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1. Background

- Unintentional, non-fire-related carbon monoxide (CO) poisoning is a leading cause of poisoning death.¹ CO poisoning causes 500 deaths and more than 20,000 non-fatal injuries in the United States annually.¹⁻²
- CO is a by-product emitted by many common fossil fuel-burning appliances.³ Dubbed the "silent killer," CO is a toxic, colorless, and odorless gas that can poison when trapped in enclosed areas.
- The incidence of CO poisoning spikes after major storms and disasters, as residents turn to portable generators for power and heat.⁴⁻⁶ Generators are often placed in unventilated areas, leading to poisoning.⁴
- Despite this trend, little is known about the beliefs and attitudes that drive improper generator placement or the failure to use CO alarms in post-disaster situations.
 - **Common CO-Emitting Products**
 - Portable generators

 - Hot water heaters (gas) Automobiles/trucks
- Gas and charcoal grills
- Kerosene/portable heaters
- Chainsaws
- Pressure washers

2. Populations at Risk

• Gas stoves

Furnaces (natural gas, oil)

A systematic literature review identified six common scenarios for CO poisoning.⁷ Two of the most prominent scenarios occur after major storms or natural disasters hit areas.

- Summer Storm Poisonings. These poisonings occur when hurricanes, tornados, or other summer storms cause power outages and damage residences.⁴⁻⁸
- Residents use portable generators to provide electric power, often placing them in unventilated areas. Some residents use power tools in unventilated areas to clean up debris.
- Homeowners especially Hispanics and African Americans who live in Southeastern coastal states are at highest risk.
- Winter Storm Poisonings. These poisonings occur when snow and ice storms cause power outages and isolate residents.⁹⁻¹¹
- Residents use portable generators to provide electric power and heat homes, often placing them in unventilated areas.
- Homeowners especially Whites who live in the Midwest, New England, Great Plains, and Pacific Northwest are at highest risk.

3. CO Poisoning Prevention

Two protective behaviors could help eliminate CO poisoning in storm and disaster scenarios.

- **Proper Generator Placement.** Residents should place portable generators outdoors and away from doors and windows. Generators should be at least 25 feet from any house.
- **CO Alarm Installation.** Residents should install battery-powered (or battery-back-up) CO alarms in bedrooms, hallways, and common living areas.⁸

Several studies have already shown that improper generator placement and lack of CO alarms lead to poisoning.^{4, 6, 10-11,13} **Study Goal:** Understand <u>why</u> residents adopt these risk behaviors. Identify the attitudes and beliefs that drive generator placement, storm preparations, and CO alarm installation.

4. Methods

- **Summer Storm Focus Groups.** We conducted two focus groups (n=17) with portable generator owners in Wilmington, NC.
- Winter Storm Focus Groups. We conducted two focus groups (n=15) with portable generator owners in Asheville, NC. **Recruitment/Eligibility**. We recruited participants via a local research firm. All participants had used generators during storm-related power outages.
- **Data Analysis.** We entered participant responses into an ordered meta-matrix that segmented responses by group and topic. We then summarized the trends across each topic and distilled findings.

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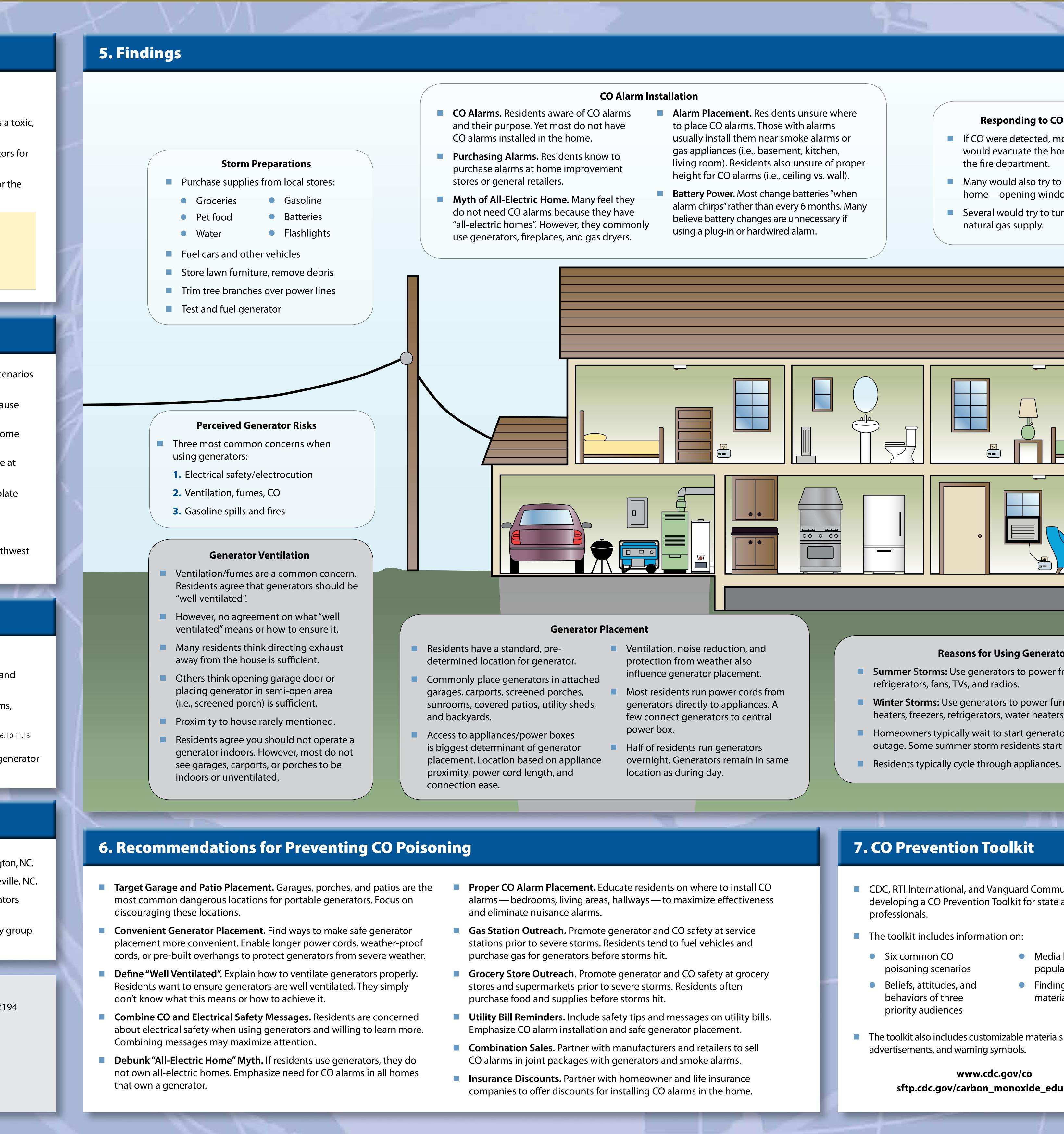
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Understanding Risk Behaviors for Storm- and Disaster-Related Carbon Monoxide Poisoning



Responding to CO Poisoning Carbon Monoxide Knowledge Most residents familiar with CO and have heard of CO poisoning. Correct beliefs: CO is colorless, tasteless, odorless. Individuals often poisoned in their sleep. Symptoms include headache, drowsy, dizzy, nausea. • CO poisoning can be fatal. Incorrect beliefs: • CO emissions confused with natural gas leaks. Sickened pets can alert residents to CO's presence. Current behavior and generator placement protecting against CO poisoning. Cars, furnaces, stoves, grills, portable heaters, fireplaces, and other appliances seen as common CO sources. Most residents know that generators emit CO. **Preventing CO Poisoning** Utility Bill Reminders. Include Residents suggest several F strategies for promoting safety tips and reminders on CO alarms and preventing natural gas, electric, and other utility bills. poisonings: Combo Packages. Sell CO Weather Channel PSA. Air alarms in tandem with public service announcements generators. Sell joint CO/smoke on The Weather Channel alarms at hardware stores. in advance of severe storms. Homeowner Insurance Local News Outreach. Most **Discounts.** Offer discounts on residents hear about CO homeowner's insurance if CO poisoning on local news. Air ads or PSAs on local TV and alarms installed. radio stations. Free Detectors. Fire departments can offer free **Educational Booths.** detectors and education at Host booths at schools, state fairs and community supermarkets, hardware stores, malls, home and garden shows, events. and community events. References ¹CDC (2008). Nonfatal, unintentional, non-fire-related ⁸Cukor, J., & Restuccia, M. (2007). Carbon monoxide carbon monoxide exposures—United States, poisoning during natural disasters: The Hurricane Rita experience. Journal of Emergency Medicine. 2004-2006. Morb Mortal Wkly Rep, 57(33), 896-899. Available online 5 July 2007. ²CDC (2007). Carbon monoxide-related deaths United States, 1999–2004. MMWR Morb Morta ⁹Ghim, M., & Severance, H. W. (2004). Ice storm-related carbon monoxide poisonings in North Carolina Wkly Rep, 56(50), 1309-1312. A reminder. South Med J, 97(11), 1060-1065. ³CDC (2005c). Unintentional non-fire-related carbon ¹⁰CDC (2004c). Use of carbon monoxide alarms to monoxide exposures — United States, 2001-Media habits of at-risk 2003. MMWR Morb Mortal Wkly Rep, 54(2), 36-39 prevent poisonings during a power outage populations North Carolina, December 2002. MMWR Morb ⁴Van Sickle, D., Chertow, D. S. et al. (2007). Carbon Mortal Wkly Rep, 53(9), 189-192. monoxide poisoning in Florida during the 2004 Findings from message/ hurricane season. Am J Prev Med, 32(4), 340-346. Lin, G., & Conners, G. P. (2005). Does public education materials testing reduce ice storm-related carbon monoxide ⁵McVay, J. Personal interview. Dec. 14, 2007. exposure? *J Emerg Med*, 29(4), 417-420. ⁶CDC (2006a). Carbon monoxide poisonings after two ²Krenzelok, E. P., & Roth, R. (1996). Carbon monoxide major hurricanes—Alabama and Texas, August-... the silent killer with an audible solution. Am J October 2005. MMWR Morb Mortal Wkly Rep, *Emerg Med,* 14(5), 484-486. 55(9), 236-239. ¹³Runyan, C. W., Johnson, R. M. et al. (2005). Risk and ⁷Poehlman, J. A., Rupert, D.J., & Williams, P.N. (2008) protective factors for fires, burns, and carbon Audience profiling for carbon monoxide poisoning monoxide poisoning in U.S. households. Am J prevention: Review of literature and formative *Prev Med*, 28(1), 102-108.

If CO were detected, most residents would evacuate the home and call 911 or Many would also try to ventilate the home—opening windows and doors. Several would try to turn off power or **Reasons for Using Generator** Summer Storms: Use generators to power freezers, A/C units, Winter Storms: Use generators to power furnaces, central heaters, freezers, refrigerators, water heaters, lights, and TV. Homeowners typically wait to start generator until after power outage. Some summer storm residents start earlier. CDC, RTI International, and Vanguard Communications are developing a CO Prevention Toolkit for state and local health The toolkit also includes customizable materials — flyers, PSAs, sftp.cdc.gov/carbon_monoxide_education research recommendations. Research Triangle Park, NC: RTI International.