, chemical spills, chemical storage data, population/demographics, and locations of schools, universities, nursing homes, and hospitals. To pilot test the software, the Kenosha County Health Department selected the Recreational Complex (RecPlex), located in Pleasant Prairie, Wisconsin, because it serves between 800,000 and 1,000,000 members and guests of all ages and is located less than 300 feet from the Amtrak rail line. In addition, 2 chemical processing plants and a major regional electric power generating station are located less than 1.5 miles from the facility. NTSIP staff and partners from other state agencies conducted a table-top exercise simulating a freight train derailment of acrylonitrile. The exercise identified areas for improvement that included appointing a liaison from the responder community to work with the RecPlex on a regular basis to build rapport. This improvement may make the RecPlex less vulnerable if a chemical event occurs nearby.

3.6 Industry

For all qualifying NTSIP-eligible incidents, staff enter into the database the relevant industry code based on the North American Industry Classification System (NAICS). The NAICS is the standard used by federal statistical agencies in classifying business establishments for collecting, analyzing, and publishing statistical data related to the U.S. business economy.

During 2013-2014, the largest number of NTSIP-eligible incidents (*n* = 1,566, 36.6%) was attributed to the transportation and warehousing sector (NAICS codes 48 and 49) (Table 14). This sector includes transportation by air, rail, water, truck, and transit, as well as ground passenger transit, pipeline transport, scenic and sightseeing transport, transportation support activities, and postal service and courier transport. Second in the number of incidents was the manufacturing sector (NAICS codes 31, 32, and 33) (*n* =604 or 14.1%). The largest number of incidents (n = 431), within this code grouping was in NAICS code 32 which includes printing and associated activities, as well as the manufacture of wood, paper, printing, petroleum and coal, chemical, plastic and rubber, and non-metallic minerals.

However, educational services (NAICS code 61) incidents resulted in the greatest number of people injured (n=258, 16.9%), followed by private vehicles and residences (n=245, 16.0%) (Table 14). These incidents are particularly concerning, because children, who are more vulnerable to chemical exposures, are likely to be exposed at these locations. Although transportation and warehousing incidents were the most frequent, they resulted in fewer injured people than other categories. These data are consistent with our finding in Section 3.1 that fixed-facility incidents were more likely to result in a greater number of injured people.

4.0 National Database

NTSIP uses data collected and reported from the cooperative agreement partner states, coupled with supplemental data from governmental reporting agencies (i.e., DOT and NRC), to create annual national estimates of chemical incidents. These national estimates are important for monitoring trends and for publishing information about relevant chemical exposure prevention. For a detailed description of the national database, its core functions, and key partnerships, refer to Table 1.

NTSIP calculates fixed-facility estimates using the NRC Integrated Risk Information System (IRIS) data and estimates transportation-related incidents using DOT HMIS data. Calculations for estimating fixed-facility and transportation data use a matching ratio derived by comparing state-reported NTSIP incidents to incidents reported from the appropriate data source (NRC for fixed-facility and DOT for transportation) for current NTSIP reporting states. This ratio is then applied to NRC or DOT records for non-participating NTSIP states to derive an estimate of NTSIP-eligible chemical incidents for a particular year. The NTSIP national database is accessible on the NTSIP website http://www.atsdr.cdc.gov/ntsip/

The national database also includes annual maps of both fixed-facility and transportation-related incidents. On the NTSIP website, a user can view a cumulative map that represents data from all modeled years or query by a specific year of interest.

Currently, NTSIP has modeled estimates for national chemical incidents dating back to 2000. Table 16 shows the estimated number of incidents for the remaining 43 states that currently do not report to NTSIP. These are crude estimates and may not reflect the true number, depending on the reliability of incident reporting to the respective system (DOT/NRC) in each state. Data from 2014 is not included because it is incomplete.

Table 16. NTSIP-eligible incident estimates for fixed-facility and transportation incidents for the 43 states not currently reporting to NTSIP and actual counts for the 7 NTSIP funded states (bolded).

		2013 Estimated or Reported Incidents[1]	
State	**State Abbreviation**	**Fixed-facility**	**Transportation**
Alabama	AL	168	66
Alaska	AK	68	53
Arizona	AZ	47	94
Arkansas	AR	119	54
California	**CA**	**724**	**449**
Colorado	CO	92	107
Connecticut	CT	72	52
Delaware	DE	50	3
Florida	FL	614	208
Georgia	GA	253	176
Hawaii	HI	43	3
Idaho	ID	31	10
Illinois	IL	247	402
Indiana	IN	116	149
Iowa	IA	86	51
Kansas	KS	133	100
Kentucky	KY	135	127
Louisiana	**LA**	366	135
Maine	ME	48	8
Maryland	MD	139	70
Massachusetts	MA	100	73
Michigan	MI	190	99
Minnesota	MN	98	78
Mississippi	MS	109	31
Missouri	**MO**	**102**	**111**
Montana	MT	18	16
Nebraska	NE	63	19
Nevada	NV	24	36
New Hampshire	NH	29	13
New Jersey	NJ	231	131
New Mexico	NM	22	27
New York	**NY**	884	314
North Carolina	**NC**	138	137
North Dakota	ND	49	17
Ohio	OH	277	310
Oklahoma	OK	222	57
Oregon	**OR**	32	9
Pennsylvania	PA	392	257

		2013 Estimated or Reported Incidents[1]	
State	**State Abbreviation**	**Fixed-facility**	**Transportation**
Rhode Island	RI	18	9
South Carolina	SC	72	39
South Dakota	SD	17	5
Tennessee	**TN**	152	172
Texas	TX	1,386	463
Utah	**UT**	70	50
Vermont	VT	12	5
Virginia	VA	272	64
Washington	WA	345	61
West Virginia	WV	125	17
Wisconsin	**WI**	67	112
Wyoming	WY	50	9
	Total[2]	9,118	5,057

[1]Actual reported incidents are in bold font, and non-bolded numbers are calculated estimates.

[2]The total number of incidents for both fixed-facility- and transportation-related events may not add up to the numbers reported on the website, because estimates may change slightly over time due to changes in the matching ratio and DOT data edits.

Overall, an estimated 14,175 chemical incidents occurred in 2013; for fixed-facilities, 9,118 occurred during 2013.. Estimated transportation-related incidents were 5,057 during 2013.. Unfortunately, no incident database currently includes reported data from all states; therefore, NTSIP estimates chemical incidents that occur in states that do not participate in NTSIP.

As additional data sources are determined to complement the state-reported data and as the methodology is further refined, more precise estimates of national chemical incidents and injuries will become available.

5.0 Incident Investigations (ACE)

When large-scale chemical incidents occur, state and local governments often need assistance to respond to and collect pertinent information about spills. In these instances, a state can request the assistance of NTSIP's Assessment of Chemical Exposures (ACE) team, which will help characterize exposure data, as well as gather information about acute health effects that may result from exposure. Since the inception of the program, the ACE team has responded to a number of large-scale chemical exposure incidents across the country. Previous reports have covered a chlorine release at a metal recycling facility in California, an ammonia release from a refrigeration facility in Alabama, a chlorine gas release in a chicken processing plant in Arkansas, and a vinyl chloride release resulting from a train derailment in New Jersey.

5.1 Elk River, West Virginia Chemical Spill: An ACE Investigation

On January 9, 2014, an estimated 10,000-gallon chemical spill into the Elk River contaminated the water supply of approximately 300,000 West Virginia residents. The majority of the spill was 4-methylcyclohexanemethanol; approximately 7% was a mixture of propylene glycol phenyl ethers. West Virginia declared a state of emergency and issued a "Do not use" water order for nine counties.

Toxicological data are limited for these chemicals, but known human health effects include skin, eye, and respiratory tract irritation. After the spill, patients began reporting to emergency departments for health effects possibly caused by chemical exposure.

The WV Bureau for Public Health (WVBPH) requested assistance from the ACE team to investigate the health effects associated with the chemical spill and make recommendations for public health recovery for the community. In addition, WVBPH asked the ACE team to survey area hospitals to understand the impact of the chemical spill on their operations and make recommendations for improving disaster epidemiology capacity at WVBPH.

The team reviewed medical charts from 584 emergency department visits at 10 hospitals. Of 369 patients whose visits met inclusion criteria, 356 (96%) were treated and released and 13 (4%) were admitted. The most frequently reported symptoms were nausea (38%), skin rash (28%), vomiting (28%), abdominal pain (24%), and diarrhea (24%). Routes of exposure included direct contact with skin or mucous membranes (53%), ingestion (44%), inhalation (15%) and multiple routes (18%).

The ACE team surveyed staff at the 10 hospitals. Six hospitals had received a "Do not use" water order. Besides water, these hospitals needed other supplies, including sanitizing hand gel and wipes, ice, clean linens, and steam-sterilized surgical equipment. The hospitals cancelled all non-emergency surgeries, endoscopies, and hemodialysis.

WVBPH used results from the hospital chart reviews for local outreach and education to address the public's concerns about spill-related health effects. Hospitals used the hospital survey findings in planning for potential future emergencies that might occur when their water supply is compromised. WVBPH used the disaster epidemiology capacity report to plan for health department responses to future disasters and to provide support for hiring an epidemiologist in an environmental health/public health preparedness position.

6.0 Conclusions

Both NTSIP federal and state staff will continue to monitor data to determine specific trends in chemical incidents and develop outreach and prevention activities targeted at reducing injuries and deaths associated with these trends. This report highlights data useful in understanding and preparing for response to chemical releases. For example, the data show that the same chemicals are released every year and that residential and educational facilities where children are present are high-risk locations for chemical releases. Many audiences, including local emergency planning committees, first responder communities, state departments of environmental quality and health, and other federal agencies, can use these data to evaluate chemical spills and focus resources to further mitigate risk and save lives.

The ACE team continues to be a vital resource when large-scale spills occur and states need additional assistance. The team's activities and response demonstrate the importance of timely and effective risk communication to the public during a chemical emergency.

The data collected through individual state reporting, coupled with the information gained through both the national database estimates and ACE incident investigations, ensure a recorded history of chemical incidents. As these chemical disasters and incidental releases continue to occur, the data collected by this program will become even more important for proactively preventing chemical releases and for focusing critical limited resources toward key priorities.

For additional information on state surveillance activities, the ACE team, the national database estimates, or any of the programs' resources and updates, please visit the NTSIP website at www.atsdr.cdc.gov/ntsip/.

7.0 References

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Appendix A: 2013-2014 NTSIP Publications

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