Building a Tracking System for Carbon Monoxide Poisoning; A Public-private Partnership to Link Health and Environmental Data

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Outline

- Background
  - Carbon monoxide as a EPHT indictor
- Building an EPHT system for unintentional CO poisoning
    - Health outcome indicators
    - Hazard indicators
    - Linkage indicators
    - Intervention indicators

Carbon Monoxide as an EPH Indicator

Ideal attributes of an EPHI:

- Measurable
- Trackable over time
- Incorporated in clear-case definitions
- Based on demonstrated links between environment and health
- Useful and understood by diverse populations
- Informative to the public and to responsible agencies
- Action-oriented
- Tied to public health objectives

Communication to Stakeholders Health Outcome Indicators:

- Annual number and incidence of CO poisonings among Maine residents

- Annual number and incidence of occupationally-related CO poisonings among Maine residents

Health Outcome Indicators: Data

Maine hospital visits data:

- All hospital records collected electronically:
  - Legislative mandate (VA exempt)

- What data:
  - Hospital discharge – since 1990
  - Out-patient visits – since 1998
  - ED – since 2000
    - Subset hospital discharge + outpatient

Maine Hospital Visits Data

Great data source – some issues:

- Comparability with other states
  - 90% states have discharge data
  - 50% of states have ED data
- Coding validity
- No patients identifiers
  - Can’t do case follow-up
  - Zip code-level only
- Has a ‘scrambled’ medical record number
  - Can see multiple visits at the same facility

Maine Hospital Visits Data

Begun initial assessment to answer:

- Can we monitor the occurrence?
- Can we detect exposure events?
  - What magnitude? What types?
- Can we assess trends?
- Can we identify/track risk factors through data linkage

Case definition: Unintentional, Non-fire related CO Poisoning

CSTE Case Definition:

- Included
  - Confirmed and probable cases
  - Maine residents

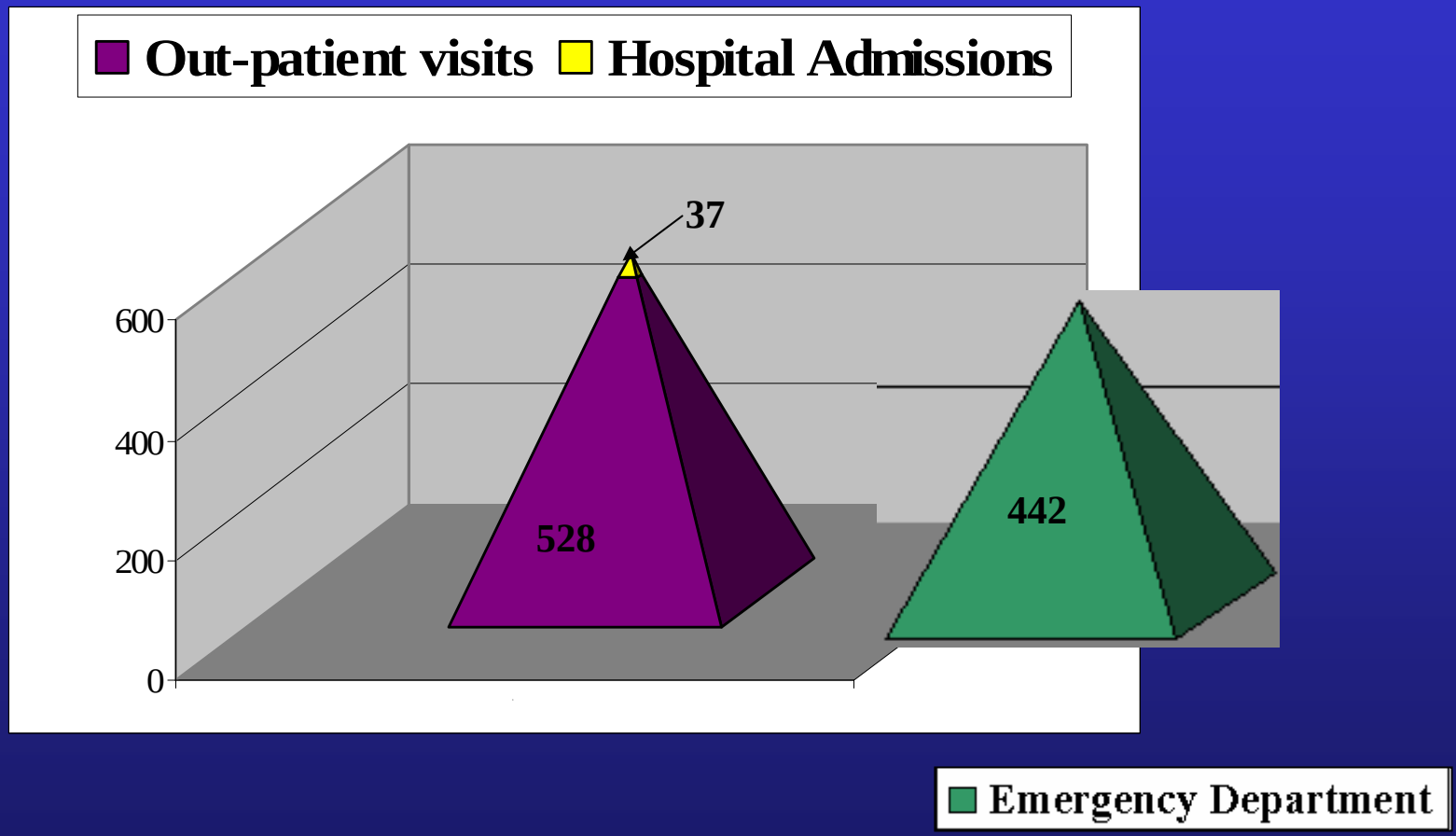
- Excluded any records with mention E-codes* for:
  - Suicide or self-afflicted injury (E950-E959)
  - Assault by poisoning (E962.2)
  - Accidents caused by fire or flames (E890-899)

*E code = external cause of injury

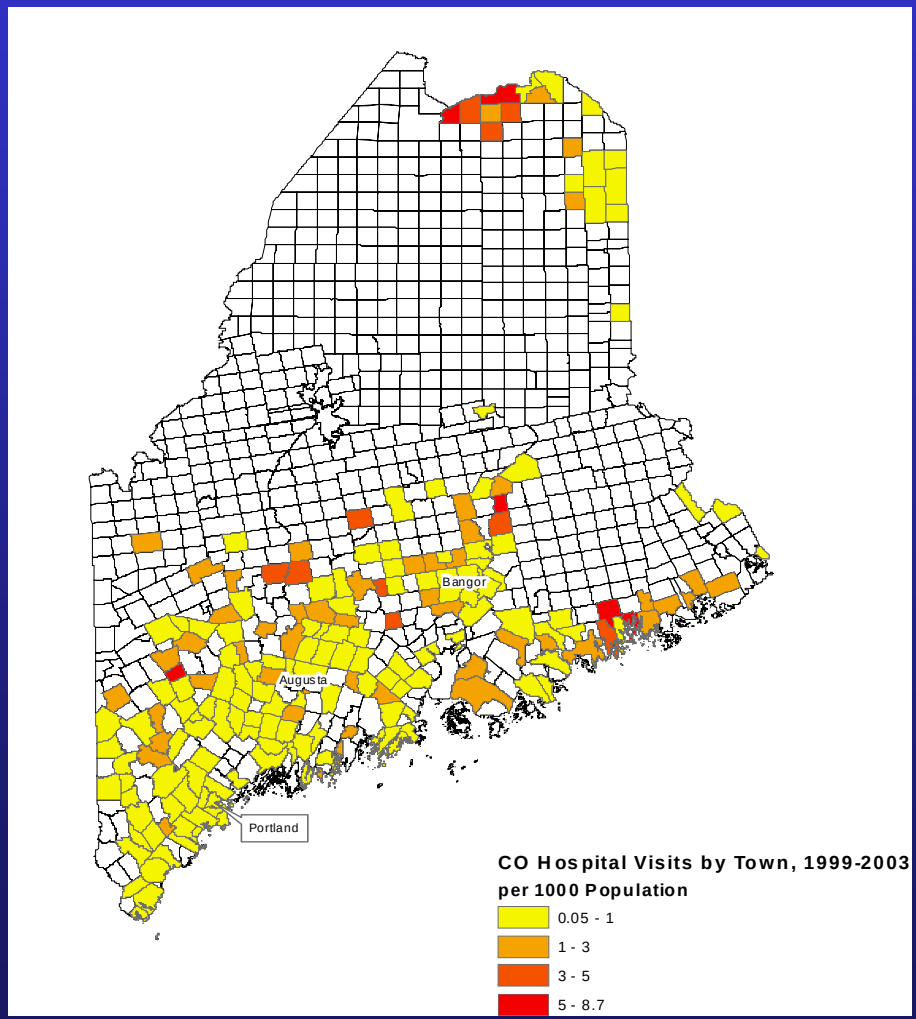
Unintentional, Non-fire Related CO Poisoning; Maine Hospital Visits Data

YEAR	*Out-patient Visits*	*Hospital Discharge*	2000-2002 *ED Visits*
1998	414 (37.4%)	19 (28.8%)	
1999	165 (14.9%)	10 (15.2%)	
2000	134 (12.1%)	6 (9.1%)	107 (24.2%)
2001	150 (13.6%)	11 (16.7%)	129 (29.2%)
2002	110 (9.9%)	6 (9.1%)	97 (21.9%)
2003	134 (12.1%)	14 (21.2%)	109 (24.7%)
Total	1107	66	442

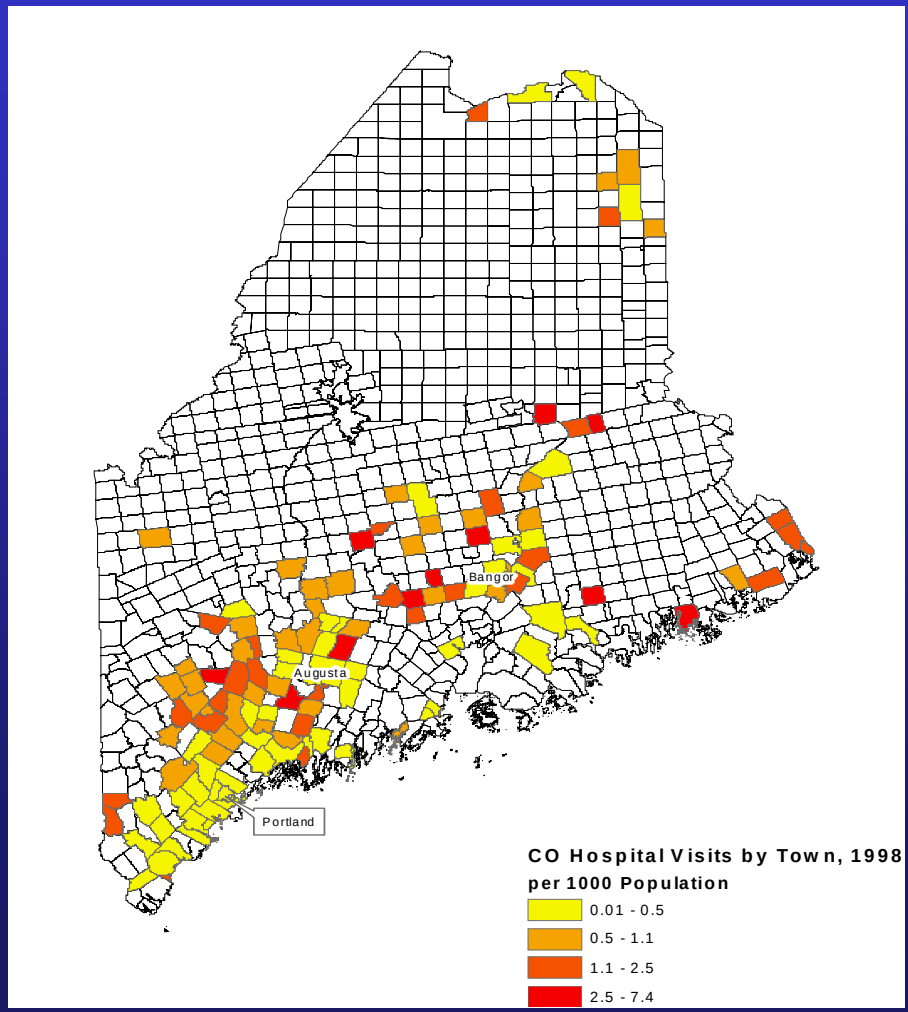
Contribution of Hospital-visits Data Sets to Capturing CO Poisoning:2000-2003



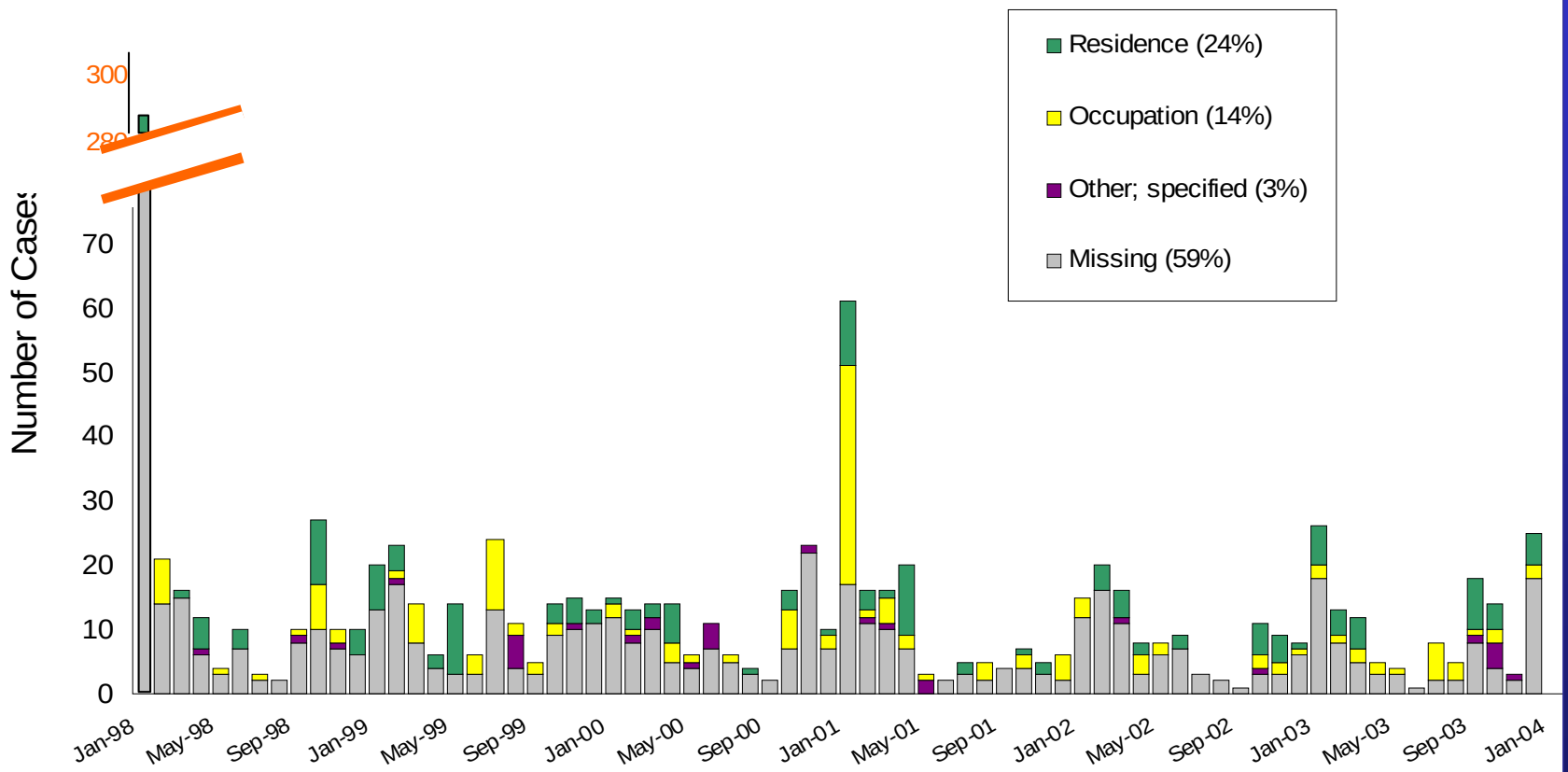
Maine Outpatient Data; 1998 –2003
CO Poisoning/1,000



Maine Outpatient Data; 1998
CO Poisoning/1,000



Out-patient Visits for CO Poisoning* by Type of Occurrence**; Maine 1998 - 2003; (N = 1107)



*Defined by E-code for "Place of occurrence" and payer code for "Worker's compensation“

** 1998 CSTE case definition; Confirmed and probably cases; excluding intentional and fire-related cases

ED Visits for CO Poisoning Comparison With National Data

US*	
Age Group	*Rate per 100,000*
0-4	8.2
5-14	5.7
15-24	6.1
25-34	6.9
45-54	5.3
55-64	4.2
65+	3.5
SEX	
Male	5.0
Female	5.6
Total	5.3

Maine	
Age Group	*Rate per 100,000*
0-17	6.6
18-34	14.1
35-64	8.7
65+	3.3
TOTAL	8.6
SEX	
Male	9.3
Female	7.8
Total	8.6

*CDC. Unintentional non-fire-related carbon monoxide exposures – United States, 2001-2002 MMWR: Jan.21 2005 / 54(02);36-39

E-code* and Payer Code Information

Place of occurrence** / Worker's Compensation		
	Out-patient Visits	Hospital Discharge
Residence	264 (23.8%)	21 (31.8%)
Work	156 (14.1%)	6 (9.1%)
Other (Specified)	33 (3.0%)	3 (4.5%)
Missing	654 (59.1%)	36 (54.5%)
Total	1107	66

*E code = external cause of injury

*Defined by E-code for "place of occurrence and payer code for "Worker's Compensation"

CO Poisoning; Out-patient Data Analysis

SEX	Ice Storm (1/7/98- 2/6/98)	All other dates 1998-2003	P-Value
Female	181 (61.6%)	368 (45.3%)	
Male	113 (38.4%)	445 (54.7%)	
Total	294	813	<0.001

Health Outcome Data: Initial Impressions

- Sufficient numbers to track over time
- See expected periodicity
- Can detect specific exposure events
- Can discern some information about type and place of exposure event

Hazard Indicators

- Number and percent of CO poisoning attributable to recognized sources
  - Alternative heating sources
  - Domestic fuel
  - Car exhaust
- Number of households with a generator (generator ownership)

CO Hazard data: What do we know about Maine?

Sources of CO poisoning, ice storm in central Maine (Stringent case definition)

- 100% Alternative fuel sources
  - Generators – 74%
  - Other alternative heating source – 26%
    - Kerosene heater; charcoal grill; portable gas range; 9.3% had a CO detector at home

Daley RW, Smith AE, Paz-Argandona E et.a. An outbreak of carbon monoxide poisoning after a major ice storm in Maine. J Emergency Med. 2000;18(1):87-93

CO Hazard data: What do we know Nationally?

Unintentional non-fire-related CO exposures*:

Furnace – 18.5%	Motor vehicle – 9.1%
Generators – 2.8%	Gas water heater – 4.2%
Space heater – 1.9%	Gas line leak – 4.9%
Stove/gas range – 4.9%	Machinery – 1.5%
OTHER – 9.3%	UNKNOWN – 42.8%

- 9.3% had a CO detector at home

*CDC. Unintentional non-fire-related carbon monoxide exposures – United States, 2001-2002. MMWR: Jan.21 2005 / 54(02);36-39

Out-patient-Hospital Visits Data; Hazard Information

Description of CO-related E-codes*	
Any CO-related E-code	739 (66.8%)
E868.3 : Carbon monoxide domestic fuel	178 (16.1%)
E868.0 : Liquefied petroleum gas	35 (3.2%)
E868.1 : Other unspecified utility gas	22 (2.0%)
E868.2 : Motor vehicle gas exhaust	162 (14.6%)
E818: Motor vehicle; non-collision	16 (1.4%)
E862: Poisoning petroleum products/solvents	1 (0.1%)
E866: Poisoning other liquid/solid	1 (0.1%)
E868.8: Other carbon monoxide poisoning	176 (15.9%)
E868.9: Unspecified. carbon monoxide poisoning	183 (16.5%)

*External cause of injury (how did this happen)?

Linkage indicators

- Carbon monoxide poisonings attributable to power outages
- Number and percent of CO poisoning attributable to recognized sources during power outages

Linkage indicators: Data

- Pilot project with Central Maine Power Company
  - Cover >75% of population
  - Sophisticated IT systems
- Have met and agreed to data sharing plan
  - Data:
    - Zipcode level
    - Outage yes/no; % of units out of power
  - Received data April

Linking With Power Outage Data

Will use case-cross over analysis to describe:

- Contribution of power outages to CO poisoning
- Other risk factors
  - Size and cause of outages
  - Geographic area
  - Demographics

Intervention Indicators

- Percent of households with a CO monitor
- Percent of households with generators placed in an enclosed structure

Intervention Indicators: Data

- Developed 9-question BRFSS module
  - Generator use, placement and ownership
  - CO monitor use (national questions)
- Ran in 2004

BRFSS Results

QUESTION	N	Weighted Percent	95% CI
A carbon monoxide or CO detector checks the level of carbon monoxide in your home. It is not a smoke detector. Do you have a carbon monoxide detector in your home? (YES)	3304	36.90%	(34.9-38.9)
Is your carbon monoxide battery powered or have a battery for back-up power? (YES)	1150	84.10%	(81.6-85.5)
When was the last time you checked the batteries? (WITHIN LAST YEAR)	1135	80.10%	(77.3-82.8)

BRFSS: Generator use

- Ever use a generator during a power outage?

  25.1% *(95% CI: 23.2-26.9)*

- Respondent characteristics; those **more** likely:
  - Annual household income >$50,000 (P =<0.0001)
  - Male head of HH (P =<0.0001)
  - Higher educational level; college grad. (P = 0.002)
  - Married (P = 0.01)
  - Male (P = 0.04)
  - Younger age; 18-34 (P = 0.0361)

BRFSS: Generator use

Where was the generator usually placed when it is running?

- Women were more likely to report running a generator in an attached or detached structure then men (P= <0.0206)
- Especially during rain or snow (P= <0.0001)

CO Poisoning; Out-patient Data Analysis

SEX	Ice Storm (1/7/98- 2/6/98)	All other dates 1998-2003	P-Value
Female	181 (61.6%)	368 (45.3%)	
Male	113 (38.4%)	445 (54.7%)	
Total	294	813	<0.001

Conclusion

- Feasible to build a CO surveillance system in EPHT based on ED or outpatient data
  - Core indicators
  - Include data linkage to increase understanding between environment and health outcomes
  - State/regional-specific information has value
- Communication
  - Requires ongoing input/feedback from stakeholders

CSTE Case definition; 1998 Carbon Monoxide Poisoning

Confirmed Case; any mention:

- Principle diagnosis of CO poisoning (N-986):

  OR

- E-code, indicating exposure to carbon monoxide (exclusively) is listed,
  E868.3, E868.8, E868.9, E952.1, or E982.1.

Probable Case; any mention:

E-code indicating acute carbon monoxide poisoning inferred from motor vehicle exhaust gas exposure
E868.2, E952.0, or E982.0.

BRFSS: CO detector in household

Respondent characteristics; Those **less** likely

Strongly associated; P =<0.0001

- Older age; 65+
- Lower household income; <$50,000;
- No children in the household
- Female head of household
- Not married or living as a couple

Borderline association (P-value approx 0.05)

- Lack of any health care coverage
- Lower educational level (< H.S.)

CO Poisoning; Out-patient Data Analysis

AGE GROUP	Ice Storm (1/7/98- 2/6/98)	All other dates 1998-2003	P-Value
0-17	67 (22.8%)	169 (20.8%)	
18-34	73 (24.8%)	279 (34.3%)	
35-64	119 (40.5%)	331 (40.7%)	
65+	35 (11.9%)	34 (4.2%)	
Total	294	813	0.03

Out-patient-Hospital Visits Data; Hazard Information

E-CODE; ANY MENTION	Ice Storm (1/7 - 2/6/1998) N %	All other dates 1998-2003 N %	OR (95%CI)	*P-value*
Any CO-related E-code	217 73.8%	522 64.2%	1.5 *(1.2 - 2.1)*	0.003
E868.3: CO domestic fuel	82 27.9%	96 11.8%	2.9 *(2.1 - 4.0)*	<0.0001
E868.2: Motor vehicle gas exhaust	19 6.5%	143 17.6%	0.3 *(0.2 - 0.5)*	<0.0001
E818: Motor vehicle; non-collision	1 0.3%	15 1.9%	0.2 *(0.0 - 1.4)*	0.06
E868.8: Other CO poisoning	68 23.1%	108 13.3%	1.9 *(1.4 - 2.8)*	<0.0001