Cluster of Unintentional Carbon Monoxide Poisonings Presenting to the Emergency Departments in Kingston, Ontario during 'Ice Storm 98'

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Unintentional carbon monoxide (CO) poisoning is a substantial health problem.¹⁻⁵ While numbers of poisonings have been decreasing, in the United States it is a common cause of fatal injury with 800 to 1,000 cases annually.¹

CO is a colourless, odourless, toxic gas that is produced when fuel burns without sufficient oxygen.⁶ Its main sources are motors, heaters and appliances that use carbon-based fuels.⁶ Low CO levels result in non-specific symptoms including nausea, dizziness, fatigue and headache, while higher levels lead to unconsciousness, heart failure and death.

Many cases of CO poisoning occur when individuals are not aware of specific hazards.¹ These poisonings occur frequently during power outages, due to the use of alternative methods of heating and cooking.⁷⁻¹⁰

The purpose of this report is to describe a cluster of unintentional CO poisonings that presented to the two emergency departments (EDs) in Kingston, Ontario. These poisonings occurred following the severe ice storm that swept through western Québec and eastern Ontario in January 1998. This analysis demonstrates: the importance of CO poisoning as a public

health issue during power outages; and, how an injury surveillance program can be used to monitor sentinel patterns of injury at a community level.

METHODS

The Canadian Hospitals Injury Reporting and Prevention Program (CHIRPP) is an emergency room-based computerized injury surveillance program operated in sentinel Canadian hospitals. Both the Kingston General and Hotel Dieu Hospitals (Kingston) participate in this program. Records are maintained for all persons presenting for the treatment of an injury or poisoning.

Cases of carbon monoxide poisoning presenting for treatment at the two emergency departments were identified through the CHIRPP system. The individual charts were then abstracted for more detailed information. The study period spanned the time from January 7, 1998 at 12 noon (start of the ice storm) through Monday, January 19, 1998 at 2 pm (lifting of the state of emergency in Kingston). All cases were described by: age and sex; source of poisoning; carboxyhemoglobin (COHgb) level; treatment and disposition; and day of presentation. Univariate (frequencies, medians, inter-quartile ranges) and bivariate statistics (cross-tabulations, t-tests) were employed.

On several occasions, the same incident caused multiple cases of CO poisoning. Incidents and cases were described separately by source of CO poisoning, and date of presentation.

RESULTS

During the 13-day ice storm, 22 cases of CO poisoning presented to the Kingston EDs, representing 11 incidents of CO exposure (Table I). All cases presented with symptoms suggestive of CO poisoning and had measurable COHgb levels. Eight individuals (36%) arrived by ambulance.

The most common sources of CO poisoning were gas generators (n=13; 59%) followed by charcoal barbecues (n=5; 23%). The source of CO poisoning was based on the patient's self-report; there were no cases of patients reporting more than one source.

There were equal numbers of males and females affected, and this did not vary by source of exposure. The median age of those seen was 47 years (inter-quartile range: 28-67). Age varied by source of exposure with older individuals (>65) being poisoned by charcoal barbecues and kerosene heaters, and those less than 65 by generators and propane barbecues (p<0.001).

The median COHgb level for all cases combined was 15% (inter-quartile range: 2-19 %). COHgb levels varied by source of exposure (Table I) with charcoal briquettes causing the highest levels.

Most persons (n=19; 86%) were advised and/or treated with high-flow oxygen in the ED and discharged home (Table I). One individual was admitted due to a myocardial infarction, a known complication of carbon monoxide poisoning. Two were transferred to a hyperbaric chamber in Toronto for high-pressure oxygen thera-

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py. Both were exposed to CO from charcoal briquettes. High-pressure oxygen therapy was recommended to three other individuals who declined (two of these were exposed through charcoal briquettes and one through a gas generator). All of these patients recovered and were discharged home.

The majority (n=17; 77%) of the poisonings were treated between four to six days after the onset of the ice storm (Figure 1).

DISCUSSION

Unintentional CO poisonings are generally an uncommon cause for presentation to the ED in Kingston. For example, in the three years ending December 31, 1996, there were a total of 12 cases treated in the two Kingston EDs. During the ice storm crisis, 22 individuals were seen in the EDs. According to the regional coroner there was also one case of fatal unintentional CO poisoning from a gas generator. This involved an elderly gentleman who was on home oxygen for chronic obstructive pulmonary disease. Most cases seen in the ED had a relatively mild toxicity (50% had COHgb levels of < 10%) and were treated and then released. Patients exposed to fumes from charcoal briquettes had moderate to high levels of COHgb (18-36%) and required more intensive care.

Carbon monoxide poisonings are preventable and should be anticipated during power outages. The community must be informed that gas and charcoal appliances need to be used in outdoor environments only. Most individuals understand that CO is hazardous, but some do not perceive the risks associated with indoor use.¹¹ Such information should be disseminated through a variety of sources including: the media, rental companies, door-to-door canvassing, and emergency shelters.⁸ Messages need to be culturally and language sensitive.^{8,9} Further, it can be anticipated that certain appliances (particularly generators) are placed indoors to prevent these appliances from being stolen. The media and rental agencies can suggest or provide chains with locks for outdoor use. The fact that charcoal briquettes are sources of CO also needs to be communi-

TABLE I
Summary Data of Carbon Monoxide Poisonings Presenting to Emergency Departments in Kingston, Ontario, January 1998

Source	Gas Generator	Charcoal Barbeque	Propane Barbeque	Kerosene Heater	Total
Number of cases	13	5	2	2	22
Number of incidents	6	3	1	1	11
Age: median (inter-quartile range)	36 (25-54)	71 (67-71)	26 (19-33)	79 (78-80)	47 (28-67)
Sex					
male	7	2	1	1	11
female	6	3	1	1	11
COHgb level: median (inter-quartile range)	3 (2-13)	27 (19-31)	19 (18-21)	13 (11-14)	15 (2-19)
Disposition					
advice only	5	0	0	0	5
treated with follow-up as required	8	3	2	1	14
admitted	0	0	0	1	1
transferred	0	2	0	0	2

Figure 1. Number of incidents and cases per incident* of unintentional carbon monoxide poisoning following a winter storm, by day of presentation to the emergency department, Kingston, Ontario, January 1998

* Each box represents one incident. Numbers within the boxes indicate the number of people who were affected during each incident.

cated. While there are legal labelling requirements for charcoal,¹² these should be reviewed in light of the present findings: 1) the legal requirements state that the container convey that toxic fumes may occur, however, there is no mention specifically of carbon monoxide; 2) U.S. studies have shown that there is a higher risk for CO poisoning among minority (e.g., Asian) cultures;^{1,8,9} this suggests that warn-

ings may need to be produced in languages other than French and English.^{8,9} Warnings should also be required on the barbecues or grills themselves.¹³ One family presented to the ED after the power was restored and the electric CO detector went off. All CO detectors should be manufactured with a battery back-up.

Preventive measures were implemented in the Kingston area during the ice storm.

The local public health unit produced a media release that was broadcast widely during the second week. There was also a disaster hot line at City Hall, which was manned by health unit personnel. These preventive measures should be implemented earlier in the course of an environmental disaster and their effectiveness should be formally evaluated. It is imperative that disaster plans be reviewed in light of these data. Public officials can contribute to the latter by generating recommendations for future power outages.

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REFERENCES

1. Hampson NB, Kramer CC, Dunford RG, Norkool DM. Carbon monoxide poisoning from indoor burning of charcoal briquets. *JAMA* 1994;271(1):52-53.
2. Gomez Carrasco JA, Lopez-Herce Cid J, Bernabe de Frutos MC, Garcia de Frias E. [Carbon monoxide poisoning. A home accident to remember]. *Anales Espanoles de Pediatria* 1993;39(5):411-14.
3. Mathieu D, Mathieu-Nolf M, Wattel F. [Carbon monoxide poisoning: Current aspects]. *Bulletin de l'Académie Nationale de Médecine* 1996;180(5):965-71.
4. Risser D, Schneider B. Carbon monoxide-related deaths from 1984-1993 in Vienna, Austria. *J Forensic Sciences* 1995;40(3):368-71.
5. Kim YS. Seasonal variation in carbon monoxide poisoning in urban Korea. *J Epidemiol Commun Health* 1985;29:79-81.
6. Anonymous. Deaths from motor-vehicle-related unintentional carbon monoxide poisoning - Colorado, 1996, New Mexico, 1980-1995, and United States, 1979-1992. *MMWR* 1996;45(47):1029-32.
7. Centers for Disease Control. Unintentional carbon monoxide poisonings following a winter storm - Washington, January 1993. *MMWR* 1993;42(6):109-11.
8. Wrenn K, Connors GP. Carbon monoxide poisoning during ice storms: A tale of two cities. *J Emerg Med* 1997;15(4):465-67.
9. Houck PM, Hampson NB. Epidemic carbon monoxide poisoning following a winter storm. *J Emerg Med* 1997;15(4):469-73.
10. Centers for Disease Control. Unintentional carbon monoxide poisoning following winter storm - Washington, January 1993. *JAMA* 1993;269(11):1372-73.
11. Greife AL, Goldenhar LM, Fruend E, et al. Carbon monoxide poisoning from gasoline-powered engines: Risk perception among mid-west flood victims. *Am J Public Health* 1997;87(3):466-67.
12. Health Canada. Regulations respecting the advertising, sale and importation of charcoal. Health Canada, Health Protection Branch, Product Safety, Scarborough, Ontario.
13. Fain DB, McCormick GM. A burning issue: The Japanese 'fire basin'. *Am J Forensic Med Pathol* 1988;8:301-3.

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