Carbon Monoxide (CO) Poisoning

Shahed Iqbal, PhD, MBBS, MPH

Air Pollution and Respiratory Health Branch
National Center for Environmental Health

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Presentation Topics

- Background
- Health effects
- Epidemiology
- Surveillance
- CO poisoning during disasters
- Prevention
- Recommendations
Carbon Monoxide (CO)

- Colorless, odorless gas

- Produced due to incomplete combustion of hydrocarbons

- Non-occupational sources include:
  - Heating and cooking appliances
  - Motor vehicle exhaust
  - Generators and gasoline powered equipment
Pathophysiology

- Has higher affinity for hemoglobin
- Causes tissue hypoxia and direct tissue damage
- Can impact systems vulnerable to lack of oxygen
Health Effects

- Non-specific flu-like symptoms (e.g., fatigue, dizziness, headache, confusion, nausea, vomiting)
- Collapse, coma, cardio-respiratory failure, and death
- 15–49% develop neuro-cognitive sequelae
Epidemiology

- Exposures
  - Non-fatal: Children (<5 years), Females
  - Severe and Fatal: Elderly (>65 years), Males

- Season: Winter

- Region: Midwest, Northeast

- "Outbreaks": Natural disasters
Surveillance Estimates

- ~450 deaths annually (1999 – 2004)
- >4,000 hospitalizations (2005)
- >20,000 ED visits (2007)
- ~30% with working CO alarms (2007)
Surveillance Data Sources

- Deaths
- Hospitalizations
- ED visits
- Outpatient and physician’s office visits
- Exposures (Fire department, EMS, Poison control centers)
- Health behaviors (e.g., generator use, CO detector use)

- National Vital statistics System
- HCUP National Inpatient Sample (NIS)
- HCUP National Emergency Department Sample (NEDS)
- National Poison Data System (NPDS)
- NHIS, BRFSS, AHS
Surveillance Data Sources in Disasters

- Deaths: Coroner’s office
- Hospitalizations: Hyperbaric oxygen treatment facilities, Hospital association
- ED visits: Hospital association, Dept. of Public Health
- Outpatient and physician’s office visits
- Fire department, EMS, Poison control centers: Poison control center, Fire department, EMS data
- Health behaviors (e.g., generator use, CO detector use): Needs assessment
<table>
<thead>
<tr>
<th>Event</th>
<th>Exposures</th>
<th>Persons</th>
<th>Source of CO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ice storm NC 2002</td>
<td>176</td>
<td>176 (1 death, 3 Hosp, 173 ED)</td>
<td>Another report: 7 deaths and 48 cases, 17 from charcoal fire/indoor grill</td>
</tr>
<tr>
<td>4 major hurricanes FL 2004</td>
<td>51</td>
<td>167 (6 deaths, 77 HBOT, 13 Hosp, 81 ED)</td>
<td>Generator 96% (5 out of 6 deaths)</td>
</tr>
<tr>
<td>Hurricanes Katrina &amp; Rita AL, TX 2005</td>
<td>27</td>
<td>88 (10 death, 24 HBOT, 10 hosp., 44 ED)</td>
<td>Generator 93% (3 out of 4 deaths)</td>
</tr>
<tr>
<td>Hurricane Ike TX 2008</td>
<td></td>
<td>7 deaths 58 – PCC 34 – HBOT</td>
<td>Generators &gt;82% of all exposures; Majority were residential exposures</td>
</tr>
</tbody>
</table>
FIGURE 1. Number of cases of fatal (n = six) and nonfatal (n = 167) carbon monoxide poisoning, by date of exposure — Florida, August–September 2004

* Landfall dates for Hurricanes Charley (August 13), Frances (September 5), Ivan (September 16), and Jeanne (September 25), respectively.
Carbon monoxide exposures in the wake of Hurricane Ike by date and data source--September 2008*

* Counts should not be summed as cases from various data sources were not reconciled.
Figure 1. Number of reported carbon monoxide cases — Kentucky, January 26–February 14, 2009

- Deaths
- Non-Fatal, Confirmed
- Non-Fatal, Probable

January 26–February 14

Number of Case Reports
FIGURE 2. Emergency Department visits for carbon monoxide (CO) poisoning, with power outages and mean daily temperature — Kentucky, January 26–February 14, 2009

Lutterloh et al (in prep.)
CO Poisoning During Disasters

- Leading cause of morbidity and mortality

- Common sources (excluding motor vehicles):
  - Gasoline-powered generators
  - Charcoal grill/briquette
  - Kerosene heater
  - Pressure washer
  - Gas stove

- Pre-disaster communication is critical
Communication Media: Pre and Post Disaster

- **Traditional**
  - TV, Radio, Newspaper (e.g., IA flood)
  - Websites, email list serve
  - Pamphlet / flyers
  - Occupational groups, community organizations

- **Electronic social media**
  - Text messages (e.g. KY ice storm)
  - Facebook
  - Twitter
Perception: “I am not dead yet.”

- **2005 & 2006 HealthStyles survey:**
  - ~50% - Okay to run generators in basement with window open or in garage with doors open
  - Most believed – Do not require a CO detector with a new furnace or while running a generator
  - >50% did not have a CO detector
  - Most believed – Annual inspections of heating system is important

- <2% of population in FL considered CO poisoning to be a serious health risk after 4 major hurricanes in 2004
Health Behavior Data

- Working CO detectors at home: ~30%
  - More in owner-occupied (37%) vs. renter-occupied (22%) and in newer houses (33%)

- Use of generators after disasters: 18%–31%
Prevention

- Primary prevention
  - Maintenance of home heating systems
  - Proper placement of generators

- Secondary prevention
  - Installation of battery-operated or battery back-up CO detectors
Prevention Strategies

- Education and communication
  - Season, region, weather event, target population

- Product safety regulations
  - More conspicuous public health messages on generators
  - CO detectors provided with generator purchase

- Engineering solutions
  - Auto shut-off, higher combustion, weatherization, etc.

- CO detector legislation
  - Example: Mecklenburg County, NC
Recommendations

Findings from recent studies

- Generator placement
  - CO exposure even when placed 25 ft away
  - Depends on wind direction and other factors

- Adherence to CO detector ordinance
  - 67% reported having working CO detector at home in Mecklenburg County, NC

Other CDC recommendations

- Website: www.cdc.gov/co
Contacts:

- Shahed Iqbal: Siqbal@cdc.gov
- Fuyuen Yip: FYip@cdc.gov
- Jackie Clower: JClower@cdc.gov
- Scott Damon: SDamon@cdc.gov

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Disclaimer: “The findings & conclusions in this presentation are those of the author(s) & do not necessarily represent the official position of the Centers for Disease Control & Prevention (CDC).”