



SURVEILLANCE BRIEF

Wisconsin Environmental Public Health Tracking Program

DECEMBER 2015

AN INVISIBLE KILLER: CARBON MONOXIDE POISONING IN WISCONSIN

By Christy Vogt, MPH, CHES^a;
Megan Christenson, MS, MPH^{a,b}; Joe Olson^a;
Paul Creswell, PhD^a

^aWisconsin Environmental Public Health Tracking Program

^bBuilding Resilience Against Climate Effects Program



SUMMARY - Carbon monoxide (CO) is a gas that cannot be seen or smelled but is potentially poisonous to humans. Symptoms of CO poisoning include shortness of breath, headache, impaired coordination, nausea, vomiting, dizziness, and loss of consciousness.

CO poisoning can affect anyone, but infants, pregnant women, and those with chronic respiratory conditions are at increased risk of negative outcomes from CO exposure.

In Wisconsin, CO poisonings are most likely to occur during the winter months and tend to happen more often in the northern and western regions of the state.

We can all take steps to stop CO poisoning. Installing appropriate CO alarms, inspecting heating units annually, and avoiding the use of gas-powered equipment in or near enclosed spaces are all ways to prevent CO poisoning.

BACKGROUND

On the evening of December 13, 2014, a teenager passed out after a hockey game in southern Wisconsin. Other players and spectators had been suffering with headaches, nausea, vomiting, and dizziness. When the player passed out, emergency

management was notified and arrived at the ice rink.

Emergency response staff suspected carbon monoxide (CO) poisoning and contacted the Lake Delton Fire Department to conduct air quality tests

in the ice arena. The fire department found dangerously high levels of CO; one of the tests showed levels more than eight times the recommended limit.¹ The arena was immediately evacuated and players and attendees were triaged to four area hospitals for

care. In total, 92 people were seen in area emergency departments, with 80 percent meeting the case definition for carbon monoxide poisoning.^{2,3}

While this specific event was the largest in Wisconsin’s history, CO poisonings are unfortunately not uncommon in the state. CO is a natural result of combustion and is therefore present at some level wherever fires, engines, or generators are used. In the past year, Wisconsin has had CO poisoning events in movie theaters, trailers, and homes. CO poisoning can be dangerous, even deadly, but it is also preventable.

HOW CARBON MONOXIDE WORKS

Carbon monoxide (CO) is an odorless and invisible gas that is created whenever fuel or other materials are burned.⁴ CO is found in smoke and vehicle exhaust and is also a product of portable generators, stoves, gas ranges, and heating systems. Tightly enclosed spaces that are poorly ventilated, such as garages, trailers, ice shacks, and homes with closed windows and doors, are often implicated in CO poisoning cases. When CO is inhaled, it binds to hemoglobin and deprives the body of oxygen. This oxygen deprivation causes shortness of breath, headache, impaired coordination, nausea, vomiting, dizziness, and loss of consciousness.⁵ Serious cases of poisoning can lead to long-term difficulties including psychological problems.⁶

FIGURE 1. Wisconsin Carbon Monoxide Poisoning Emergency Department Visit Rate by Age, 2013

Age-adjusted rate per 100,000 population

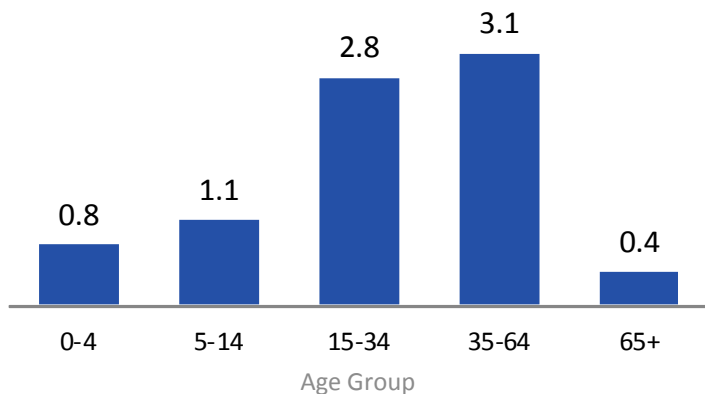
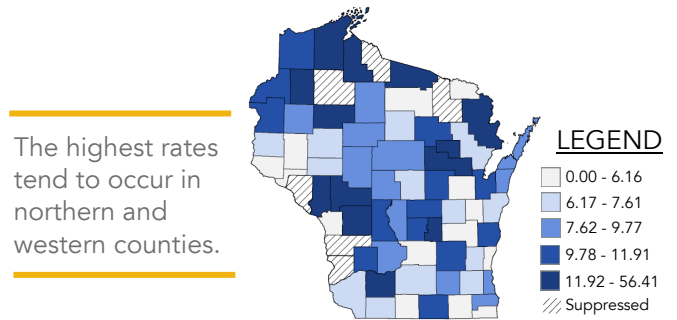


FIGURE 2. Carbon Monoxide Poisoning Emergency Department Visit Rate by County
Age-adjusted rate per 100,000 population



CARBON MONOXIDE POISONING IN WISCONSIN

Risk Factors

While anyone can be poisoned by CO, some populations are at an increased risk of morbidity from CO exposure. Pregnant women are at particular risk because CO has been known to result in miscarriage and developmental problems for the fetus.⁷ Infants and people with chronic respiratory conditions, such as asthma, emphysema, or chronic obstructive pulmonary disease (COPD), are more likely to experience symptoms from CO exposure.

Additionally, because CO binds to hemoglobin, people with anemia can experience symptoms very quickly. Adults aged 65 and older are also at increased risk of CO-related morbidity, as they are more likely to have chronic conditions such as heart disease.⁵ Figure 1 shows the rate of CO-related emergency department visits in Wisconsin for 2013 by age.

Certain hobbies can also put people at risk for CO exposure. Hunters, anglers, and campers often stay in tents or shanties that may be poorly ventilated. Outdoor enthusiasts who use gasoline or propane heaters or grills should be aware that carbon monoxide can build up when ventilation is lacking. Hockey players, figure skaters, and other athletes who exercise in enclosed ice arenas are also at increased risk of exposure to carbon monoxide. While electric ice-

resurfacing equipment is becoming more prevalent, the majority of resurfacing equipment is still gas-powered. When ice resurfacing equipment malfunctions or when there is not adequate ventilation in the arena, people using these facilities are at risk for CO exposure and poisoning.

Different areas of the state also see more CO poisoning events. The geographic variability in age-adjusted county rates of CO poisoning in Wisconsin

can be seen in Figure 2 (previous page). Menominee County has the highest rate of emergency department (ED) visits due to carbon monoxide poisoning. Counties with the highest rates of ED visits tend to be located in the northern and western parts of the state.

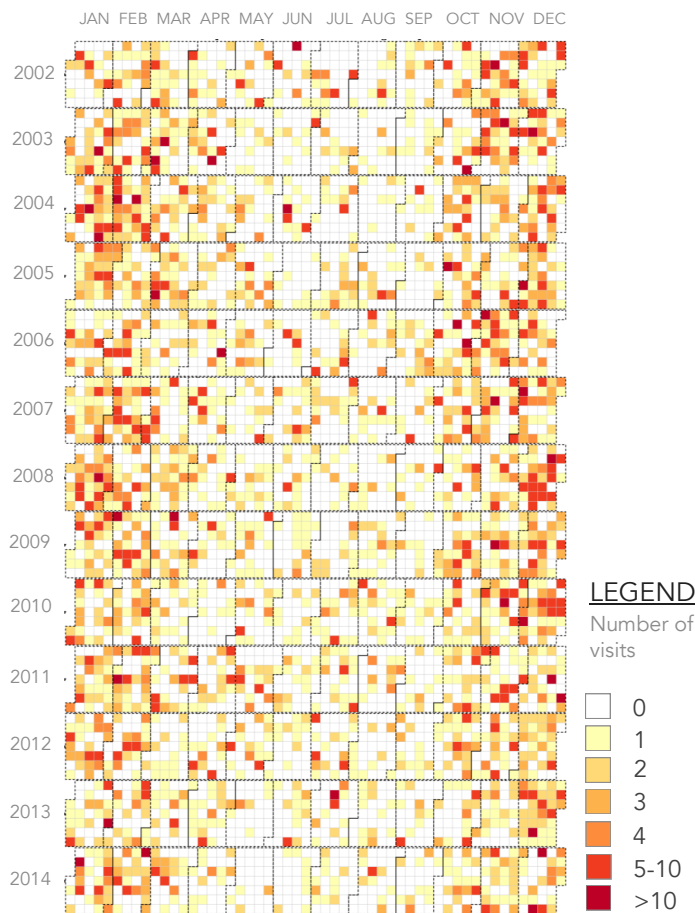
Seasonality

There are seasonal variations to CO exposure. Figure 3 depicts the number of CO-related emergency department (ED) visits throughout Wisconsin. In this map, darker shades reflect more ED visits for CO poisonings. It is clear from the figure that CO poisonings fall sharply during the summer months and increase in the fall and winter. This is expected, as CO poisoning events are more likely to happen during winter months when furnaces and generators are turned on to heat homes.

FIGURE 3. Seasonality of Carbon Monoxide Emergency Department Visits in Wisconsin, 2002-2014

Each square represents one day.

More visits tend to occur during the months of October-March.



Laws and Regulations

Wisconsin state law requires CO alarms be installed and maintained in homes, apartment buildings, and any establishments that are used for sleeping or lodging purposes.⁸ In homes, CO alarms must be installed in the basement and on each level. Alarms are not required in attics, garages, or storage areas.⁹

Although Wisconsin law does not require facilities such as movie theaters, indoor ice rinks, and other enclosed arenas to have CO alarms, the Wisconsin Department of Health Services recommends that these venues install alarms as a best practice.²

DHS Response

When large-scale CO poisonings occur, the Wisconsin Poison Center is likely to receive several calls from patrons and medical providers. To leverage this incoming data, the Wisconsin Environmental Public Health Tracking Program has established an alert system via the Wisconsin Poison Center. This system notifies public health professionals when these events occur so they can respond appropriately.

DHS maintains resources for parents, coaches, and ice arena managers that can be used to prevent CO poisonings (see Additional Resources section).

PREVENTING CARBON MONOXIDE POISONING

Protect yourself and your family members by following these safety tips:

Make sure you have working carbon monoxide alarms. All homes in Wisconsin are required to have alarms on every level, including the basement, but not the attic or storage areas. Use a battery-powered alarm where you have fuel-burning devices but no electric outlets, such as in tents, cabins, RVs, and boats with enclosed cabins. Alarms can be purchased at hardware stores.

Have your furnace, wood-burning stove, and chimney inspected annually. Hire a professional to make sure they are functionally sound, free of debris, and vent outside properly.

Never run a car in an enclosed space. If a vehicle is running, you must have a door open to the outside.

Generators, gas or propane heaters, and grills should be used a safe distance from the home. Never run a generator in a home or garage, or right next to windows or doors.

Enclosed recreational facilities should know recommendations for preventing air quality hazards. Resources for enclosed ice arenas are highlighted in the Additional Resources section.

CONCLUSION

CO poisoning can happen any time of year, but it is more common in the fall and winter months. While some populations like infants, people with respiratory conditions, and those older than 65 are at increased risk of illness, anyone can experience symptoms of CO poisoning. Individuals and facilities can take action to prevent CO poisoning by installing and maintaining appropriate CO alarms, having heating units inspected annually, and avoiding running gas-powered equipment in or near enclosed spaces.

ADDITIONAL RESOURCES

- [Proper Installation of Smoke and Carbon Monoxide Alarms](#)
- [DHS Ice Arena Air Quality Webpage](#)
- [Recommendations for Enclosed Ice Arena Management](#)
- [Signs and Symptoms of Carbon Monoxide Poisoning Flyer](#)

REFERENCES

- ¹Minnesota Department of Health (MDH). Summary of ice arena rules. 2013. Available at <http://www.health.state.mn.us/divs/eh/indoorair/arenas/forms/keychangestorule.pdf>.
- ²Creswell PD, et al. Exposure to Elevated Carbon Monoxide Levels at an Indoor Ice Arena—Wisconsin, 2014. MMWR. 2015. Available at <http://www.cdc.gov/mmwr/pdf/wk/mm6445.pdf#page=7>.
- ³Council of State and Territorial Epidemiologists (CSTE). Public health reporting and national notification for carbon monoxide poisoning. 2015, p. 1–19. Available at <http://c.ymcndn.com/sites/www.cste.org/resource/resmgr/PS/13-EH-01.pdf>.
- ⁴Wisconsin Department of Health Services. Carbon monoxide. Available at <https://www.dhs.wisconsin.gov/air/co.htm>.
- ⁵Centers for Disease Control and Prevention. Carbon monoxide poisoning. Available at <http://www.cdc.gov/co/faqs.htm>.

- ⁶Chambers CA, Hopkins RO, Weaver LK, Key C. Cognitive and affective outcomes of more severe compared to less severe carbon monoxide poisoning. *Brain Inj* 2008;22:387–95.
- ⁷Agency for Toxic Substances and Disease Registry. Toxicological profile for carbon monoxide, 2012, p. 23. Available at <http://www.atsdr.cdc.gov/toxprofiles/tp201.pdf>.
- ⁸National Conference of State Legislatures. Carbon monoxide detector requirements, laws, and regulations, 2015. Available at <http://www.ncsl.org/research/environment-and-natural-resources/carbon-monoxide-detectors-state-statutes.aspx>.
- ⁹Wisconsin Department of Safety and Professional Services. One-and two-family dwellings need smoke alarms and carbon monoxide alarms, 2011. Available at <http://dps.wi.gov/sb/docs/SB-UdcAlarmsFeb11.pdf>.

ACKNOWLEDGEMENTS

The authors would like to thank Maggie Thelen, Jennifer Camponeschi, and Dr. Mark Werner for their editorial contributions to this surveillance brief.

ABOUT TRACKING

The Wisconsin Environmental Public Health Tracking Program is your source for environmental public health data on Wisconsin communities.

Explore the data at dhs.wisconsin.gov/epht.

FUNDING

The Wisconsin Environmental Public Health Tracking Program is funded by the Centers for Disease Control and Prevention.

Wisconsin Environmental Public Health Tracking Program

1 West Wilson, Room 150
Madison, WI 53703

phone | 608-267-2488

web | dhs.wisconsin.gov/epht

email | dhstracking@wi.gov

