

Public Health Preparedness and Response

BACKGROUND

National

The Centers for Disease Control and Prevention's (CDC) efforts in infectious disease have evolved in the last several years from addressing malaria control to global smallpox eradication to containing the West Nile virus. The agency's focus has recently expanded to include emerging infections and bioterrorism. The CDC's mission in public health preparedness and response is to lead the effort in enhancing readiness to detect and respond to bioterrorism attacks and other public health emergencies, including man-made and natural disasters.¹

In order to protect communities in the United States from infectious, occupational, environmental, and terrorist threats, the agency has included preparation for emerging health threats under its Health Protection Goals. In preparation for public health disasters, the CDC will contribute to preparation and prevention efforts of national, state, and local entities, and will support partners at these three levels to improve public health outcomes when a disaster occurs. The CDC will also assist national, state, and local efforts to recover and restore public health functions after a disaster has occurred.²

The CDC developed a coordinated plan to improve preparedness and response at the local, state, and federal levels. The initiative includes enhancing the capacity for detection, diagnosis, and management of disease outbreaks; improving the characterization and identification of causative pathogens, toxins, or selected chemical exposures; strengthening the public health response capacities to control and contain such emergencies; and improving the information technology infrastructure to rapidly transfer data

and information necessary to prepare and respond to such events. The goal is to ensure that the United States has the appropriate capacities for bioterrorism preparedness and response for public and private health care systems. These strategies will enable public health and health care professionals to detect and respond to incidents quickly, strengthening the ability to identify and control emerging infectious diseases, injuries, and other emergencies as needed.¹

Oklahoma

Oklahoma has faced several injury-related disasters that have tested its capacity for public health preparedness and response at state and local levels. Events such as the 1995 bombing of the Oklahoma City Alfred P. Murrah Federal Building, the 1999 and 2003 Oklahoma tornado outbreaks, the 2002 Interstate 40 bridge collapse, and the 2007 ice storms have made the need for a coordinated response to terrorism and other public health emergencies a priority.

The State of Oklahoma is divided into eight public health or homeland security regions so that public health and medical system planning efforts are carried out efficiently. Each region is made up of a Regional Homeland Security Advisory Council, a Regional Medical Planning Group, and a Regional Trauma Advisory Board. Each of these entities are comprised of local, regional, and state public health personnel, and authorized to develop regional medical system response plans as well as protocols to establish coordinated public health and medical system responses at each response level (Tier I, II, III, IV, and V).³

The purpose of Oklahoma's public health preparedness program is to develop emergency

ready public health departments by upgrading, integrating, and evaluating state and local public health jurisdictions' preparedness for and response to terrorism, pandemic influenza, and other public health emergencies with federal, state, local, and tribal governments, the private sector and non-governmental organizations. The emergency preparedness and response efforts are designed to support the National Response Plan and the National Incident Management System.⁴

The program is based on the CDC's preparedness goals to prevent, detect and report, investigate, control, and recover from public health disasters and improve strategies:

- Increase the use and development of interventions known to prevent human illness from chemical, biological, and radiological agents as well as naturally occurring health threats.
- Decrease the time needed to classify health events as terrorism or naturally occurring health threats in partnership with other agencies.
- Decrease the time needed to detect and report chemical, biological, or radiological agents in tissue, food, or environmental samples that cause threats to the public's health.
- Improve the time and accuracy of communications regarding threats to the public's health.
- Decrease the time needed to identify causes, risk factors, and appropriate interventions for those affected by threats to the public's health.
- Decrease the time needed to provide countermeasures and health guidance to those affected by threats to the public's health.
- Decrease the time needed to restore health services and environmental safety to pre-event levels.

- Improve the long-term follow up provided to those affected by threats to the public's health.
- Decrease the time needed to implement recommendations from after action reports following threats to the public's health.

Oklahoma also implements the National Incident Management System (NIMS). NIMS provides consistent methodology for federal, state, tribal, and local governments to collaborate effectively and efficiently to prepare for, prevent, respond to, and recover from domestic incidents, regardless of cause, size, or complexity.⁴

Under the Emergency Operations Plan (EOP), the State of Oklahoma is required to establish procedures in response to the health, medical, and environmental needs of the State in the event of a man-made or natural public health emergency. The Commissioner of Health is responsible for coordination of all state health and medical services in response to public health emergencies. The Commissioner may mandate injuries due to any condition as reportable for special study, allowing access to hospital medical records and Medical Examiner reports. The extent of medical and health services will depend on the size and type of disaster. The Oklahoma State Department of Health collaborates with various support agencies and medical system partners in order to respond to the health and medical needs of Oklahomans. Injury Prevention Service personnel will assist in the event of a public health emergency as needed. The Commissioner of Health will also inform the Governor, Director of Emergency Management, and Director of the Oklahoma Office of Homeland Security of medical and health services during emergency operations.

Emergent health-related information is distributed to healthcare providers and public health partners through an emergency communications system known as the Oklahoma Health Alert Network (OK-HAN) system. Message distribution is via facsimile, telephone, and/or email. OK-HAN is a secure website which enables registered

medical and public health personnel the ability to view and share information, and update their own professional and personal information in a secure format to ensure delivery of notifications.

Tornadoes

Oklahoma has the highest concentration of the most severe tornadoes per square kilometer in the United States, and ranks second in the total number of tornadoes. Nearly 55% of all tornadoes in the United States occur between April and June; approximately 80% occur between noon and midnight, with the majority occurring between 3:00 p.m. and 9:00 p.m.

According to the National Severe Storms Laboratory in Norman, Oklahoma, 59 tornadoes touched down on the evening of May 3, 1999. Twelve Oklahoma communities suffered damage, injuries, and/or deaths as a result. Forty-five persons were killed and nearly 600 survivors were directly or indirectly injured in the tornadoes. Approximately half of the injured population was female, and one-third of injured persons were 35 to 54 years of age. The most common types of injuries were soft tissue injuries, such as cuts, scrapes, bruises (81%); fractures and dislocations (25%); and brain injuries (20%). Thirty persons, including nine children, suffered serious traumatic brain injuries with a potential for long-term disabilities. Common causes of injury among survivors included flying or falling debris; being picked up or blown by a tornado; collapsing walls, ceilings, or roofs; and flying or falling wood or boards.⁵

Five tornadoes occurred between May 8 and May 9, 2003 in Oklahoma. The May 2003 tornadoes resulted in \$405 million in property damage. There was one death and 91 persons were treated for injuries. Sixty-nine percent of Oklahomans with tornado-related injuries were injured directly in the tornado, 8% while preparing for the tornado, 4% were injured during tornado cleanup or search and rescue, and the mechanism of injury was unknown for 19% of

persons. Eighty-four percent of injured persons were 25 years of age and older. The most common types of injuries were soft tissue injuries (87%); followed by fractures and dislocations (21%); strains and sprains (21%); brain injuries (9%); and foreign bodies (8%).⁶

During both the tornado disasters of 1999 and 2003, the Oklahoma Commissioner of Health declared tornado-related deaths and injuries reportable conditions, and investigations of tornado-related injuries were conducted by the Oklahoma State Department of Health, Injury Prevention Service. Information from medical records was collected, Medical Examiner reports were reviewed, and community field surveys were conducted.

Preparation is the most important measure that could potentially decrease the incidence and severity of tornado-related injuries. Other prevention measures include:

- Develop an effective tornado preparedness plan before a tornado alert.
- Activate a tornado preparedness plan as soon as possible when a tornado warning is issued.
- Keep an emergency kit on hand with weather band radio, flashlight, first aid supplies, medications, important documents, keys, and a whistle to blow for help.
- Check on the elderly, children, and pets when a tornado watch has been issued.
- Evacuate mobile homes and motor vehicles immediately when a tornado warning is issued and find appropriate shelter.
- Be aware of the nearest accessible storm shelter, safe room, or know the safest place to take shelter in a home/building in the event of a tornado.
- Protect the head with a helmet, if available, and protect the body from debris with blankets, heavy clothing, mattress, pillows, and/or sturdy shoes.
- After a tornado, exit damaged areas with caution and do not enter an evacuated area. Stay clear of downed power lines, sparks,

fires, gas leaks, loose debris, and other harmful materials.^{5,6}

Winter Storm

In mid-January 2007, a severe winter storm moved through Oklahoma over the course of four to five days. Ice formed on trees, power lines, and roadways causing downed trees, extensive power outages, and hazardous travel conditions. Approximately 122,000 Oklahomans were without electricity and 10,000 were still without electricity two weeks after the storm began. The Oklahoma Highway Patrol responded to nearly 400 highway traffic collisions in the first three days of the winter storm. All 77 Oklahoma counties were under federal emergency declaration and 44 counties became eligible for disaster public assistance funds. Over 900 persons were housed in shelters and more than 63,000 meals were served to persons during this time. The winter storm of 2007 cost Oklahoma more than \$39 million.

In the chaos and confusion of disasters, unintentional injuries are more likely to occur. Prevention of injuries in disaster victims and evacuees is a primary function of the state and local public health departments during times of disaster. Some of the types of injuries that will occur in disasters are unique while many mechanisms are more commonplace.

The Oklahoma Commissioner of Health declared winter storm-related injuries a reportable condition, and emergency departments and the Medical Examiner were asked to track injuries associated with the storm between January 12 and January 30, 2007. The Oklahoma State Department of Health, Injury Prevention Service collected information on more than 6,000 storm-related injury cases from 143 Oklahoma hospitals.

Falls, motor vehicle crashes, and sledding accounted for 95% of injuries to persons injured during the winter storm. The majority of persons injured were between the ages of 20 and 29, and

the highest rate of injuries occurred among persons 30 to 39 years of age. Approximately half of the injured population was male and half was female. Fifty-two percent were injured at a home or on a farm, and 34% were injured on a roadway. The most common types of winter storm-related injuries were superficial (32%), sprains and strains (29%), and fractures and dislocations (21%). There were 44 injury deaths associated with the winter storm. Males had a higher risk of deaths than females (2.7 times higher), and there were no significant differences in deaths among racial/ethnic groups or age groups.⁷

During the winter storm in January 2007, 66 Oklahomans were treated for carbon monoxide (CO) poisoning, and 96% of these injuries occurred in the home. CO poisoning had the second highest hospitalization rate of all injuries.⁷ CO poisoning occurs when carbon monoxide, an odorless, colorless, poisonous gas, is inhaled in significant concentrations causing illness and/or death. It is commonly reported after major power outages resulting from natural or man-made disasters. When alternative sources of fuel or electricity are used for heating, cooling, or cooking during these events, CO can build up quickly in enclosed or partially enclosed areas.⁸ During a subsequent winter storm in December 2007, two persons died from CO poisoning caused by a generator.

It is important to provide carbon monoxide poisoning prevention information to the public before a power outage occurs. To prevent CO poisoning:

- Install battery-powered CO detectors in the home.
- Properly install, maintain, and operate all fuel-burning appliances.
- Check and clean fireplace chimneys and flues at least once a year.
- Keep generator outdoors and pressure washers an appropriate distance away from windows, doors, and vents while in use.

- Do not use generators, pressure washers, charcoal grills, camp stoves, or other gasoline/charcoal-burning devices inside the home, basement, or garage; and do not use gas ovens or stoves to heat the home.
- Do not leave motor vehicles running inside a garage attached to the home, even if the garage door is open.
- Seek immediate medical attention if CO poisoning is suspected.^{9,10}

Evacuation Centers

At particular risk of injury during and after disasters are vulnerable populations, including children, elderly, mentally ill, hospitalized, drug addicted, etc. At no time in our nation's history was this more evident than the weeks after August 29, 2005 when Hurricane Katrina made landfall along the coastal regions of Louisiana and Mississippi. Not only were the vulnerable populations of New Orleans exposed to a dangerous and highly injurious environment in and around the floodwaters, but they were often moved to shelters without injury prevention programs in place to deal with their unique needs.

In the aftermath of Hurricane Katrina, the Oklahoma State Department of Health directed the operations of Oklahoma's primary evacuee center at Camp Gruber. Several ad hoc injury prevention programs were staged during this time for the pediatric population. One such program identified and reunited children who had been separated from their family members. This program partnered with the National Center for Missing and Exploited Children and successfully reunited 36 children with their legal guardians.^{11,12} Another injury prevention program focused on childhood injuries most likely to occur to child-evacuees in a military base setting. This program dubbed, "Operation Child-Safe," teamed with the local Safe Kids chapter to identify and remove pediatric injury hazards from the camp. Hazards such as dangerous chemicals, choking hazards, electrical outlets, missing smoke detectors, auto pedestrian dangers, inadequate car seats and

many others were identified and corrected.¹³ No major injuries occurred to the nearly 300 Camp Gruber child-evacuees during camp operations.

PROGRESS

Publications

The Injury Prevention Service (IPS) and Oklahoma State Department personnel have authored or contributed to many journal articles relating to injuries and fatalities resulting from the bombing of the Oklahoma City federal building and other disasters in Oklahoma. Summary data reports, *Injury Updates*, fact sheets and other emergency preparedness articles were also prepared (listed below).

Peer-Reviewed Publications

- Comparing reactions to two severe tornadoes in one Oklahoma community. *Disasters* 2005;29(3):277-287, Overseas Development Institute, 2005.
- Factors associated with injury severity in Oklahoma City bombing survivors. *Journal of Trauma* 2009;66:508-515.
- Fatal and non-fatal injuries among U.S. Air Force personnel resulting from the terrorist bombing of the Khobar Towers. *Journal of Trauma* 2004;57(2):208-215.
- Get off the bus: sound strategy for injury prevention during a tornado? *Prehospital and Disaster Medicine* 2005;20(3).
- Glass-related injuries in Oklahoma City bombing. *Journal of Performance of Constructed Facilities* 1999;13(2):50-56.
- Injury perceptions of bombing survivors: interviews from the Oklahoma City bombing. *Prehosp Disaster Med* 2009;23(6):500-506.
- Non-fatal bombing injuries: trends in severity among Oklahoma City bombing survivors. *J Trauma* 2009;66:508-515.
- Non-fire carbon monoxide-related deaths, Oklahoma 1994-2003. *Journal of the Oklahoma State Medical Association* 2007;100(10):376-9.

- Ocular injuries sustained by survivors of the Oklahoma City bombing. *Ophthalmology* 2000;107(5):837-843.
- Planning + Practice = Preparedness: a case study in injury prevention. *Work* 2004;23(3):199-204.
- Preventing fatalities in building bombings: What can we learn from the Oklahoma City bombing? *Disaster Medicine and Public Health Preparedness* July 2007(1);27-31.
- Risk for tornado-related death and injury in Oklahoma, May 3, 1999. *American Journal of Epidemiology* 2005;161(12):1144-1150.
- Tornado-related deaths and injuries in Oklahoma due to the May 3, 1999 tornadoes. *Weather and Forecasting*, 2002;17(3):343-353.
- Winter storm-related injuries in Oklahoma – January 2007 (Pending publication)

Other Publications

- Epidemiology of blast injuries. Protecting people in buildings from terrorism: technology transfer for blast-effects mitigation. Committee for Oversight and Assessment of Blast-effects and Related Research. National Research Council. National Academy Press. 2001.
- Funnel vision: practice and preparation save 1,200 GM employees from a tornado. *Safety+Health* 168(3):44-50 (September 2003).

Summary Data Reports

- Summary of Reportable Injuries: Oklahoma City Bombing Injuries

Injury Update Reports

- Carbon Monoxide-Related Deaths, Oklahoma, 1994-2003
- Flood-Related Deaths in Oklahoma, 1998-2000
- Injuries Treated in Hospitals Following the May 8 and 9, 2003 Tornadoes in Oklahoma City
- Investigation of Deaths and Injuries Resulting from the May, 3, 1999 Tornadoes

Fact Sheets

- Unintentional Carbon Monoxide Poisoning Deaths

Education and Planning Materials

- Floods

Collaboration

The IPS met with Public Health and Medical Systems Preparedness and Response personnel to develop a plan to collect information from hospitals on persons treated for an injury during a disaster situation. The IPS will communicate with hospitals and emergency departments through the Emergency Medical Services notification system and/or the Oklahoma Health Alert Network to provide information on reporting mandates when serious disasters occur.

GOALS/OBJECTIVES

Goal

- Assist the Emergency Preparedness and Response Service in responding to emergency situations that could potentially involve injuries and/or deaths as needed.

Objectives

- Communicate with hospitals and emergency departments through the Emergency Medical Services notification system and/or the Oklahoma Health Alert Network to collect information and provide hospitals with notification of reporting mandates when a serious disaster occurs through 2015.
- Establish a surveillance system to investigate injuries and deaths associated with public health disasters when appropriate through 2015.
- Participate in preparedness meetings during disaster situations to provide injury

investigation/ prevention perspectives through 2015.

- Prepare recommendations and provide public education on prevention measures to reduce injury and deaths due to natural and man-made disasters through 2015.

ACTION PLAN

- Maintain copies of reporting forms for use when disasters such as tornadoes and winter storms occur through 2015.
- Collect data in disaster situations as needed through 2015.
- Ensure that all IPS personnel are compliant with National Incident Management System/

Incident Command System training by 2010 and ongoing for new personnel.

- Prepare fact sheets on disaster-related safety issues for the agency website and widely disseminate when disasters occur.
- Prepare fact sheet on tornado-related safety measures by 2010.
- Prepare fact sheet on flood readiness by 2010.
- Prepare fact sheet on winter storm safety measures by 2010.
- Prepare fact sheet on carbon monoxide poisonings by 2010.
- Prepare fact sheet on proper use of generators by 2010.
- Prepare fact sheet on chain saw safety measures by 2010.

REFERENCES

- ¹ Koplan, J. CDC's strategic plan for bioterrorism preparedness and response. Retrieved 26 September 2008, from: www.publichealthreports.org/userfiles/116_SUP2/116009sup.pdf.
- ² Centers for Disease Control and Prevention. Health protection goals. Retrieved 20 October 2008, from: www.cdc.gov/goals.
- ³ Oklahoma State Department of Health. Oklahoma public health and medical response system overview. Retrieved 26 September 2008, from: [http://www.ok.gov/health/documents/Oklahoma%20Public%20Health%20and%20Medical%20Response%20System%20Overview%20\(UPDATED\).pdf](http://www.ok.gov/health/documents/Oklahoma%20Public%20Health%20and%20Medical%20Response%20System%20Overview%20(UPDATED).pdf).
- ⁴ Department of Health and Human Services, Centers for Disease Control and Prevention Public Health Emergency Preparedness. Grant guidance for development of preparedness and emergency response. Retrieved 26 September 2008, from: Public Health and Medical Systems Preparedness and Response, Oklahoma State Department of Health.
- ⁵ Injury Prevention Service, Oklahoma State Department of Health. Injury Update: Investigation of deaths and injuries resulting from the May 3, 1999 tornadoes. Retrieved 27 October 2008, from: http://www.ok.gov/health/documents/Tornado_1999.pdf
- ⁶ Injury Prevention Service, Oklahoma State Department of Health. Injury Update: Injuries treated in hospitals following the May 8 and 9, 2003 tornadoes in Oklahoma City. Retrieved 30 October 2008, from: http://www.ok.gov/health/documents/Tornado_2003.pdf.
- ⁷ Piercefield, E. Winter storm-related injuries, Oklahoma, 2007. Retrieved 29 October 2008, from: Injury Prevention Service, Oklahoma State Department of Health.
- ⁸ Centers for Disease Control and Prevention. Carbon monoxide poisoning after a disaster. Retrieved 28 October 2008, from: <http://www.bt.cdc.gov/disasters/carbonmonoxide.asp>.
- ⁹ Injury Prevention Service, Oklahoma State Department of Health. Injury Update: Carbon monoxide related deaths, Oklahoma, 1994-2003. Retrieved 27 October 2008, from: http://www.ok.gov/health/documents/CO_Deaths.pdf.
- ¹⁰ Centers for Disease Control and Prevention. Say no to CO! Retrieved 30 October 2008, from: http://www.bt.cdc.gov/disasters/pdf/co-flyer_washer-generator.pdf.
- ¹¹ CDC Health Alert Network, Centers for Disease Control and Injury Prevention September 28, 2005. Instructions for Identifying and Protecting Displaced Children. <http://www2a.cdc.gov/HAN/ArchiveSys/ViewMsgV.asp?AlertNum=00236>.
- ¹² Brandenburg, MA, Watkins, SM, Brandenburg, KL. Reunification of displaced children and their legal guardians after Hurricane Katrina. *Disasters* 2007;31(3):227-287.
- ¹³ Brandenburg, MA, Ogle, MB, Washington, BA, et al. Operation Child-Safe: A strategy for preventing unintentional pediatric injuries at a Hurricane Katrina evacuee shelter. *Prehospital and Disaster Medicine* 2006;21(5):359-365.