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Public Health Surveillance Following Hurricane Wilma in Miami-Dade County, October-November 2005

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BACKGROUND

Increased reports of communicable disease and other illness are quite common after natural disasters. Disruptions in electrical power, water systems, and sewage systems can make it difficult to maintain appropriate personal and food hygiene. Further, increased debris and use of hazardous equipment (e.g. portable generators) during clean-up and recovery efforts can lead to a number of health emergencies. Hurricane Wilma made landfall in Florida on Monday, October 24, 2005, causing heavy wind damage, water damage, and more than 956,000 power outages in Miami-Dade County. Following the storm, the Miami-Dade County Health Department, Office of Epidemiology and Disease Control (OEDC) used a number of enhanced surveillance activities to monitor public health trends in the county.

METHODS

Emergency Department (ED) Surveillance

On a daily basis, the OEDC monitors chief complaints reported during ED visits to 6 participating hospitals in Miami-Dade County. These complaints are then classified into 10 syndrome categories (e.g. respiratory, gastrointestinal, fever, etc.) and monitored for statistical deviations from expected historical thresholds. A yellow warning (mild alert) is generated if there is a statistically significant aberration at the 95% confidence level (p value <0.05). A red alert (high alert) is generated if there is an aberration at the 99% confidence level (p value <0.01). After Hurricane Wilma, the OEDC used this data for enhanced surveillance of respiratory and gastrointestinal illness.

Carbon Monoxide Exposure

Increases in carbon monoxide exposure are very common after hurricanes due to use of portable generators during prolonged power outages. The predominant manifestations of carbon monoxide poisoning are cardiovascular and neurological effects. Inhalation of carbon monoxide gas typically leads to headache, dizziness, and confusion, which might progress to dyspnea, tachypnea, syncope, and metabolic acidosis (Balzan 1996; Ernst 1998; Tomaszewski 2002).

The Florida Poison Information Center Network (FPICN) regularly monitors statewide carbon monoxide exposures through its three 24-hour call centers in Miami, Jacksonville, and Tampa. Carbon monoxide exposure is determined

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based on the following criteria established by the Centers for Disease Control and Prevention (CDC):

Laboratory criteria for diagnosis

• *Biologic*: A case in which carboxyhemoglobin concentration exists >5% in venous or arterial blood in nonsmokers and >10% in smokers, as determined by hospital or commercial laboratory tests. The typical range of carboxyhemoglobin concentrations in smokers is 6%-10%.

- *Environmental*: No confirmatory test is available for carbon monoxide in environmental samples.

Case classification

• *Suspected*: A case in which a potentially exposed person is being evaluated by health-care workers or public health officials for poisoning by a particular chemical agent, but no specific credible threat exists.
• *Probable*: A clinically compatible case in which a high index of suspicion (credible threat or patient history regarding location and time) exists for carbon monoxide exposure, or an epidemiologic link exists between this case and a laboratory-confirmed case.
• *Confirmed*: A clinically compatible case in which laboratory tests on biologic samples have confirmed exposure. The case can be confirmed if laboratory testing was not performed because either a predominant amount of clinical and nonspecific laboratory evidence of a particular chemical was present or a 100% certainty of the etiology of the agent is known.

Hurricane-Related Deaths

Hurricane-related deaths are reportable in the state of Florida. There is currently no standard, universally-accepted definition of hurricane-related death; however the following terms were used by the Florida Department of Health, Bureau of Epidemiology to characterize deaths attributable to Hurricane Wilma:

Disaster Phase-Hurricane-related deaths are classified into 3 disaster phases. Pre-impact is a death that occurred prior to storm landfall. Impact refers to deaths that occurred during storm landfall, and post-impact refers to deaths that occurred after storm landfall.

Type-Deaths are further characterized by circumstance type. A direct death is a death attributed to the physical forces of the storm. An indirect death is a death caused by unsafe or unhealthy conditions associated with preparation or occurrence of the storm (i.e. loss or disruption of usual services, personal loss, or disruption of lifestyle).

In addition to these classification methods, medical examiner reports were used to determine the probable cause of death.

RESULTS

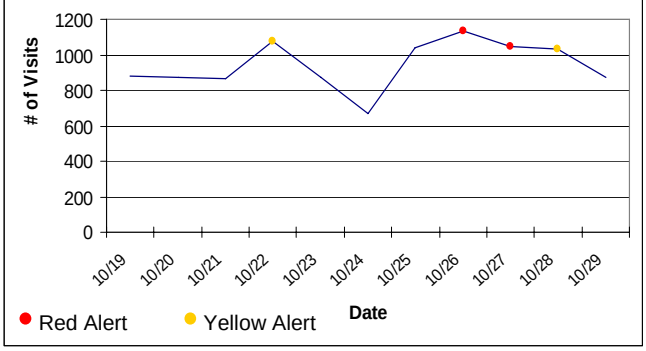
ED Surveillance

There was a significant increase in the number of overall visits that occurred at participating hospitals after Hurricane Wilma. In the 7 days before Wilma (October 17-23), there were a mean of 844 visits to hospital emergency departments. On October 26, 27, and 28, however, there were 1086, 1082, and 979 visits, respectively. The total number of expected visits returned to normal levels by October 29 (Figure 1).

With respect to the individual syndrome categories, there was a significant increase in the number of visits related to respiratory illness after the hurricane. The number of respiratory visits peaked to 179 on October 25, returning to normal levels by October 28. Most of this increase can be accounted for in the 0-4 age group. For example, of the 179 respiratory visits that occurred on October 25, 115 (64.2%) occurred among children ages 0-4 (Figure 2).

There was no overall increase in gastrointestinal (GI) visits after the hurricane at participating hospitals. The number of GI visits from October 25-29 were 121, 131, 122, and 128 respectively (with p values of 0.66, 0.44, 0.53 and 0.43) There was a slight increase in GI illness in the 0-4 age group (p value=0.02). A similar increase was also seen in the 65+ age group.

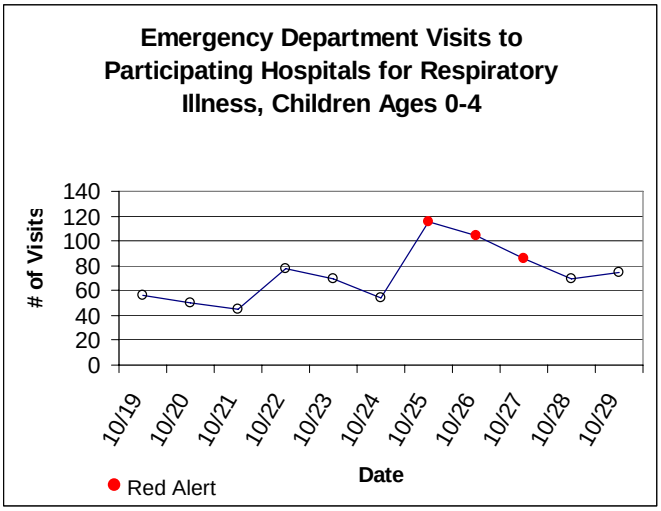
Figure 1. Total Number of Visits to Participating Hospital Emergency Departments by Date



Carbon Monoxide Exposure

As of November 14, a total of 14 carbon monoxide exposures among Miami-Dade County residents were reported to FPICN from October 26-November 3. Of these 1 was a confirmed case and 13 were probable cases. The median age among those exposed was 45.5 years (Range 21-56). Two cases were of unknown age. Eight of the 14 were female, and six were male. The most common symptoms reported were nausea, dizziness, and headache (Table 1).

Twelve of the 14 exposed persons reported generator use. None of the 12 used a generator inside the home; however, 5 persons reported generator use near the home (e.g. at a neighbor's home, on the balcony, or in the backyard). Seven of 12 generator exposures occurred in a workplace setting, four or which were linked to the same office setting. It is unknown whether or not carbon monoxide detectors were in use at the time of any of these exposures.



Hurricane-Related Deaths

As of November 30, twelve hurricane-related deaths were detected among Miami-Dade County residents. The median age among the deceased was 52. The age of one decedent was unknown, but believed to be 63 based on media reports. The youngest decedent was a one-year old who died of blunt trauma. The child was sitting on an adult's lap in the front seat of a car that got tangled in a low-hanging cable to a utility pole. When the car struck the cable, it pulled the pole down onto the passenger side of the car, killing the child. The oldest decedent was 72.

Two of the twelve deaths occurred during the impact phase of the storm. One was a man who drowned while staying on a sailboat during the storm. The second was a man at home in his trailer when the hurricane struck. Both of the deaths that occurred during the impact phase were determined to be direct deaths attributable to the physical forces of the storm.

The ten remaining deaths occurred in the post-impact phase of the storm. One was a man who died from inhalation of products of combustion after placing a generator inside his apartment. Four of the ten post-impact deaths occurred among persons involved in motor vehicle accidents where street or traffic lights were not working. Two of the ten post-impact deaths were among men who were involved in repair activities after the storm. The ten post-impact deaths were all determined to be indirect deaths.

All of the twelve hurricane-related deaths were deemed accidental.

Table 1. Carbon Monoxide Exposures Reported through the Florida Poison Information Control Network in Miami-Dade County, October 26-November 3, 2005

Variable	n	%
Case Classification		
Confirmed	1	7.1%
Probable	13	92.9%
Median age	45.5	-
Symptoms		
Nausea	8	57.1%
Headache	7	50.0%
Dizziness/Lightheadedness	6	42.9%
Vomiting	4	28.6%
Throat/oral irritation	2	14.3%
Not feeling good	1	7.1%
Numbness, tinging in fingers	1	7.1%
Generator in Use		
Yes	12	85.7%
No	1	7.1%
Unknown	1	7.1%
Location of Generator (n=12)		
Backyard/balcony	4	33.3%
Neighbor's house	1	8.3%
Office/workplace	7	58.3%

Table 2. Miami-Dade County Deaths Related to Hurricane Wilma, 2005

Variable	n	%
Disaster Phase		
Pre-Impact	0	0.0%
Impact	2	16.7%
Post-Impact	10	83.3%
Type		
Direct	2	16.7%
Indirect	10	83.3%
Probable Cause of Death		
Blunt Trauma	5	41.7%
Multiple traumatic/blunt force injuries	3	25.0%
Complications of thermal injuries	1	8.3%
Drowning	1	8.3%
Traumatic asphyxia	1	8.3%
Inhalation of products of combustion	1	8.3%
Sex		
Male	10	83.3%
Female	2	16.7%
Median age	52	-

Disaster Phases: Pre-impact= death that occurred prior to storm landfall; Impact=death that occurred during storm landfall; Post-impact=death that occurred after storm landfall.

Type: Direct death=death attributed to the physical forces of the storm; Indirect death=death caused by unsafe or unhealthy conditions associated with preparation or occurrence of the storm (i.e. loss or disruption of usual services, personal loss, or disruption of lifestyle)

DISCUSSION

Increased respiratory illness is common after a storm, as hand hygiene is often compromised due to lack of running water. This explanation, however, is not sufficient for explaining the increases seen in Miami-Dade County hospitals, for (with the exception of Miami Beach and some isolated trailer parks), there was potable water throughout Miami-Dade County after the storm. One possible explanation for the increase is the power outages that occurred throughout the county. Most doctors' offices and primary care clinics were closed for several days after Wilma due to power outages. Hospital emergency departments, however, were open shortly after the storm. As a result, hospital EDs became (for many) the only viable option for primary care in the county. Parents of young children are more likely to seek care for respiratory symptoms than other age groups; therefore, the increase in respiratory illness visits seen in the 0-4 age group is logical. The lack of increased gastrointestinal chief complaints in EDs of participating hospitals following Wilma suggests that educational messages about post-hurricane food and water safety might have had a positive impact in Miami-Dade County residents.

The number of reported carbon monoxide exposures suggests that generator safety needs to be further emphasized as a routine part of hurricane-related educational activities. Generator safety should be stressed not only after the storm, but also during storm preparation, as many residents do not have access to typical educational devices (e.g. television, newspaper, radio, and internet) after a storm because of power outages. A number of exposures occurred among residents who were not using generators in their own homes; rather, these generators were being used by neighbors or in the workplace.

Another subject that deserves pre-hurricane educational efforts is vehicle safety after the storm. Since 98% of Miami-Dade County suffered from power outages after the storm, traffic lights and street lights were also affected. More education on driving during power outages may prevent future hurricane-related vehicle accidents.

Finally, the two direct deaths that occurred during the impact phase of the storm occurred among persons who should have been evacuated prior to storm landfall. More emphasis needs to be given to the development of evacuation plans among persons living in coastal areas and trailer parks.

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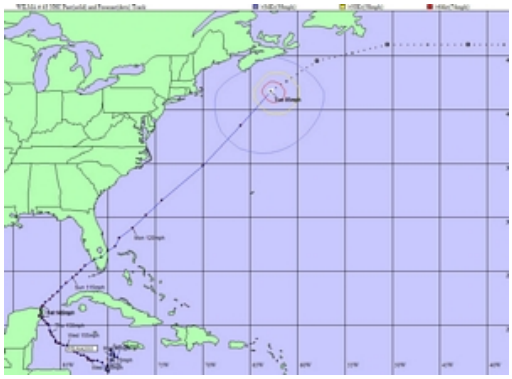
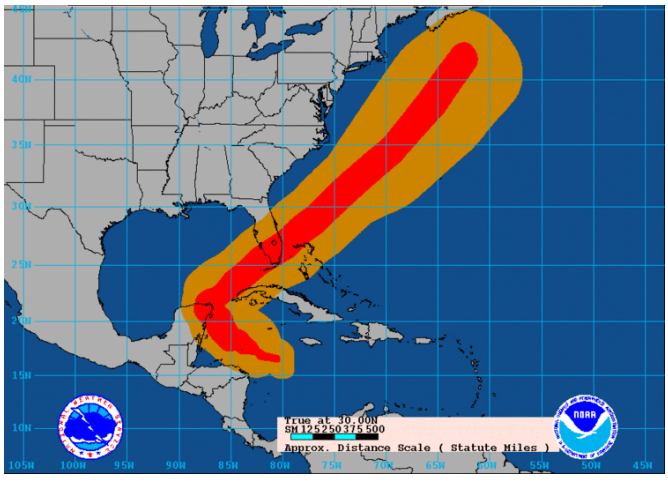
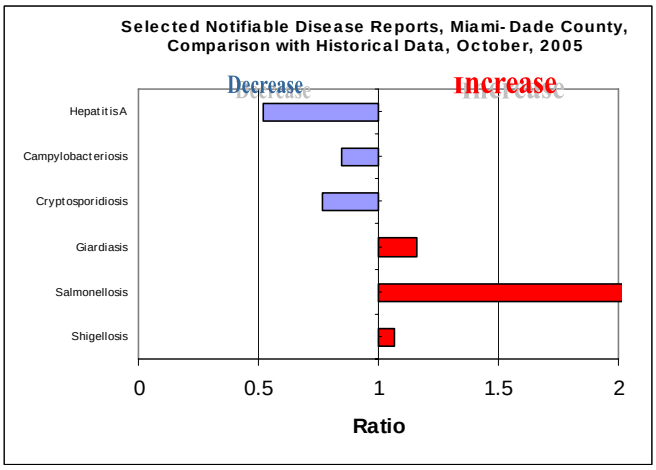


Figure 3. Map showing the path of Hurricane Wilma.



Tropical Storm Force Winds Hurricane Force Winds



*Ratio of current month total to mean of 15 month totals (from previous, comparable, and subsequent month periods for the past 5 years).

TO REPORT ANY DISEASE AND FOR INFORMATION CALL:

Office of Epidemiology and Disease Control

Childhood Lead Poisoning Prevention Program	(305) 470-6877
Hepatitis	(305) 470-5536
Other diseases and outbreaks	(305) 470-5660
HIV/AIDS Program	(305) 470-6999
STD Program	(305) 325-3242
Tuberculosis Program	(305) 324-2470
Special Immunization Program	(786) 845-0550

Monthly Report
Selected Reportable Diseases/Conditions in Miami-Dade County, October 2005

Diseases/Conditions	2005 this Month	2005 Year to Date	2004 Year to Date	2003 Year to Date	2002 Year to Date	2001 Year to Date
AIDS *Provisional	31	1081	1196	879	936	1014
Animal Rabies	0	0	0	0	0	1
Campylobacteriosis	10	115	122	115	82	105
Chlamydia trachomatis	263	3217	3946	3738	4072	3064
Ciguatera Poisoning	0	0	0	0	2	0
Cryptosporidiosis	2	27	16	11	8	11
Cyclosporosis	0	11	2	1	1	0
Dengue Fever	2	3	4	1	3	4
Diphtheria	0	0	0	0	0	0
E. coli, O157:H7	0	0	3	0	0	2
E. coli, Non-O157	0	1	1	2	1	1
E. coli, Other	0	0	1	0	0	0
Encephalitis (except WNV)	0	0	1	0	1	0
Encephalitis, West Nile Virus	0	0	15	6	2	0
West Nile Fever	0	0	6	0	0	0
Giardiasis, Acute	30	185	245	154	173	215
Gonorrhea	100	1346	1478	1573	1730	1573
Hepatitis A	6	54	37	52	130	161
Hepatitis B	2	39	28	47	38	54
HIV *Provisional	60	1193	1476	1428	1641	1362
Lead Poisoning	17	146	264	215	250	243
Legionnaire's Disease	1	6	7	5	1	3
Leptospirosis	0	2	0	0	0	0
Lyme disease	0	0	3	4	2	6
Malaria	1	8	16	12	10	14
Measles	0	0	1	0	0	0
Meningitis (except aseptic)	0	11	10	7	5	9
Meningococcal Disease	1	6	18	4	12	15
Mumps	0	0	0	0	0	0
Pertussis	0	9	9	9	6	1
Polio	0	0	0	0	0	0
Rubella	0	0	0	0	0	0
Rubella, Congenital	0	0	0	0	0	0
Salmonellosis	78	469	370	443	258	246
Shigellosis	17	223	137	263	207	118
Streptococcus pneumoniae, Drug Resistant	3	56	59	109	93	146
Syphilis, Infectious	14	137	183	158	179	166
Syphilis, Other	35	474	697	866	918	719
Tetanus	0	0	0	0	0	1
Toxoplasmosis	0	9	7	9	15	11
Tuberculosis *Provisional	17	165	196	173	191	186
Typhoid Fever	0	2	3	4	3	0
Vibrio cholera Type O1	0	0	2	0	0	0
Vibrio cholera Non-O1	0	0	0	0	1	0
Vibrio, Other	0	0	0	1	0	0

* Data on AIDS are provisional at the county level and are subject to edit checks by state and federal agencies.
** Data on tuberculosis are provisional at the county level.