

# Carbon monoxide poisoning: The silent killer

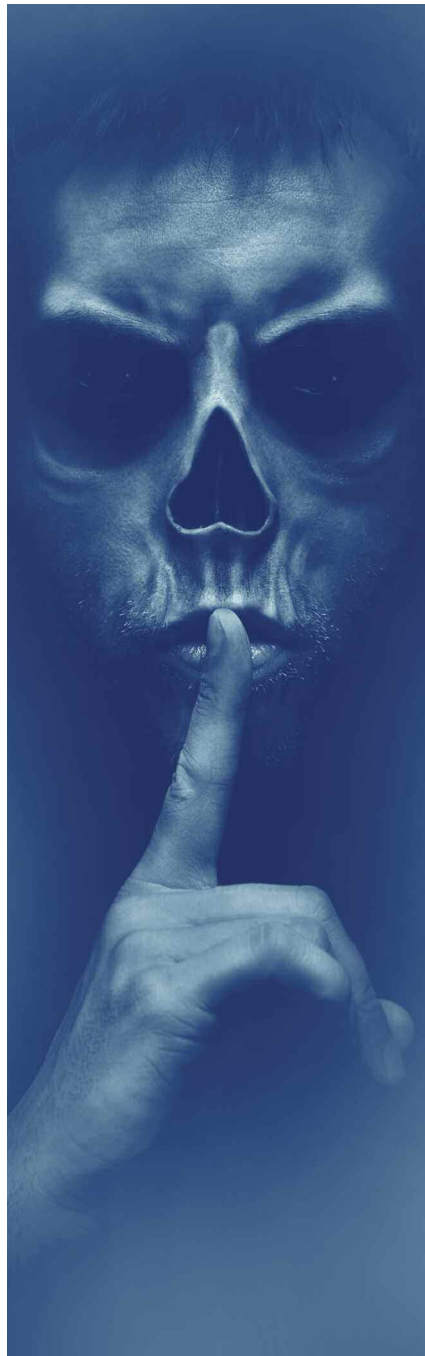
How to identify and manage victims—and prevent more CO exposures

By Amber Proctor Williams, DNP, APRN, FNP-BC, and Robin Dawson Estrada, PhD, RN, PNP-BC

**IN JUNE 2013**, a mother and her 11-year-old son drove to the North Carolina mountains for an overnight stay and checked into a nice hotel with an indoor pool. Shortly after their arrival, she went to the bathroom to remove her contacts while her son used his iPad on the bed. In the bathroom, she was overcome with nausea, prompting her to lie down on the floor. The last thing she remembered was reaching for the door and calling for her son.

What she didn't know was that their room was directly above the indoor swimming pool and pool heater. High levels of carbon monoxide (CO) had leaked from the pool heater and venting system directly into their room. Around noon the next day, hotel employees found the young boy dead and his mother unconscious in the bathroom.

CO exposure is the leading cause of poison-related deaths in the United States. More than 450 unintentional, non-fire-related CO deaths occur in the United States yearly, but the Centers for Disease Control and Prevention estimates an additional 20,000 annual exposures require emergency intervention. These figures probably underestimate the incidence of non-lethal acute exposures, because signs and symptoms of CO poisoning are vague and easily



mistaken for such conditions as the flu, gastroenteritis, or food poisoning. Also, chronic low-level CO poisoning can occur; it's particularly problematic for more vulnerable patients, such as children, pregnant females, and those with underlying cardiac and respiratory diseases.

## CO sources

Known as the silent killer, CO is a colorless, odorless, tasteless gas. A byproduct of fossil fuel combustion, it can be emitted from furnaces, automobiles, stoves, portable generators, gas ranges, charcoal, and firewood. Other devices may emit CO when they malfunction, are blocked, or are used improperly; they include gas-powered tools (for instance, leaf blowers and concrete-cutting saws) used in enclosed or semi-enclosed spaces.

More unusual means of unintentional CO poisoning including hookah smoking, exposure to methylene chloride (a compound in aerosol sprays and paint thinners that metabolizes into CO), and riding in the back of an enclosed pickup truck.

Although CO poisoning can happen anywhere at any time, it's most common in the fall and winter. With two-thirds of Americans heating their homes with fuel (such as gas, oil, or wood),

CO poisoning is most likely to occur in residences. As of September 2015, only 36 states had laws requiring CO alarms in residential structures.

### Clinical presentation, diagnosis, and treatment

When inhaled, CO competes with oxygen for binding sites on red blood cells (RBCs). It binds to hemoglobin more than 200 times more strongly than oxygen does, resulting in a compound called carboxyhemoglobin (COHb). CO-bound RBCs cause tissue hypoxia and cellular toxicity through immunologic and inflammatory processes. Symptom severity doesn't necessarily reflect the CO duration or exposure level or the victim's COHb level.

Although CO poisoning is associated with a cherry-red appearance of the skin, this actually is rare. Also, someone with CO poisoning has a normal pulse oximetry reading, because a pulse oximeter uses light and color to determine tissue saturation and can't accurately distinguish between oxyhemoglobin and COHb. However, a fast noninvasive CO assessment can be done with a special oximeter that specifically measures how much CO is delivered to tissues.

Clinical diagnosis of CO poisoning hinges on a history of CO exposure, signs and symptoms consistent with such exposure, and an elevated COHb level—usually above 3% for nonsmokers or above 10% for smokers. (See *Signs and symptoms of CO poisoning*.)

Because oxygen administration hastens CO elimination from the body, first-line treatment is high-flow, normobaric, 100% oxygen delivered by mask or endotracheal tube until COHb is normal (below 3%) and symptoms resolve. For exposures causing more severe manifestations (such as loss of consciousness or coronary symptoms) or a COHb level

## Signs and symptoms of CO poisoning

Suspect carbon monoxide (CO) poisoning if your patient has:

- headache (the most common symptom)
- fatigue
- dizziness
- nausea or vomiting
- confusion
- disorientation
- blurred vision
- arrhythmias
- chest pain
- dyspnea or shortness of breath
- loss of consciousness
- coma.

## CO alarms: What to teach patients

When teaching patients about carbon monoxide (CO) alarms, cover the following points:

- If you have a CO source in your home (such as an attached garage, gas appliances, or a fireplace), install a CO alarm on each level of your home and outside sleeping areas.
- Know that CO alarms sound with four short beeps.
- Be aware that these alarms have a shelf life and must be replaced when they expire—usually in 7 or 10 years.
- Test alarms monthly by pressing the "Test" button.
- If your alarm uses batteries, test batteries monthly and replace them when standard time changes to daylight savings time, and vice versa (every 6 months), or as needed.
- If the alarm sounds, get to fresh air and stay outside. Call 911 to find the CO source.

above 25%, hyperbaric oxygen therapy may be used to mitigate long-term neurologic sequelae.

### Improving outcomes

You can help improve outcomes for patients who've been exposed to CO. In many cases, nurses are the first contact point for those with CO poisoning. Make sure you're familiar with common signs and symptoms and maintain a high index of suspicion in patients who have these.

Rapid assessment, diagnosis, and treatment are critical in preventing long-term sequelae and death. Request that your emergency department have CO oximeters on hand to allow rapid assessment of patients who present with potential CO exposure.

In all practice settings, use targeted patient education, including a basic overview of CO alarms, alarm placement and maintenance, and what to do if the alarm sounds. (See *CO alarms: What to teach patients*.)

Reinforce patients' understanding of symptoms of CO poisoning, common CO sources, and safe heating practices. These simple health-promotion tips can prevent tragedies caused by this silent killer. (For online resources, see *Useful links for CO information*.)

### Raising public awareness


Public health measures may reduce CO exposures. Whatever your work setting, promote CO awareness and safety practices among colleagues and patients. If you're in a leadership position, partner with fire and safety officials, first responders, and medical organizations to encourage use of CO alarms and equipment in the workplace.

Initiate conversations with community leaders and legislators to advocate for residential CO alarm requirements in city and

## Useful links for CO information

Visit the following websites for more information on carbon monoxide (CO) poisoning.

### Centers for Disease Control and Prevention: Carbon Monoxide Poisoning Prevention: A Toolkit: Working Together to Keep Communities Safe

 [nphic.org/Content/Toolkits/CarbonMonoxide/cdc-carbon-monoxide-poisoning-prevention-a-toolkit.pdf](http://nphic.org/Content/Toolkits/CarbonMonoxide/cdc-carbon-monoxide-poisoning-prevention-a-toolkit.pdf)

### Consumer Product Safety Commission: Carbon Monoxide Information Center

 [cpsc.gov/safety-education/safety-education-centers/carbon-monoxide-information-center/](http://cpsc.gov/safety-education/safety-education-centers/carbon-monoxide-information-center/)

### Environmental Protection Agency

 [epa.gov/iaq/co.html](http://epa.gov/iaq/co.html)

 [epa.gov/indoor-air-quality-iaq/carbon-monoxides-impact-indoor-air-quality](http://epa.gov/indoor-air-quality-iaq/carbon-monoxides-impact-indoor-air-quality)

county laws and building codes. With the help of these collaborative partners, you can increase awareness and help shape policies and procedures related to CO safety.

CO poisoning is a nationwide problem that doesn't discrimi-

nate. Bringing about major change will require coordination with many individuals and organization—and nurses are well prepared to lead such change. As the largest and most trusted workforce in the country, we can make a difference. ★

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OSHA/NIOSH Hazard Alert: Methylene chloride hazards for bathtub refinishers. Last updated June 6, 2014. [cdc.gov/niosh/docs/2013-110/pdfs/2013-110.pdf](http://cdc.gov/niosh/docs/2013-110/pdfs/2013-110.pdf)

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