

Carbon Monoxide Poisoning Prevention: New Approaches

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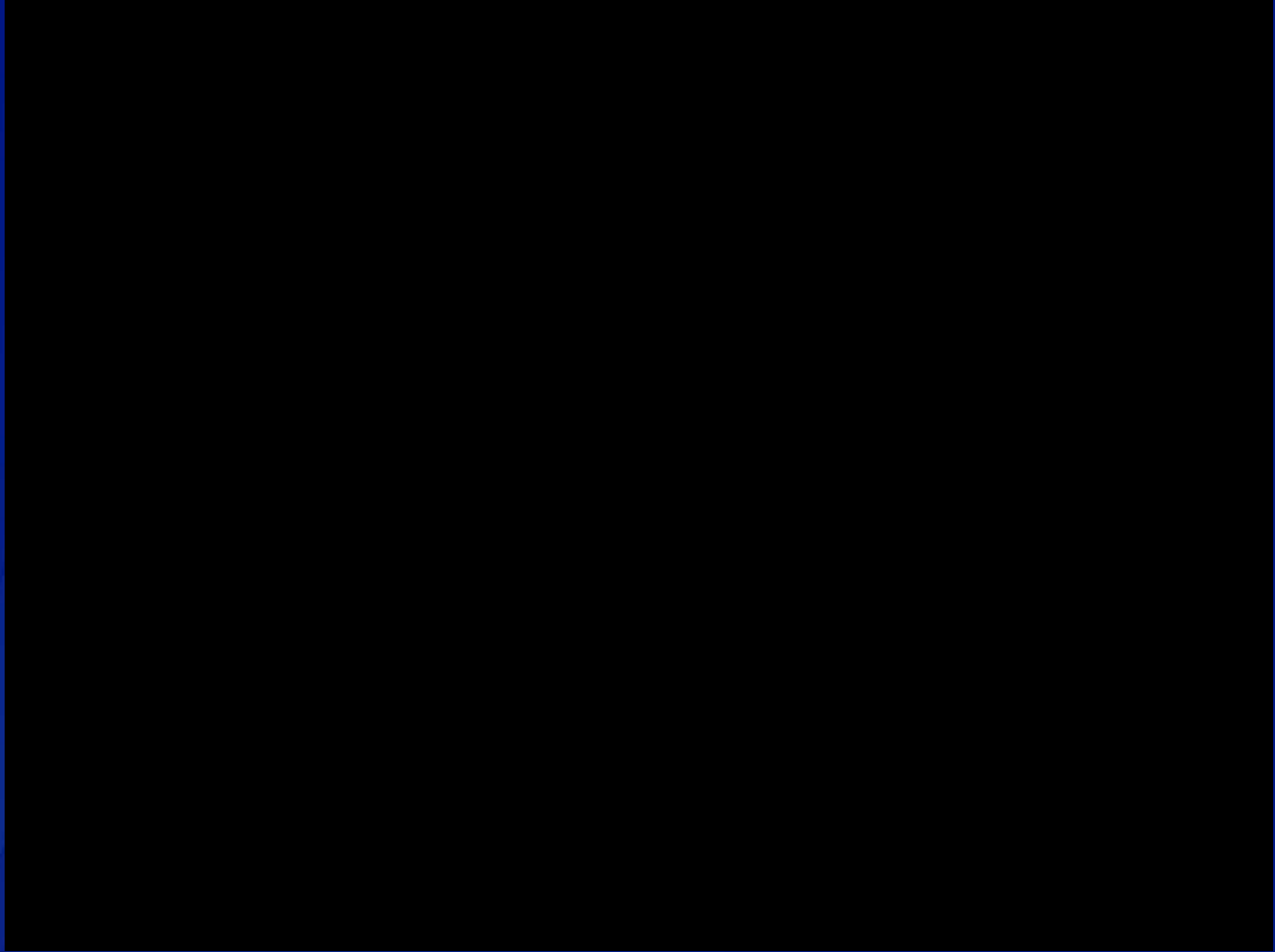


Presenter Disclosures

Scott A. Damon


The following personal financial relationships with commercial interests relevant to this presentation existed during the past 12 months:


No relationships to disclose





Carbon Monoxide Poisoning Prevention: New Approaches


**CARBON MONOXIDE (CO)
POISONING**

 **CAN'T BE SEEN**

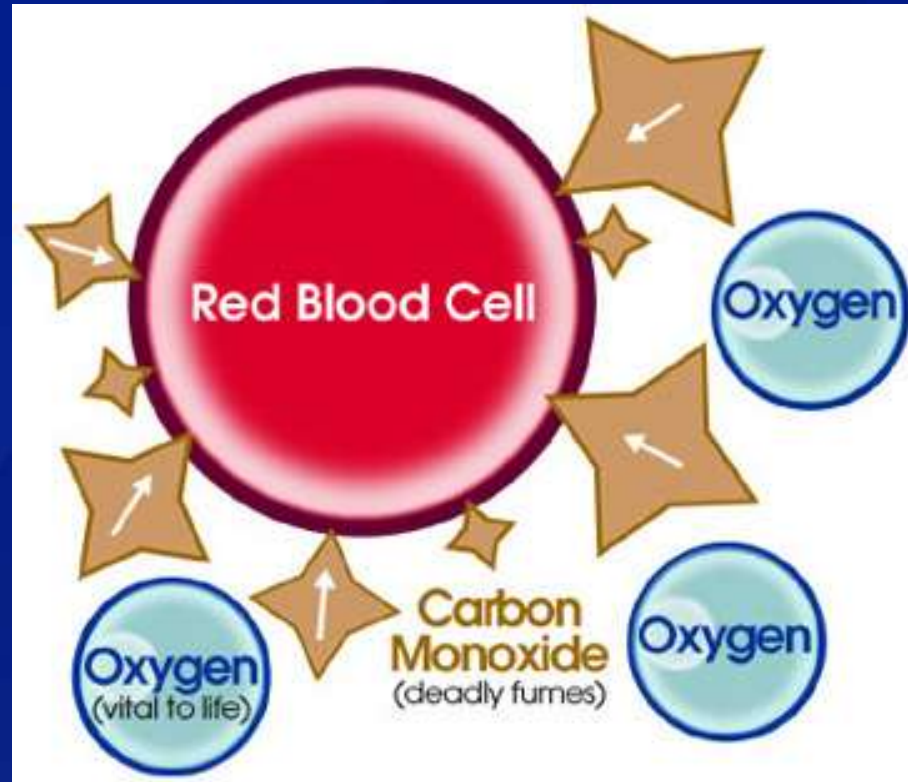
 **CAN'T BE SMELLED**

 **CAN'T BE HEARD**

 **CAN BE STOPPED**

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So What is CO Poisoning?



Why is CO Poisoning Important?

Leading cause of non-drug poisoning deaths **every year** in the U.S.

- ~450 deaths
- over 20,000 individual ER visits

How Does CO Poisoning Occur?

- Summer Storm Poisonings
- Winter Storm Poisonings
- Non-storm poisoning

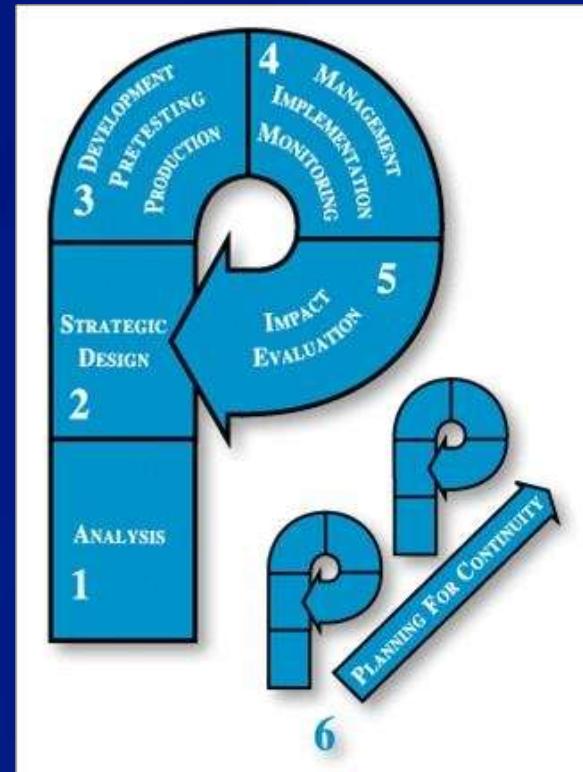
Primary & Secondary Prevention

CO Poisoning can be prevented by:

- Having gas- and oil-burning appliances regularly inspected and maintained
- Keeping portable generators more than 20 feet from the home
- Installing battery-operated CO detectors in the home

Research Methodology

- Summer Storm Focus Groups
- Winter Storm Focus Groups
- Nonemergency residential poisonings
- Data Analysis
- Prototype design
- Field testing



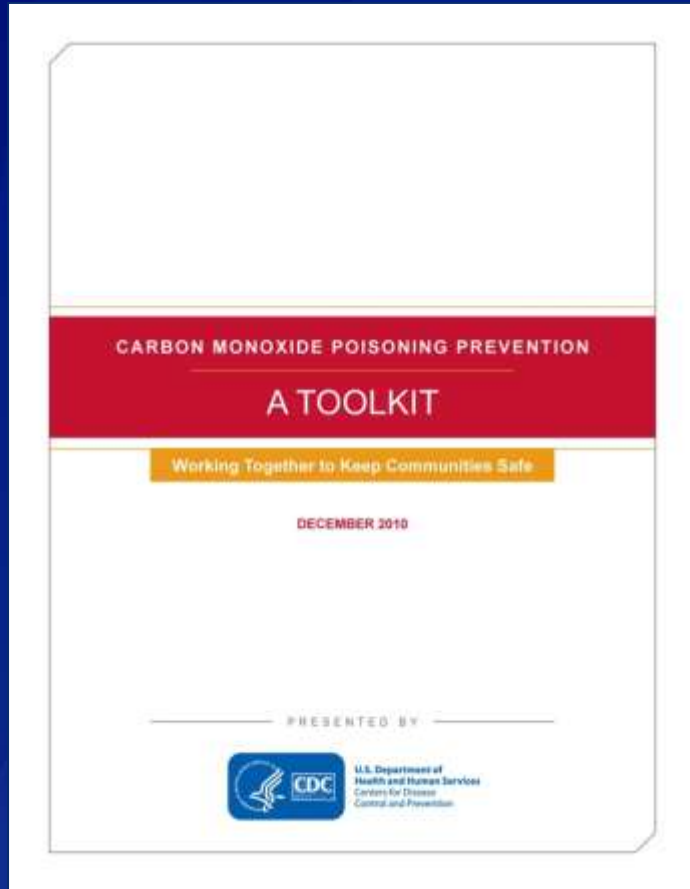
Findings: Lack of Awareness of CO Sources and Detectors

- Many do not consider themselves at risk.
- Homeowners service their furnaces sporadically; few have annual inspection/ maintenance contracts.
- Many portable generator owners place their generators in enclosed spaces.
- Most are unsure where to place CO detectors or how many they should install.
- Most change batteries “when a detector chirps” rather than every 6 months.

More Findings




Toolkit Contents



- CO Poisoning Scenarios and At-Risk Populations
- Formative Research on Residential CO Poisonings
- Formative Research on Summer Storm CO Poisonings
- Formative Research on Winter Storm CO Poisonings
- Field Test/Focus Group Findings with Homeowners

Easy to Use Materials



WHEN THE POWER GOES OUT, KEEP YOUR GENERATOR OUTSIDE

Portable back-up generators produce the carbon gas carbon monoxide (CO). CO is an odorless, colorless gas that kills without warning. It claims the lives of hundreds of people every year and makes thousands more ill. Follow these steps to help your family safe.

PORTABLE GENERATORS

- Never use a generator inside your home or garage, even if doors and windows are open.
- Only use generators outside, more than 20 feet away from your home, doors, and windows.

CO DETECTORS

- Install battery-operated CO detectors near every sleeping area in your home.
- Check CO detectors regularly to be sure they are functioning properly.


CARBON MONOXIDE (CO) POISONING




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DANGER!

CARBON MONOXIDE (CO) POISONING



Carbon monoxide (CO) is an odorless, colorless gas that kills without warning. It claims the lives of hundreds of people every year and makes thousands more ill. Many household items including gas- and oil-burning furnaces, portable generators, and charcoal grills produce the carbon gas. Following these important steps can help your family safe.

CO DETECTORS


- Install battery-operated CO detectors near every sleeping area in your home.
- Check CO detectors regularly to be sure they are functioning properly.

OIL & GAS FURNACES

- Have your furnace inspected every year.

PORTABLE GENERATORS

- Never use a generator inside your home or garage, even if doors and windows are open.
- Only use generators outside, more than 20 feet away from your home, doors, and windows.



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PROTECT YOUR FAMILY

CARBON MONOXIDE (CO) CAN BE DEADLY



PROTECT YOUR FAMILY. INSTALL A CO GAS DETECTOR.

www.cdc.gov/co

CARBON MONOXIDE (CO) POISONING




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PROTECT YOUR FAMILY FROM CARBON MONOXIDE POISONING WHILE YOU PROTECT THEM FROM THE COLD.

CARBON MONOXIDE (CO) POISONING



Carbon monoxide (CO) is an odorless, colorless gas that kills without warning. It's produced by gas- and oil-burning furnaces. Keep your family safe by following these steps:

- Install battery-operated CO detectors near every sleeping area.
- Check CO detectors regularly to be sure they are functioning properly and
- Have your furnace inspected every year.



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WHEN YOUR FURNACE KICKS ON, BE SURE POISON GAS ISN'T COMING OUT



Gas- and oil-burning furnaces produce carbon monoxide (CO), an odorless, colorless, poison gas that kills without warning. It's produced by gas- and oil-burning furnaces. Keep your family safe by following these steps:

- Have your furnace inspected every year.
- Install battery-operated CO detectors near every sleeping area in your home.
- Check CO detectors regularly to be sure they are functioning properly.

CARBON MONOXIDE (CO) POISONING




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Strategies

- Media Engagement
- Partnership Expansion

Building Partnerships



Please join us

- ❑ scd3@cdc.gov
- ❑ **To download materials:**
 - Go to: <ftp://sftp.cdc.gov/>
 - User name = co-ed
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Residential Carbon Monoxide Alarm Ordinance Awareness and Alarm Prevalence



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National Healthy Homes Conference, Denver, CO

June 22, 2011

Presentation Outline

- ❑ **Introduction: Carbon Monoxide (CO)**
- ❑ **Pathophysiology & Health Effects**
- ❑ **Epidemiology**
- ❑ **Background & Timeline**
- ❑ **Methods**
- ❑ **Results**
- ❑ **Conclusions**
- ❑ **Future Steps**

Carbon Monoxide (CO)

- ❑ Colorless, odorless gas**

- ❑ Produced due to incomplete combustion of hydrocarbons**

- ❑ Non-occupational sources include:**
 - Heating and cooking appliance**
 - 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 (e.g., brain, heart)**

Health Effects

- ❑ **Non-specific symptoms (e.g., fatigue, dizziness, headache, confusion, nausea)**
- ❑ **Coma, cardio-respiratory failure, and death**
- ❑ **15–49% develop neuro-cognitive sequelae**

Epidemiology: Unintentional, non-fire-related exposures

❑ Mortality & Morbidity

- >20,000 Emergency Department visits
- >2,000 hospitalizations
- ~450 deaths

❑ Exposures

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

❑ Season: Winter

❑ Region: Midwest, Northeast

❑ 'Outbreaks': Natural disasters



Most cases occur in residential settings and are preventable with installation of CO alarms

**CO ALARM PREVALENCE STUDY,
MECKLENBURG COUNTY (MC), NC**

Background & Timeline

□ June 24, 1999

- Car left running in the garage of a condominium
- Two residents, two neighbors dead; 3 more fell sick
- No code violations
- Stakeholders included County Health Department, Fire Department, Building Development Commission

□ September 6, 2000: County-wide CO alarm ordinance passed (65% MC homes included)

□ January 1, 2004: Ordinance amended to include all homes

□ March, 2009: MC Health Department – CDC Survey

Objective

To determine whether awareness of the CO alarm ordinance was associated with having an alarm at home

Survey Design

- ❑ **A stratified random sample of 1200 addresses drawn**
 - Mecklenburg County Master Address Table
 - Stratified by housing type (i.e., single-family, multi-family, condominiums)
 - Sampled addresses proportional to overall housing type distribution in county
- ❑ **Eight to 11 two-member teams visited the homes**
- ❑ **Survey conducted from March 7 to 14, 2009**

Data Collection

- ❑ **44-item questionnaire administered**
- ❑ **One adult (≥ 18 years) respondent from each household**
- ❑ **Data collected on:**
 - Sociodemographic characteristics (e.g., age, sex, race, education)
 - Household characteristics (e.g., household members, home construction year, homeownership status)
 - CO exposure sources (e.g., home heating systems, use of generators, charcoal grills)
 - CO alarm characteristics (e.g., presence and number of alarms, year alarm obtained)
 - Alarm ordinance awareness

Table 1 : Summary of recruitment of households (N=1,146)

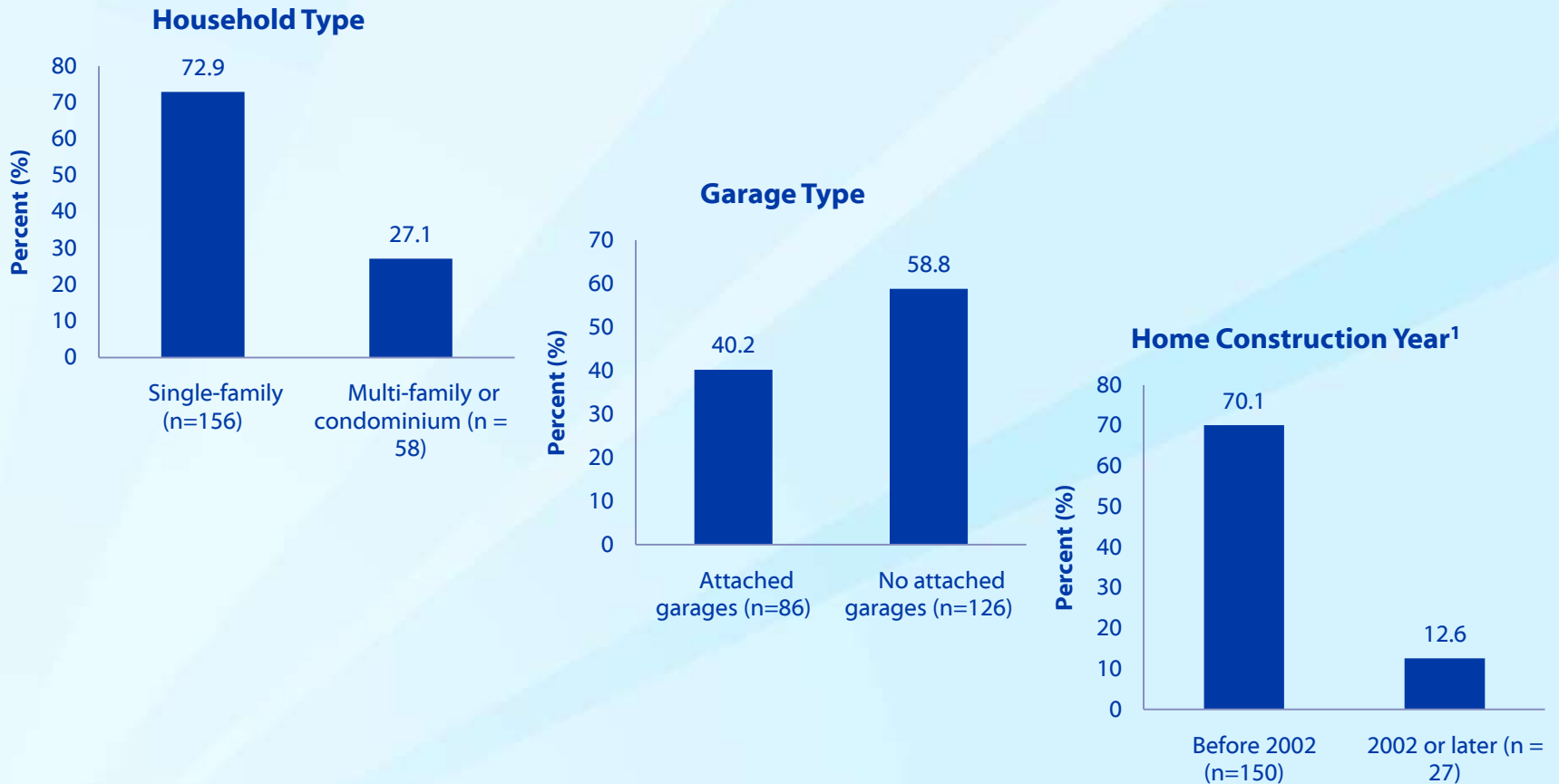
| Recruitment characteristics | n | % |
|--|-----|-------|
| Total valid addresses | 914 | 100.0 |
| Total completed interview | 214 | 23.4 |
| Total partial interview or refusal | 131 | 14.3 |
| No one home | 485 | 53.1 |
| House inaccessible, no adults present, language barrier, missing information | 84 | 9.3 |

Table 2: Sociodemographic characteristics of survey respondents (N=214)

| Variable | n | % |
|----------------------------------|-----|------|
| Age | | |
| <45 years | 93 | 42.5 |
| ≥45 years | 119 | 55.6 |
| Sex, male | 95 | 44.4 |
| Race | | |
| White | 126 | 58.9 |
| Black | 63 | 29.4 |
| Other race | 15 | 11.7 |
| Education | | |
| High school graduate or less | 52 | 24.3 |
| Some college or higher education | 159 | 74.3 |
| Homeowners | 148 | 69.2 |

*Column percentages do not always add up to 100% because missing values (including don't know and refused) totaling <3% are not reported

Figure 1: Household characteristics of survey respondents (N=214)



¹ Don't know , refused, or missing =17.3%;

*Percentages do not always add up to 100% because missing values (including don't know and refused) totaling <3% are not reported

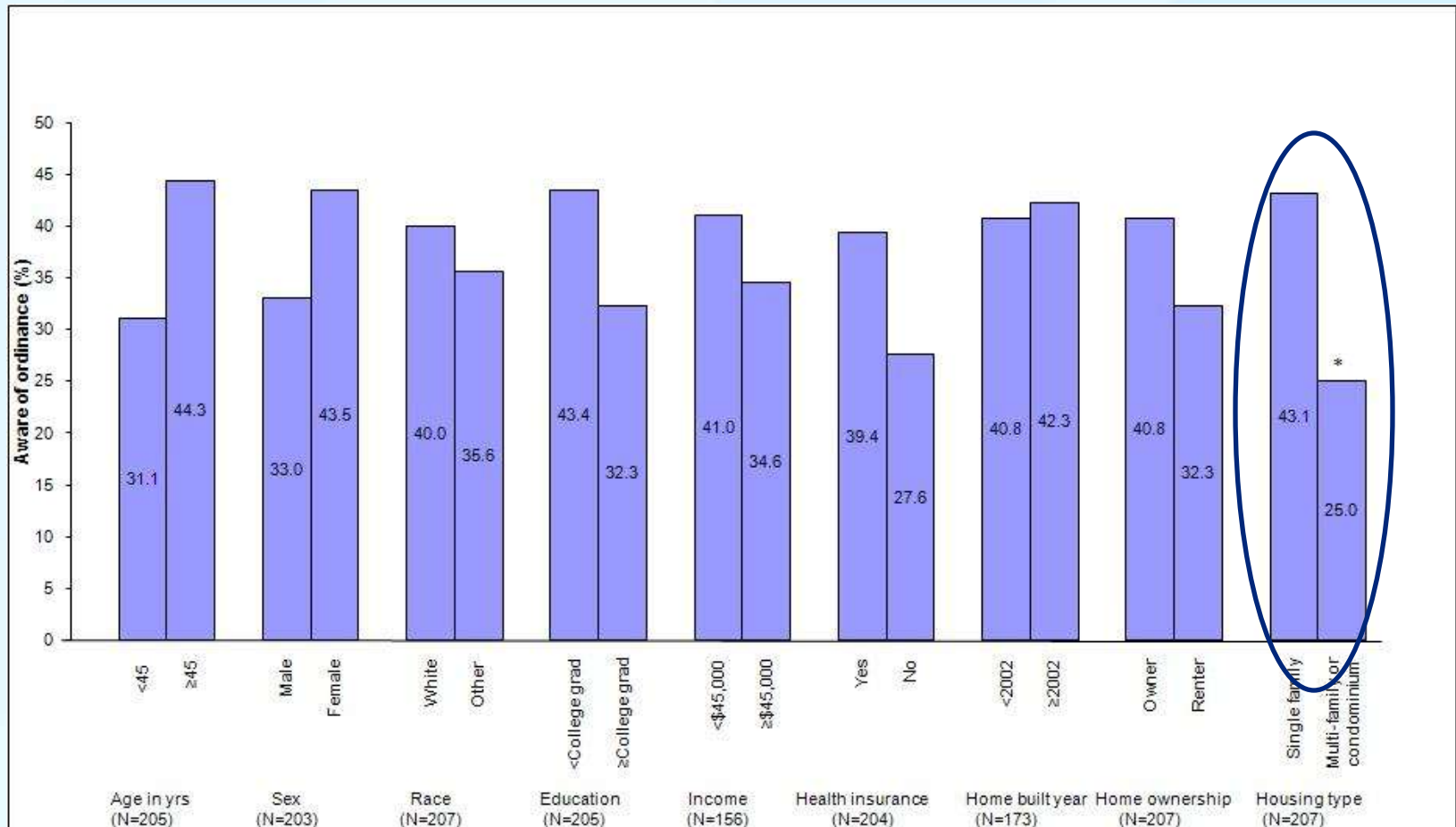
Table 3: Alarm ordinance and alarm characteristics (N=214)

| Variable | n | % |
|--|-----|------|
| Aware of CO alarm ordinance | 79 | 36.9 |
| At least one working CO alarm present | 145 | 67.8 |
| Year alarm installed (N=145) ¹ | | |
| Before 2002 | 43 | 29.7 |
| 2002 or later | 64 | 44.1 |
| How alarm obtained (N=145) | | |
| Bought alarm | 69 | 47.6 |
| Alarm came with the house or given by landlord | 67 | 46.2 |
| CO alarm working on visual inspection (N = 93) | 70 | 75.3 |

¹Don't know or missing=26.2%;

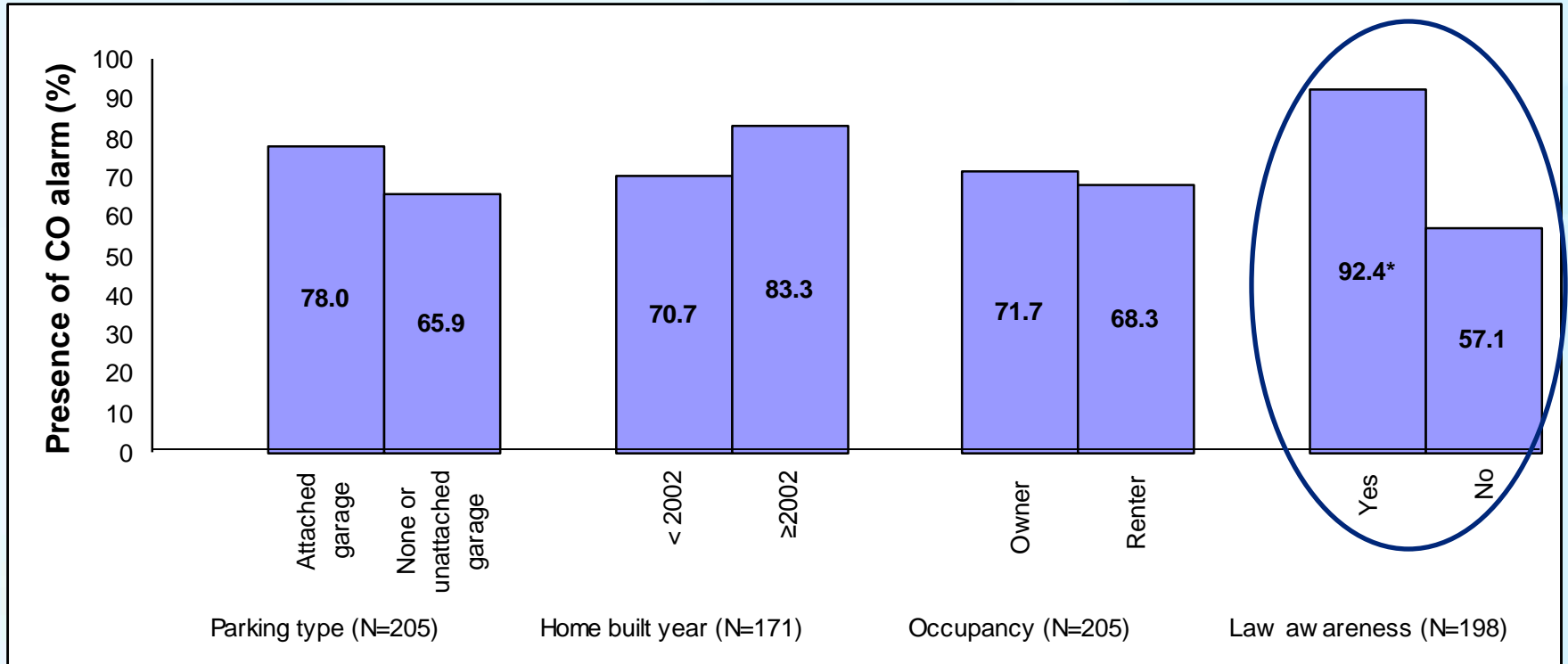
*Columns percentages do not always add up to 100% because missing values (including don't know and refused) totaling <3% are not reported

Figure 2: Alarm ordinance awareness by select characteristics



*Statistically significant (p < 0.05)

Figure 3: Presence of CO alarm by parking structure type, house built year, occupancy, and alarm ordinance awareness



*Statistically significant (p < 0.05)

Table 4: Adjusted associations between CO alarm presence and select (N=214)¹

| Variable | Odds Ratio (95% CI) |
|------------------------------|----------------------|
| Attached garage | |
| No | 1.00 |
| Yes | 2.51 (1.02, 6.15)* |
| Home built year | |
| Before 2002 | 1.00 |
| 2002 or later | 2.20 (0.58, 8.38) |
| CO alarm ordinance awareness | |
| No | 1.00 |
| Yes | 9.21 (3.27, 25.90)** |

¹Adjusted for age, sex, homeownership status; *p-value <0.05; **p-value <0.0001; CI = Confidence Interval

Strengths and Limitations

□ Strengths

- First study to evaluate a residential CO alarm ordinance
- Respondents represented MC population well
- Data collected on wide range of relevant variables
- Robust statistical methodology used

□ Limitations

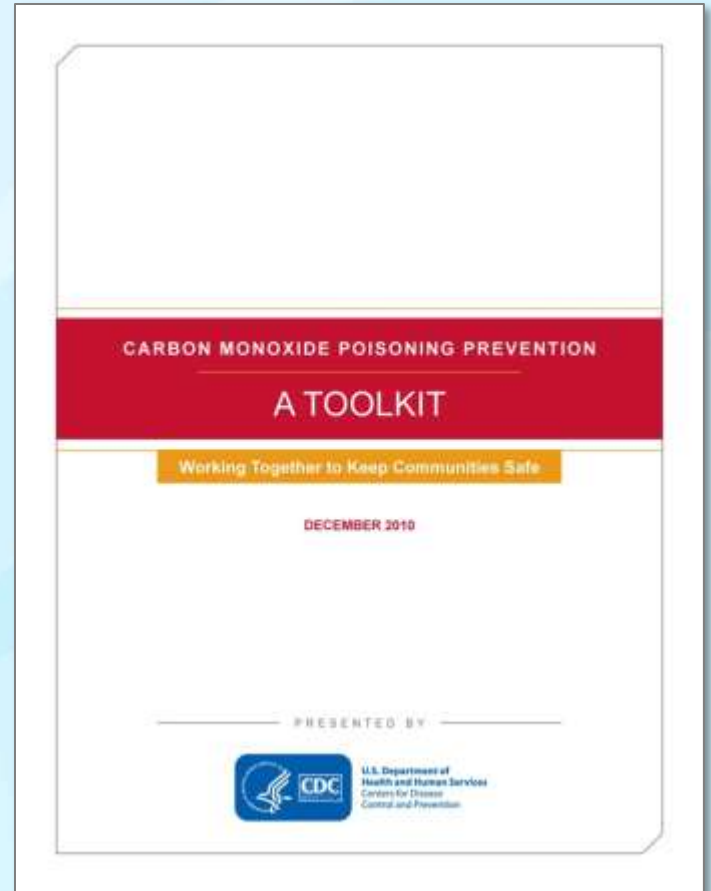
- Low response rate (23.4%)
- Cross-sectional data
- Population sensitivity to adverse CO-related events

Conclusions

- ❑ **Prevalence of residential CO alarms higher than reported national estimates (68% vs. ~30%)**
- ❑ **Homes with attached garages and homes where respondents were aware of the ordinance were more likely to have CO alarms**
- ❑ **Education and outreach needed to increase awareness**
- ❑ **Partnership among stakeholders needed for wider enforcement**
- ❑ **MC example can be followed for enactment and enforcement of similar ordinances at local levels**

Future Steps

- ❑ **Effectiveness study in terms of CO-related mortality and morbidity at local and national level**
- ❑ **Expand CDC-Stakeholders partnership**
- ❑ **Continued effort on population level education and awareness**



Thank you

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The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.



Table : Mecklenburg County CO alarm ordinance description and dates

| Date effective | Description |
|-------------------------------|--|
| <p>January 1, 2001</p> | <p>Owner-occupied homes (with attached garage, fossil fuel burning appliance or fireplace) – Required alarm by January 1, 2001 but ordinance not enforced until July 2001</p> <p>Rental dwelling units (attached garage, fossil fuel burning appliance or fireplace) – CO alarm must be installed by January 1, 2002 for any new rental lease agreement signed after December 31, 2001</p> <p>New construction (attached garage) – New construction of homes with permits issued after January 1, 2001 must have CO alarm installed to obtain certificate of occupancy</p> |
| <p>January 1, 2004</p> | <p>All existing dwelling units including rental dwelling units and units to be constructed, regardless of the source of energy, and regardless of whether the dwelling unit has an attached garage, should have at least one operable CO alarm that is battery-powered or is AC powered with battery-back up installed in accordance with the manufacturer’s recommendation.</p> <p><u>Note:</u> The ordinance went into enforcement since July 1, 2004. For any new rental units, the enforcement date was January 1, 2005</p> |

Table : Comparison of distribution of survey households with Mecklenburg County households by housing type

| Housing type | Mecklenburg County n (%) | Survey n (%) |
|--------------------|-----------------------------|--------------------|
| Single family | 256,981 (63.2) | 156 (72.9) |
| Multi-unit housing | 120,597 (29.7) | 44 (20.6) |
| Condominium | 28,692 (7.1) | 14 (6.5) |
| Total | 406,270 (100.0) | 214 (100.0) |

Table : Sociodemographic characteristics comparison between survey respondents and Mecklenburg County population

| Characteristics | Mecklenburg County* | Survey |
|---|--------------------------------|---------------|
| White race | 60.4% | 58.9% |
| Black race | 29.3% | 29.4% |
| Other race including multi-racial | 10.3% | 11.7% |
| High school graduates for age 18+ years | 88.3% | 94.9% |
| Homeownership | 63.8% | 69.2% |

* U.S. Census Bureau: 2006-2008 American Community Survey 3-year estimates. (www.census.gov)