

CARBON MONOXIDE (CO) POISONING



**CAN'T BE
SEEN**



**CAN'T BE
SMELLED**



**CAN'T BE
HEARD**



**CAN BE
STOPPED**

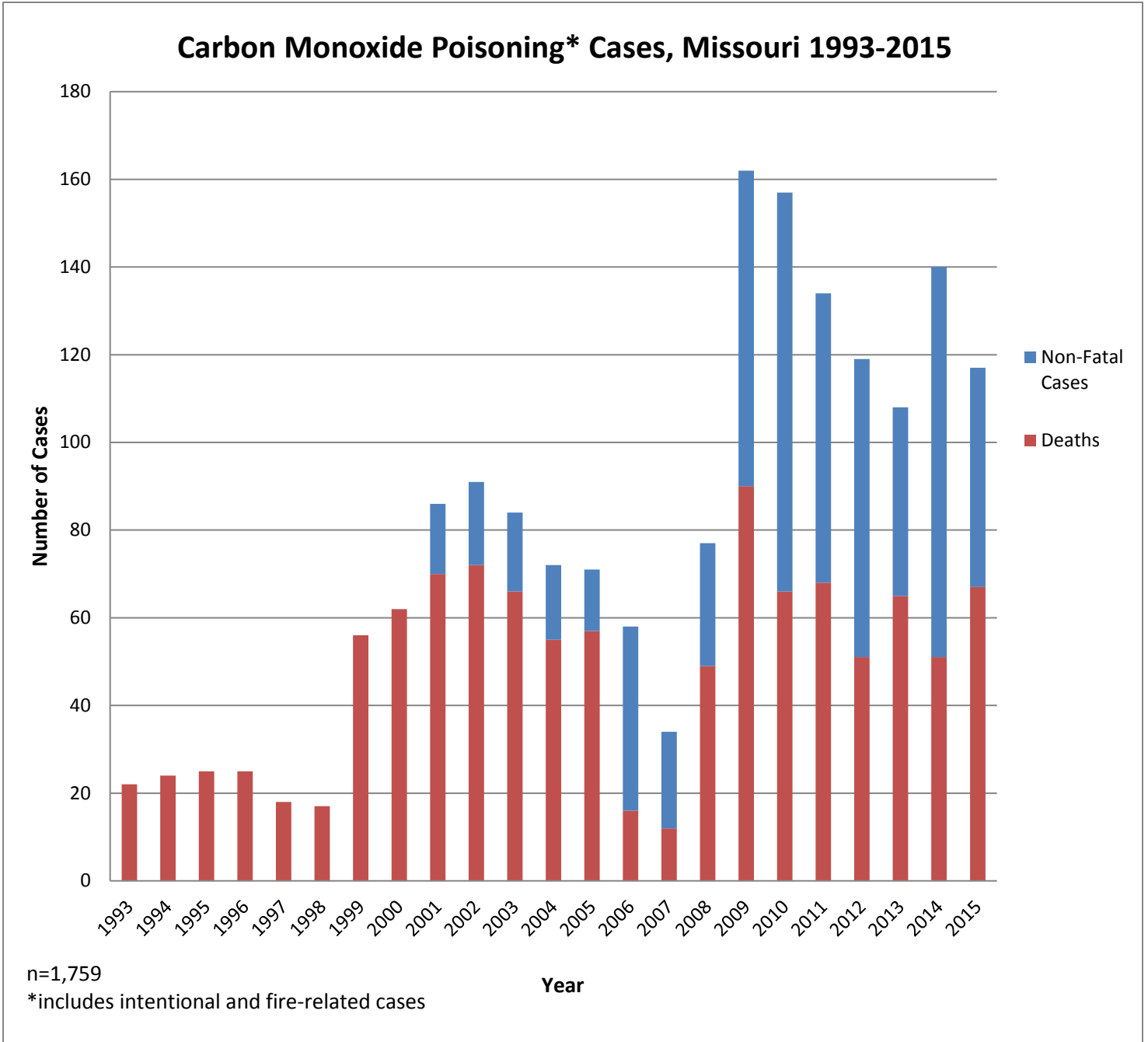
Missouri Carbon Monoxide Poisoning Surveillance

Carbon monoxide (CO) poisoning is an important public health problem in the United States. Centers for Disease Control and Prevention ([CDC](#)) statistics show that more than 400 Americans die from unintentional CO poisoning not linked to fires, more than 20,000 visit the emergency department, and more than 4,000 are hospitalized each year.

The Missouri Department of Health and Senior Services (DHSS) Bureau of Environmental Epidemiology (BEE) defines CO poisoning as a carboxyhemoglobin (COHb) level of greater than or equal to 15% (COHb \geq 15%) (although lower levels can cause symptoms and illness) or a death certificate stating CO as the underlying or a contributing cause of death. In order to ascertain additional cases of non-fatal CO poisoning, BEE initiated a project using hospital data. Beginning with calendar year 2009 data, Missouri inpatient, outpatient, and emergency department data was queried using diagnosis codes. Medical records for previously unreported cases were requested and reviewed. New cases are included in this report. While this effort added many additional cases to the surveillance system, information on the circumstances and sources of CO exposure was often unobtainable due to the length of time from the occurrence of the incident and the time the case was found. Due to underreporting, cases for years prior to 2009 are primarily deaths. In 2015, data from the [Missouri Poison Center](#) became available to BEE staff. This data is also queried to find additional, unreported cases of CO poisoning. Information on deaths is received from the DHSS Bureau of Vital Statistics ([BVS](#)), medical examiners and coroners. The number of deaths reported here differs from information published by BVS as this report includes deaths that list CO exposure as either an underlying or contributing cause. Data published by BVS and BEE are not directly comparable due to differences in case ascertainment and classification.

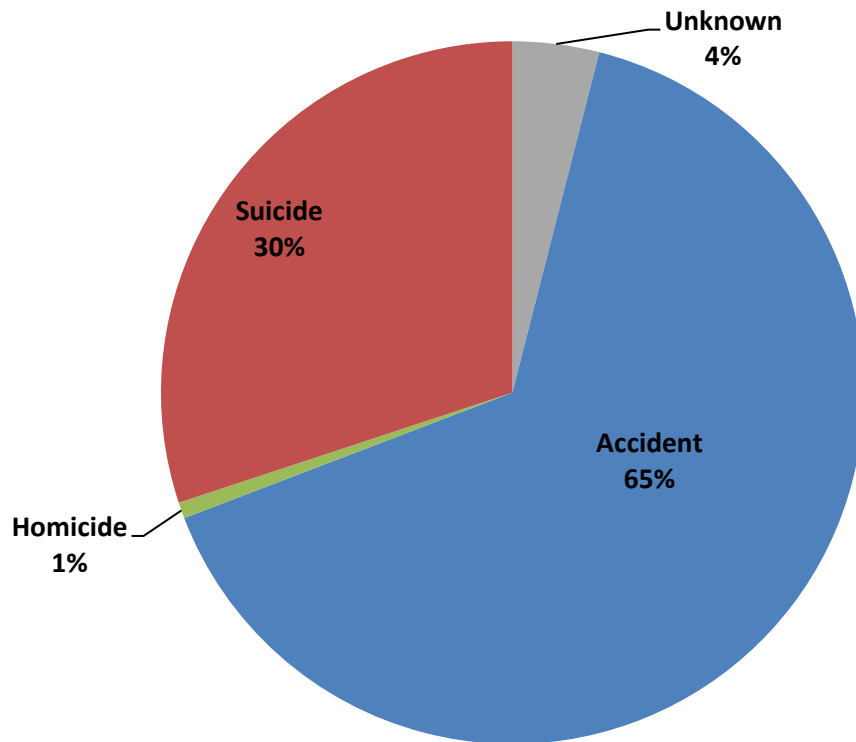
Under the Missouri Code of State Regulations, [19 CSR 20.20-020](#), health care providers have been required to report cases of CO poisoning to DHSS since 1993. Information included here represents reported cases only. Data from 2014 and 2015 is preliminary due to delays in receiving data for new case ascertainment. The actual number of Missourians suffering CO poisoning is unknown because many cases are not reported, particularly poisoning cases not resulting in death. Click [here](#) to report a case of CO poisoning.

Missouri conducts on-going statewide surveillance of morbidity and mortality from CO. There were 1,759 cases of CO poisoning, including 1,104 fatalities, reported to the DHSS BEE in calendar years 1993-2015.



Of those 1,759 cases, 529 (30.1%) were suicides/suicide attempts and 13 (.7%) were homicides. There were 1,147 (65.2%) accidental poisonings and 70 (4.0%) cases with unknown intent.

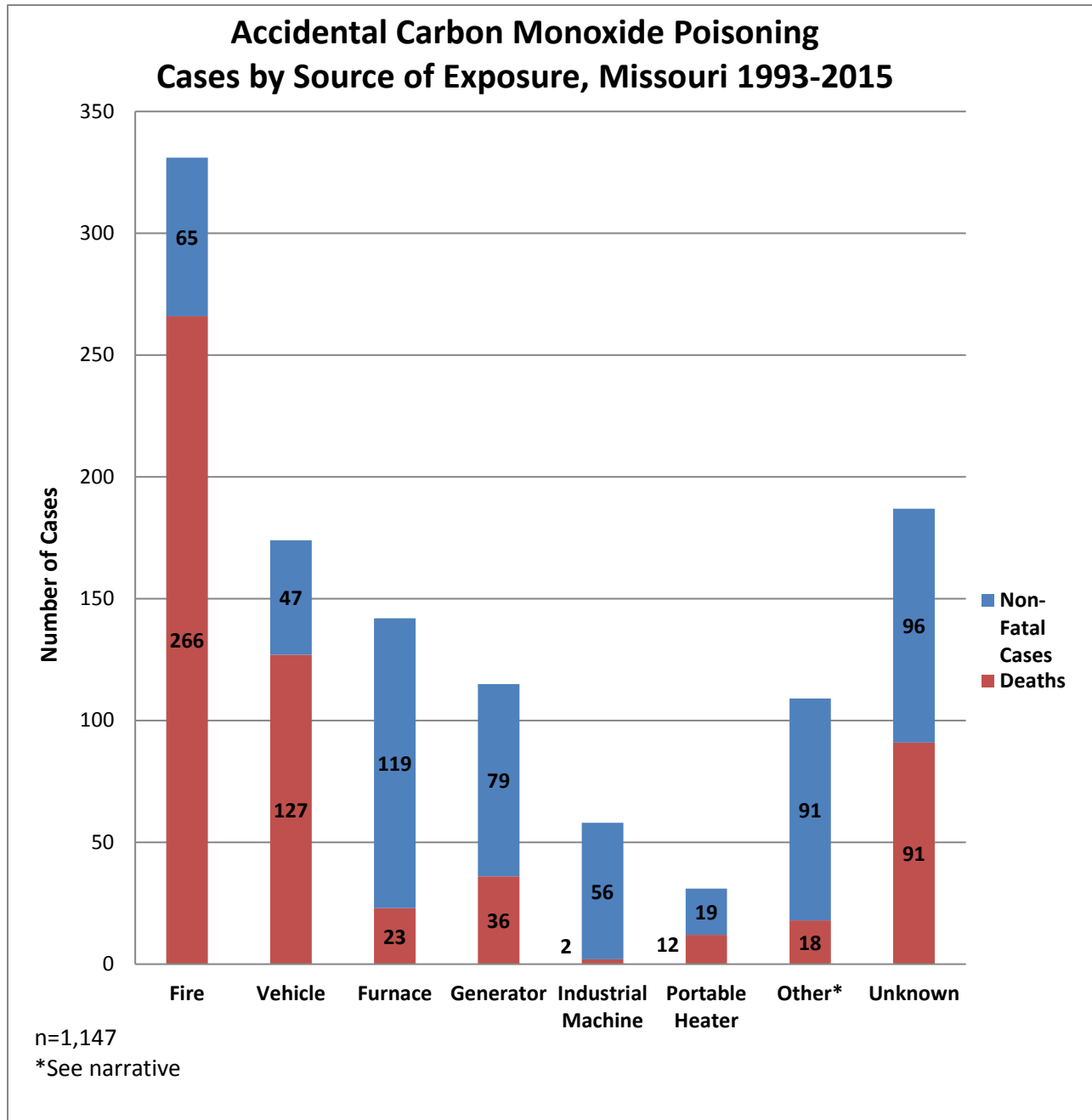
Carbon Monoxide Poisoning Cases by Intent, Missouri 1993-2015



n=1,759

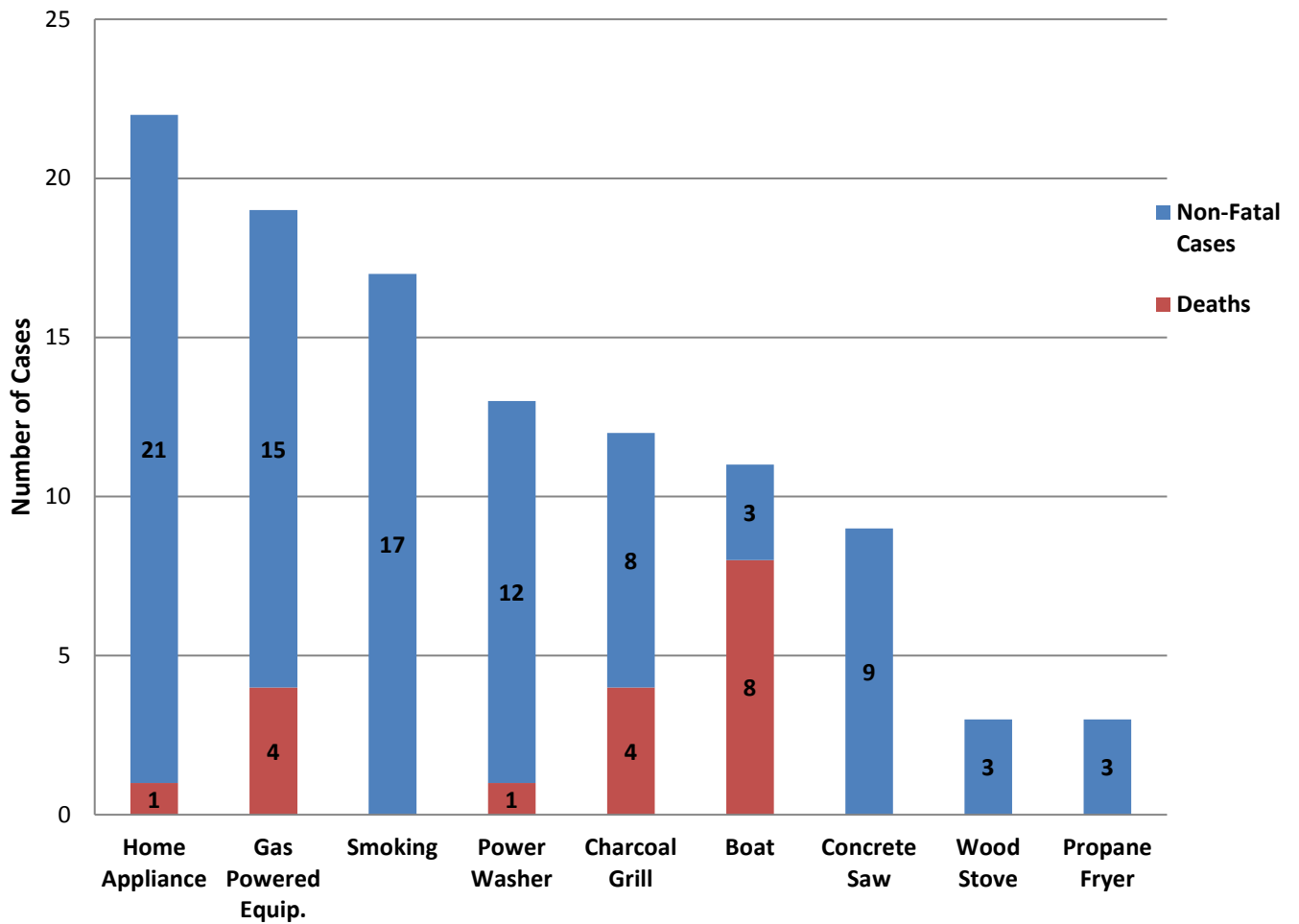
Fires were the most common cause of the 1,147 accidental CO poisonings in calendar years 1993-2015, comprising 331 or 28.9% of the cases. Of the 331 accidental, fire-related cases, 120 (36.3%) were incidents where there was more than one victim.

Non-fire sources of accidental CO poisonings included vehicles—particularly automobiles accidentally left running in a garage (174 or 15.2% of all 1,147 accidental cases), faulty furnaces (142 or 12.4%), generators (115 or 10.0%), industrial machines (58 or 5.1%), and portable heaters (31 or 2.7%). The source of CO for 187 (16.3%) accidental cases was unknown.



Other less common but still hazardous sources of CO poisoning include household appliances such as kitchen ranges, water heaters, and clothing dryers (22 or 20.2% of total 109 cases from other sources), gasoline powered equipment (19 or 17.4%); smoking tobacco products (17 or 15.6%); power washers (13 or 11.9%); charcoal grills (12 or 11%), boat exhaust (11 or 10.1%), concrete saws (9 or 8.3%), wood stoves and propane fryers (3 each or 2.8%).

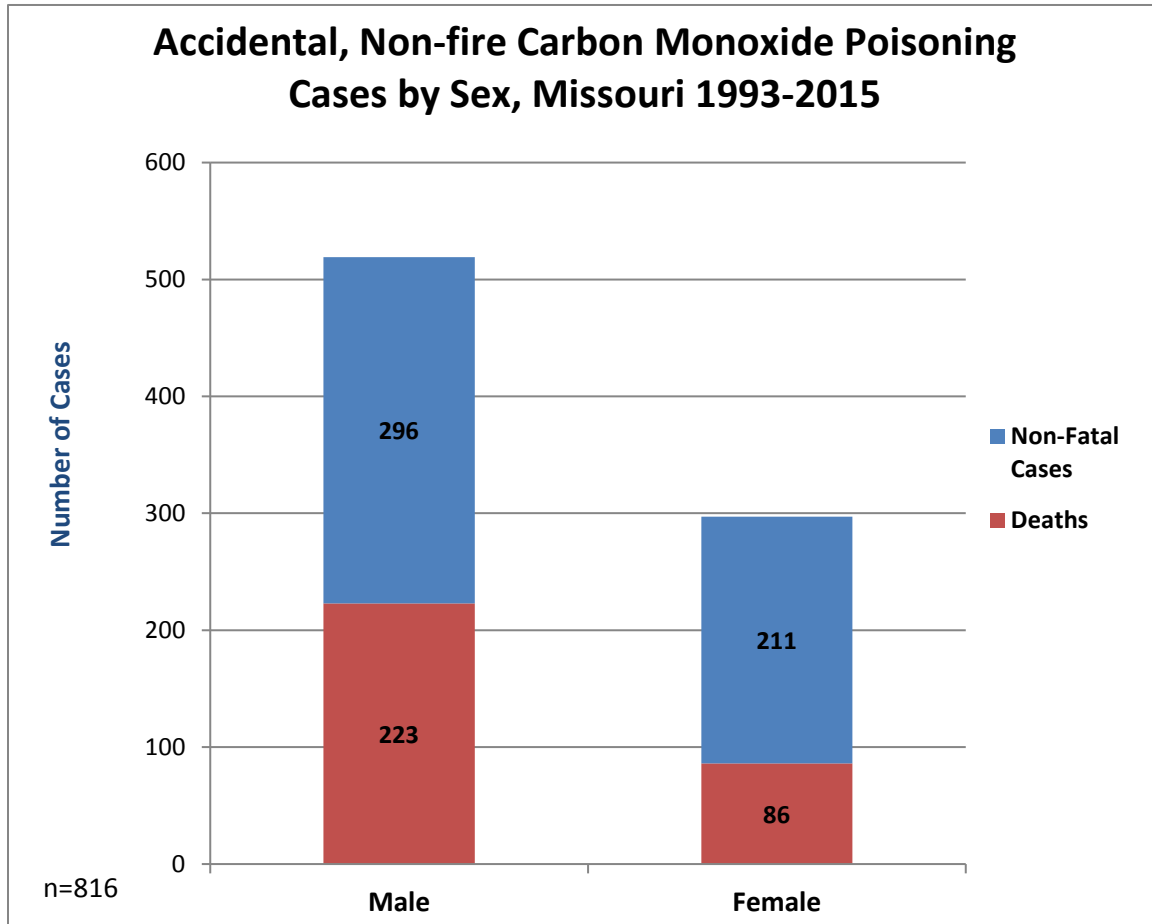
**Accidental Carbon Monoxide Poisoning
Cases from Less Common Sources, Missouri 1993-2015**



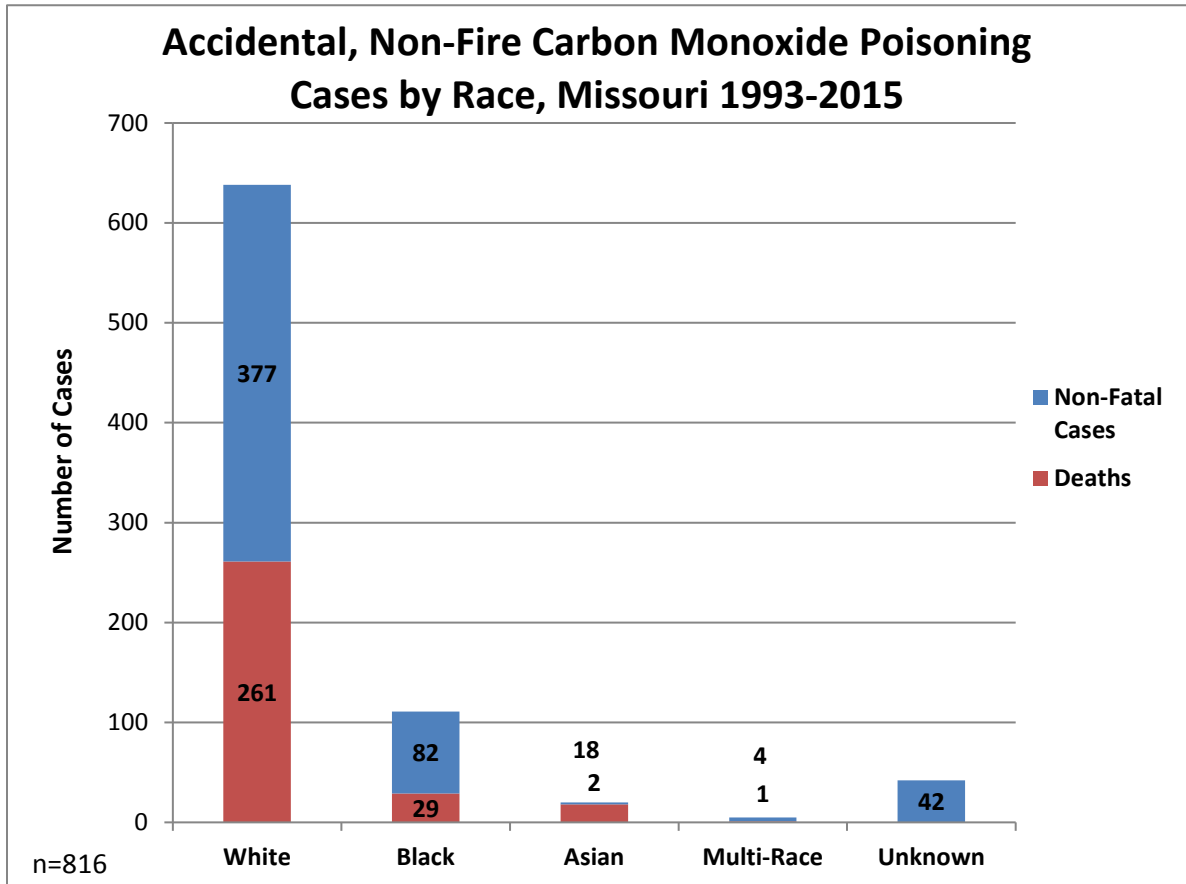
n=109

The following data analyses were performed on a data set consisting of only the 816 unintentional, non-fire-related cases of CO poisoning reported in calendar years 1993-2015. In this report, poisonings where the only known source of CO exposure is due to smoking are included as unintentional.

There were 519 (63.6%) cases of CO poisoning in males, including 223 fatalities. Females comprised 297 (36.4%) cases with 86 deaths.

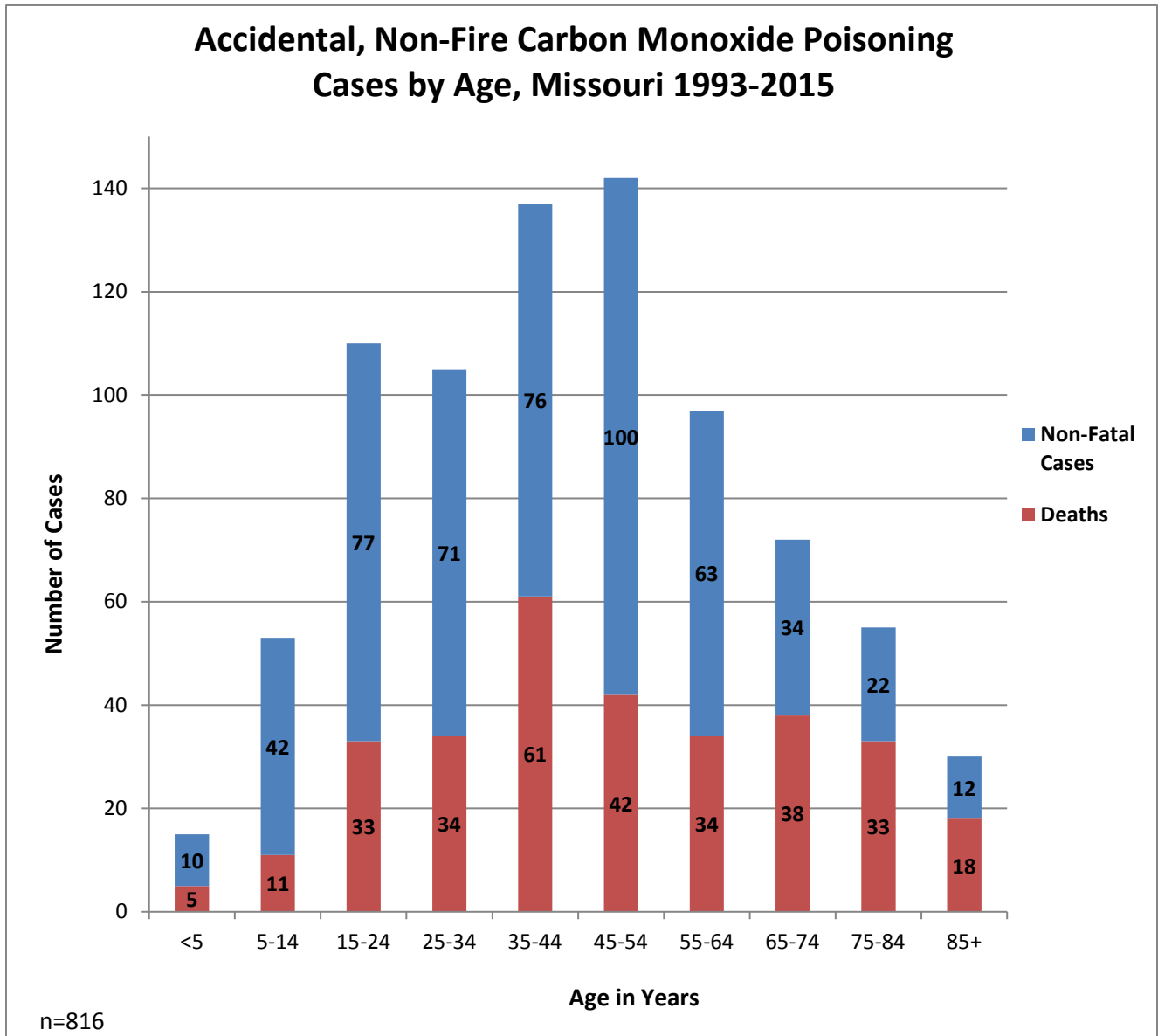


Race was known for 774 (94.9%) individuals reported with CO poisoning, including all fatalities. Of the individuals where race was known, 638 (78.2%) were White or Caucasian, 111 (13.6%) were Black or African American, 20 (2.5%) were Asian, and 5 (0.6%) were of mixed race. Race was unknown for 42 (5.1%) of cases.



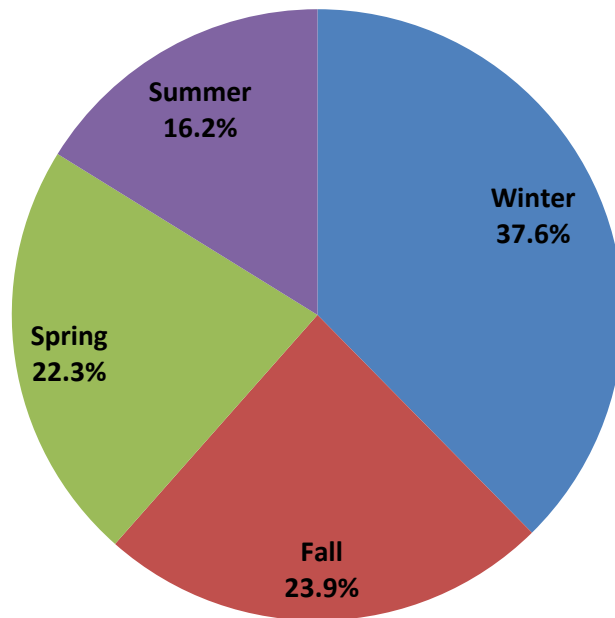
From 1993-2015, 33 (4%) of individuals reported with CO poisoning were of Hispanic ethnicity. There were 750 (91.9%) non-Hispanic cases. Ethnicity was unknown for 33 (4%) cases.

Of the 816 cases of accidental, non-fire-related CO poisoning, the majority (591, 72.4%) of individuals were age 15 to 64 years old. There were 68 (8.3%) cases in people less than 15 years and 157 (19.2%) in those older than 65 years.



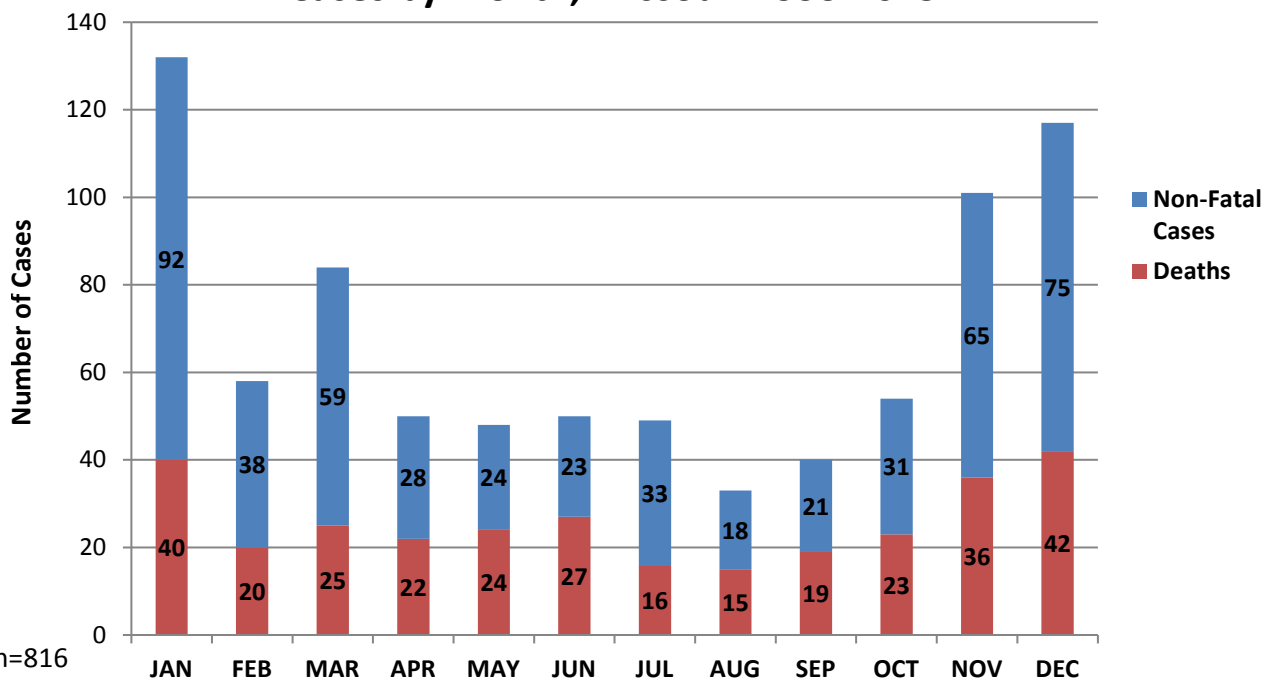
Of the 816 accidental, non-fire-related CO poisonings in Missouri, 307 (37.6%) occurred during the winter season of December, January, and February. Increased use of home heating systems; use of gasoline-powered generators during and after winter storms; and indoor use of charcoal grills, portable stoves, and space heaters all contribute to the increased dangers of CO exposures during winter. There were 195 (23.9%) cases during fall (September, October, November) and 182 (22.3%) during spring (March, April, May). The summer season of June, July and August had the fewest CO cases (132 or 16.2%).

Accidental, Non-Fire Carbon Monoxide Poisoning Cases by Season, Missouri 1993-2015*



n=816

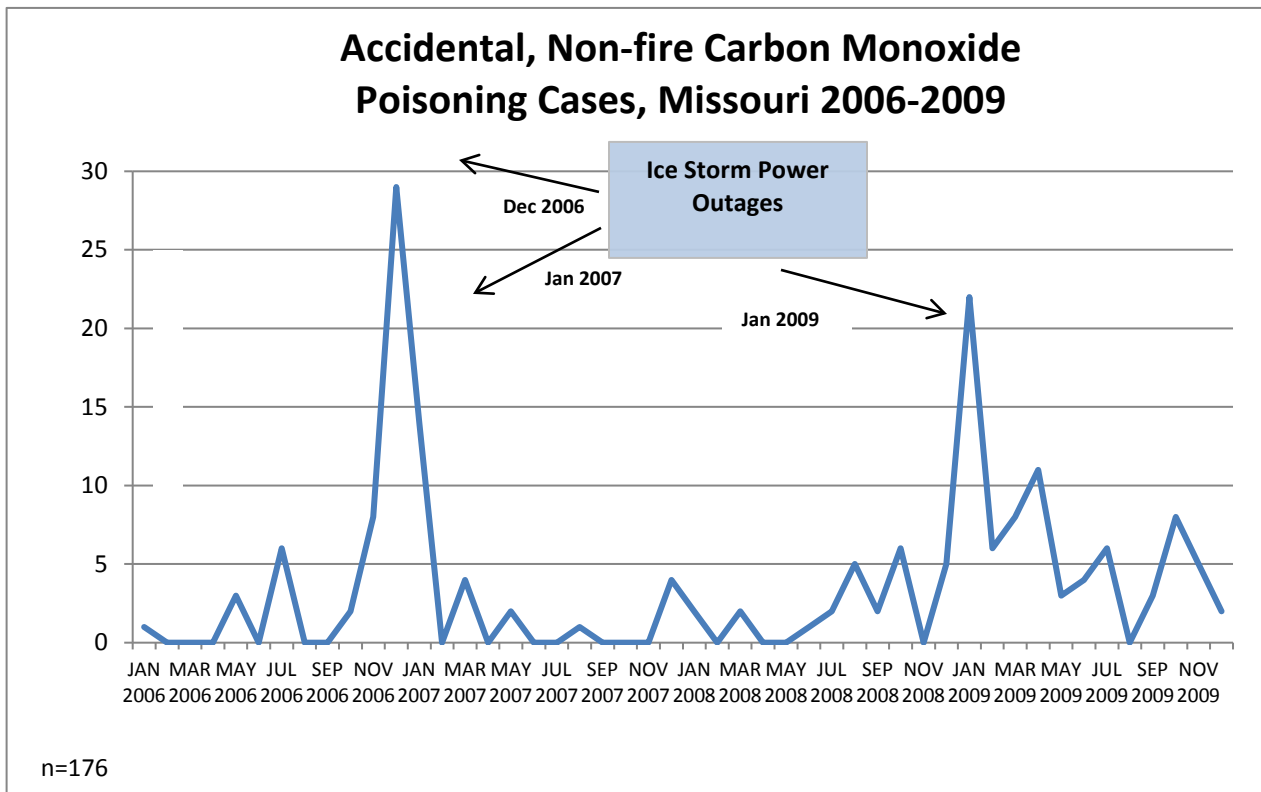
Accidental, Non-Fire Carbon Monoxide Poisoning Cases by Month, Missouri 1993-2015



n=816

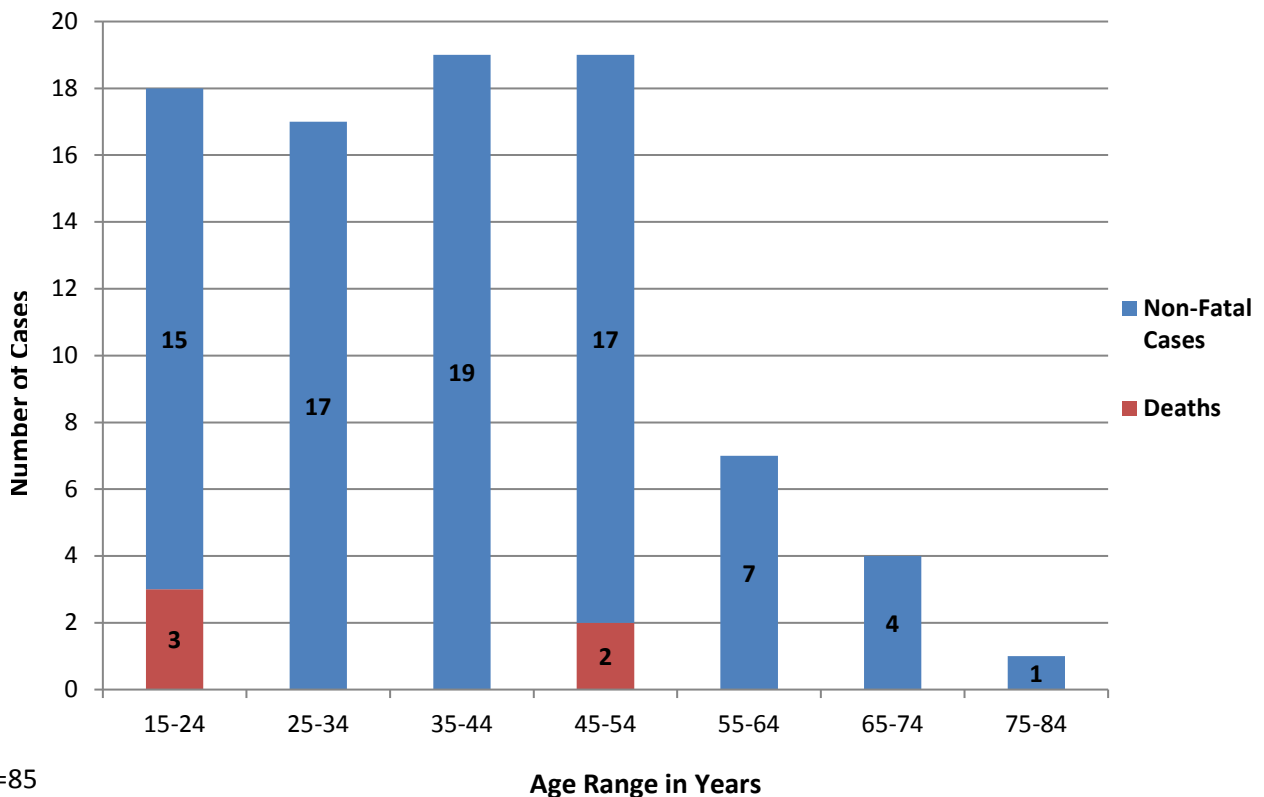
There were severe ice storms resulting in widespread electrical power outages in Missouri in December 2006, January 2007, and January 2009. During these weather events, the number of individuals reported with CO poisoning increased, primarily from the use of gasoline powered generators (43, 63.2%). From 2006 through 2015, a total of 68 cases of CO poisoning, including 16 deaths, were reported to have occurred during power outages. While there surely were additional cases due to storms and outages prior to 2006, those have not been documented.

| Accidental, Non-Fire Carbon Monoxide Poisoning Cases during Weather-Related Power Outages, Missouri 2006-2015 | | | | |
|--|-----------|-----------------|-----------|--------------|
| | Deaths | Non-Fatal Cases | Total | Percent |
| Generator | 11 | 32 | 43 | 63.2 |
| Portable Heater | 3 | 3 | 6 | 8.8 |
| Charcoal Grill | 2 | 2 | 4 | 5.9 |
| Unknown | 0 | 15 | 15 | 22.1 |
| Total | 16 | 52 | 68 | 100.0 |



Occupational cases of CO poisoning comprised 85 (10.4%) of the reported accidental, non-fire cases. There were 80 non-fatal cases and 5 fatalities. Males (73 or 85.9%) were most commonly exposed to CO at work, and 4 of the 5 fatalities were male. There were 12 (14.1%) females exposed at work. The distribution of occupational cases was consistent in the age ranges of 15 to 54 year olds (73 cases comprising 85.9% of the 85 occupational cases). There were 12 (14.1%) occupational exposures in individuals age 65 years and older. Three (60%) of the five occupational CO fatalities were between the ages of 15 to 24 years. Common types of industrial machines used in workplaces that cause CO include forklifts and welders. In one incident in 2014, there were a total of 12 workers with carboxyhemoglobin levels >15% seen in an emergency room after being exposed to CO from commercial parts washers that used gas-powered heaters in an industrial setting. The event triggered an inspection by the Occupational Safety and Health Administration (OSHA) that resulted in citations and a financial penalty for putting workers at risk.

Accidental, Non-Fire Occupational Carbon Monoxide Poisoning Cases by Age, Missouri 1993-2015



**Accidental, Non-Fire Occupational
Carbon Monoxide Poisoning Cases, Missouri 1993-2015**

| | Deaths | Non-Fatal Cases | Total | Percent |
|-----------------------|----------|-----------------|-----------|--------------|
| Industrial Machine | 1 | 42 | 43 | 50.6 |
| Furnace | | 6 | 6 | 7.1 |
| Gas Powered Equipment | 3 | 6 | 9 | 10.6 |
| Generator | | 5 | 5 | 5.9 |
| Portable Heater | | 5 | 5 | 5.9 |
| Vehicle | | 5 | 5 | 5.9 |
| Concrete Saw | | 4 | 4 | 4.7 |
| Power Washer | 1 | 2 | 3 | 3.5 |
| Unknown | | 5 | 5 | 5.9 |
| Total | 5 | 80 | 85 | 100.0 |

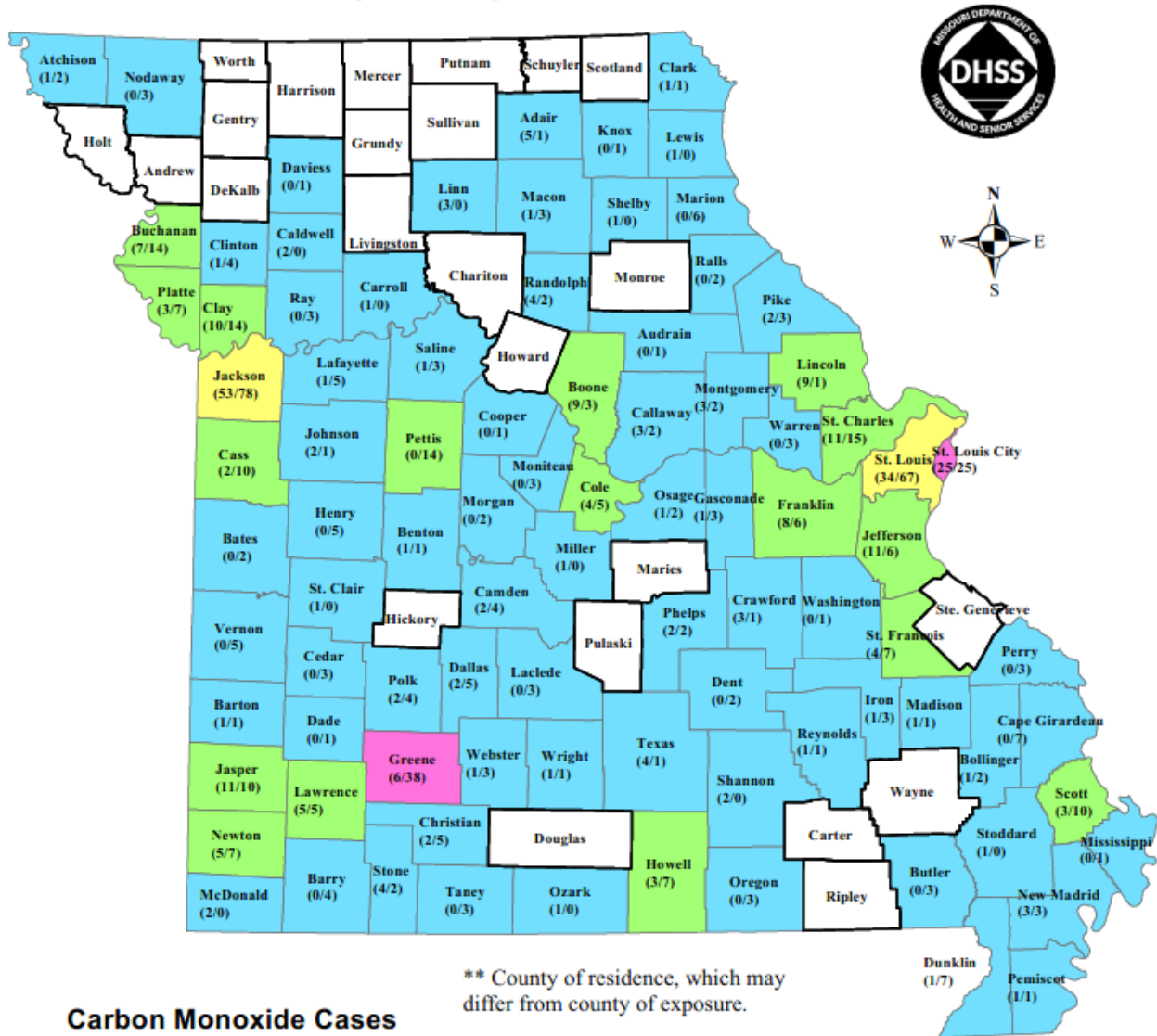
Often, cases of CO poisoning occur in clusters with several people becoming ill or dying in the same incident. Of the 816 accidental, non-fire CO cases from 1993-2015, 390 were incidents with one or more victims. During the same timeframe, there have been six events where there were four or more associated fatalities.

- A husband, wife and their two children died from using a gasoline powered generator as an electrical source overnight in a trailer at a raceway.
- Four adults died at a popular tourist area. The boat in which they were found had a faulty gasoline marine generator. The manufacturer of the generators later recalled them.
- Five young men died of vehicle exhaust in a car that had been running inside a garage behind their home.
- Seven people, including two toddlers, died in a home when an automobile was accidentally left running in an attached garage.
- Two couples died on a houseboat on a river due to a malfunctioning boat generator. The boat was equipped with a CO detector, but the device had no batteries.
- A family of four was found deceased in their rented home due to a malfunctioning gas furnace. The home did not have a CO detector.

The geographic distribution of accidental, non-fire CO poisoning overexposures to Missouri residents from 1993 through 2015, shows there were 803 cases, including 300 (37.3%) fatalities, in 91 of Missouri's 114 counties and St. Louis City, based upon the victim's address of residence.

As well as victim address of residence, BEE collects data on location of CO overexposure. There were 13 reported cases of residents from eight other states who became ill while in Missouri. Nine (64.3%) of those non-Missouri residents died of their exposure while visiting. Cases where CO exposure to a Missouri resident occurred in another state are excluded, as are cases that originated in another state but were hospitalized or died in Missouri.

Number of Accidental Non-Fire Related Carbon Monoxide Cases in Missouri by County** for 1993 - 2015



** County of residence, which may differ from county of exposure.

Carbon Monoxide Cases

- 1 - 8
- 9 - 26
- 27 - 50
- 51 - 131
- No CO Cases

Total number of Missouri resident exposure cases is 803. 13 non-Missouri resident cases were also reported but not included in this map.

Numbers on map in brackets represent the fatal cases followed by the non-fatal cases.

*Source: Bureau of Environmental Epidemiology

Date: 11/28/2016