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Dying to Play Video Games: Carbon Monoxide Poisoning From Electrical Generators Used After Hurricane Ike

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What's Known on This Subject

CO is the most common cause of poisoning death in the United States. Epidemics of CO poisoning have been reported related to storms and power outages, usually associated with the use of generators.

What This Study Adds

This is the first study to suggest that generators are commonly used immediately after a large-scale power outage to power entertainment electronics for children. This is also the first report of region-wide use of cell phone text messages for CO-poisoning alerts. Children should be educated regarding the hazards of CO poisoning.

ABSTRACT

BACKGROUND. Carbon monoxide (CO) poisoning is common after major storms because of loss of electrical power and use of alternate fuel sources for heat and electricity. In past epidemics of hurricane-related CO poisoning, the source has typically been gasoline-powered electrical generators. Although it is typically believed that generators were used to power air conditioning and refrigeration, this report demonstrates an unsuspected reason for their use.

PATIENTS AND METHODS. After Hurricane Ike's landfall in September 2008, major power outages were associated with an epidemic of CO poisoning from electrical generators, as expected. Staff at Memorial Hermann Hospital-Texas Medical Center treated or telephone-triaged cases from the Houston area. A review of the details of those cases forms the basis of this report.

RESULTS. Memorial Hermann Hospital-Texas Medical Center staff treated or triaged 37 individuals exposed to CO from gasoline-powered electrical generators in 13 incidents in the first 36 hours after landfall of the hurricane. Notably, 54% (20 of 37) of the patients were under the age of 18 years. Symptoms ranged from mild to severe, with 1 child dying at the scene. Eleven patients were treated with hyperbaric oxygen. Among 9 incidents in which the reason for generator use was determined, 5 were due to generators powering video games or televisions to watch movies or programs. These 5 incidents in which video games were being powered accounted for 75% (15 of 20) of the pediatric poisonings.

CONCLUSIONS. Generator-related CO poisoning is indeed common during power outages after hurricanes. However, generators are commonly being used to provide electricity to power entertainment devices for children, such as video games. Additional public education about CO risk is needed, perhaps directed at older children and teenagers through the schools in regions susceptible to hurricanes. *Pediatrics* 2009;123:e1035–e1038

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Key Words

carbon monoxide, poisoning, hurricanes, generators, video games

Abbreviations

CO—carbon monoxide
HBO₂—hyperbaric oxygen
MHH-TMC—Memorial Hermann Hospital-Texas Medical Center
UHMS—Undersea and Hyperbaric Medical Society

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CARBON MONOXIDE (CO) poisoning is common in the United States, resulting in an estimated 50 000 emergency department visits annually.¹ In fact, CO poisoning remains the most common cause of poisoning death in the United States. However, major storms have been associated with epidemics of CO poisoning when they result in widespread power outages and people turn to the use of alternate fuel sources for generation of electricity and heat.² A significant source of storm-related CO poisoning arises from the improper use of gasoline-powered generators, operated by homeowners to provide electrical power.² The most common reason offered by those poisoned from improper generator use is that they simply were unaware of the risk for CO poisoning.³

Hurricane Ike made landfall on the Texas coast early Saturday morning on August 13, 2008. It struck Galveston with 110 mph winds and then advanced to Houston and beyond. The Public Utility Commission of Texas reported that by 8:00 AM on August 13, 1.97 million of 2.08 million (95%) customers were without power in 11 South Texas

TABLE 1 Characteristics of Incidents of CO Poisoning From Gasoline-Powered Electrical Generators in Texas During the Week After Landfall of Hurricane Ike

Incident	Poisoned, <i>n</i>	Age, y	Clinical Findings	COHb, %	Generator Location	Reason for Generator Use
1	5	5, 7, 7, 15, 32 ^a	Headache; chest pain; 1 child death	5.2, 4.5, 7, 3.6	Living room	Unknown
2	2	65, ^a 82 ^a	Altered mental status; amnesia; incontinence; instability	12.1, 19.2	Living room	Power lights to play cards
3	1	29	Loss of consciousness	29.8	Attached garage	Power video games and movie
4	10	20 mo, 23 mo, 4, 11, 13, 15, 15, 17, 34, 72	Nausea; vomiting; loss of consciousness	1.6, 2.5, 5.1, 5.2, 6.9, 10.7, 13.1, 14.8, 18, 19.2	Attached garage	Power video games and movie
5	4	4, 8, 11, 29	Nausea; vomiting; headache; fatigue	15.4, 16.8, 18.7, 23.1	Attached garage	Power video games
6	5	8, 13, 13, 46, 80	Vomiting; headache	5.3, 5.3, 14.1, 16.6, 19.3	Attached garage	Power video games
7	2	54, ^a 65 ^a	Loss of consciousness; headache	15.9, 16.3	Attached garage	Power television, lights, and refrigerator
8	1	41 ^a	Coma; vomiting; amnesia	16.1	Unknown	Unknown
9	5	6 mo, 19 mo, 3, 24, ^a 24	Nausea; vomiting; loss of consciousness; dizziness; weakness	1.4, 2.2, 4.1, 10.5, 11.5	Attached garage	Power well pump and fans
10	1	23 ^a	Coma	25	Bedroom	Power video games
11	1	52 ^a	Headache; nausea	7.5	Kitchen	Refrigerator
12	1	23 ^a	Headache; nausea	9.6	Garage	Unknown

COHb indicates carboxyhemoglobin.

^a The ages of the 11 patients treated with hyperbaric oxygen.

counties.⁴ A week later on August 20, 1.08 million customers in those same areas remained without power. As predicted, a number of individuals were poisoned with carbon monoxide from electrical generators. What was not predicted were the reasons they were using generators to produce electricity.

METHODS

The Undersea and Hyperbaric Medical Society (UHMS) partners with the Centers for Disease Control and Prevention to provide surveillance for episodes of acute CO poisoning. Of the estimated 50 000 emergency department visits for CO poisoning in the US annually, ~1500 are referred for treatment with hyperbaric oxygen (HBO₂).^{1,5} UHMS members report nonidentifiable information about cases treated with HBO₂ via a secure Internet survey site, coordinated by Dr Hampson on behalf of the UHMS. Summarized data are forwarded to the Centers for Disease Control and Prevention on a periodic basis or on demand in the event of a suspected epidemic.

In the week after Hurricane Ike's landfall, a total of 11 cases of CO poisoning treated with HBO₂ in Texas were reported. All individuals were poisoned with CO from gasoline-powered electrical generators and were treated at the Memorial Hermann Hospital-Texas Medical Center (MHH-TMC), the location of the only hyperbaric oxygen treatment facility in Houston capable of treating emergency patients. Review of the details of their case histories, those of others simultaneously poisoned and triaged at MHH-TMC but not treated with HBO₂, and patients with CO poisoning triaged by telephone by the MHH-TMC staff but treated locally form the basis for this report.

RESULTS

As is seen in Table 1, 37 individuals exposed to CO from

gasoline-powered electrical generators in 12 incidents were treated or triaged by the MHH-TMC staff in the first 36 hours after landfall of the hurricane. The number poisoned in each episode ranged from 1 to 10 (median: 2). Patient ages ranged from 6 months to 82 years (average: 25 ± 23 years, mean ± SD). Blood carboxyhemoglobin levels averaged 11.55% ± 7.38% (*n* = 37; range: 1.4%–29.8%). Clinical symptoms are listed in Table 1. Several patients experienced loss of consciousness or presented in coma. As noted, 11 patients were treated with hyperbaric oxygen. There was 1 death, a 3-year-old child who died at the scene. Patients with the most severe symptoms (eg, mental status change, chest pain) were prioritized for treatment. One patient with a history of loss of consciousness (number 3, Table 1) refused hyperbaric treatment because of claustrophobia and another refused because several of her less severely poisoned small children were being treated with sea level oxygen.

Most gasoline-powered electrical generators were operated while located in garages attached to the home. Among the 9 incidents where the reason for generator use was determined, 5 were being used to power video games and 1 to watch movies or power televisions. The 5 events in which generators were powering video games resulted in 75% (15 of 20) of the pediatric poisonings. Only 2 generators were reported being used for food refrigeration.

DISCUSSION

Storm-related CO poisoning is common and predictable. In a recent review,² almost all cases of CO poisoning were the result of loss of electrical power after a storm. Among winter storms with ice and snow, the source of CO poisoning is most commonly indoor use of charcoal briquettes for heating and cooking, followed by electrical

generators. In hurricane-related power outages, almost all poisonings result from improper use of electrical generators.

Carbon monoxide detectors have been shown to be an effective means of secondary CO-poisoning prevention. However, in previous studies after storms, CO detectors were not present in most of the homes where poisonings occurred. This may be due to the fact that only a minority of states have statutes that mandate the presence of CO alarms in residences,⁶ and if alarms are present, they are sometimes not in working order. Even if a home has a CO alarm, a generator should never be used indoors. It is recommended that the generator be placed at least 50 feet from the house. Education about the importance of both the proper use of generators and the importance of CO detectors could be performed simultaneously.

Generators were the cause of almost all CO poisonings after Hurricane Katrina.⁷ In those cases, however, they were thought to be used to power home air conditioners and/or for food refrigeration. This is the first report in the literature indicating that generators are commonly used to power video games and other entertainment for children and young adults in the days immediately after a hurricane.

It is estimated that children in the United States spend >25% of their waking hours either watching television or playing video games, ~4.5 hours per day for children between 8 and 18 years of age.⁸ Fully 97% of American teenagers play computer, Web, portable, or console video games.⁹ Among "daily gamers," 65% are boys and 35% are girls. Video gaming is not necessarily bad, because many games are educational and no strong relationship has been demonstrated between the quantity of game playing and teenagers' involvement in civic and political activity.⁹ It is simply an extremely common way for teenagers to spend their time, with approximately equal time spent playing video games each day as reading magazines, books, or newspapers.¹⁰

It is interesting to note that a study examining CO poisoning in Washington state over a decade found that specific minority racial/ethnic groups had a significantly increased risk for accidental poisoning compared with whites.¹¹ Socioeconomic data were not available in that study, but the authors noted that such differences could have played a role. One could speculate that the same groups who spend the most time playing video games also are less likely to be educated about CO-poisoning risk and exposure prevention.

The fact that generators continue to be the source of so many cases of CO poisoning suggests that an adequate public education program regarding their risks has not been accomplished in this country. Recognizing the large volume of individuals with CO poisoning arriving for treatment, clinical staff at MHH-TMC reached out to the local news media to remind the citizens of Southeast Texas of the dangers of CO poisoning, performing multiple interviews in multiple languages. Because many communication lines were down, including telephone lines and access to television, AT&T assisted in this mes-

sage delivery by sending a text message to all of its cell phone customers.

The requirement for generator manufacturers to include a warning label about CO poisoning on the devices was recently mandated by the US Consumer Product Safety Commission.¹² However, this only applies to newly manufactured generators, so generators purchased before the date of warning label implementation will remain without the mandated label. It is clear that public education programs must be continued. Other measures currently being considered to reduce generator-related CO poisoning include generator weatherization so that owners are more willing to leave them outdoors, installation of catalytic converters, and incorporation of CO monitors on generators, which would shut off the device if ambient CO measurements rose above a predetermined level.

CONCLUSIONS

Discovering that generators are so frequently used to power entertainment devices for children suggests that school programs covering the dangers of CO poisoning should be considered in states at risk for hurricane-related power outages. Text messaging proved one of the most reliable forms of communication during this storm, and telephone companies should be enlisted during such an event to communicate important public safety messages. This study emphasizes that more education is still needed regarding the dangers of CO poisoning, particularly because nondisaster-related CO poisoning is still the number one cause of poisoning death in the United States.

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