

Public Health Emergency: Designing a Shelter for Tornado Victims

Introduction

Approximately 1,000 tornados occur annually within the United States and none of the lower 48 states is immune. However, tornados occur most frequently in the Midwest and Southwest and are more common between March and May. Due to the fact that tornados can produce winds of up to 200 miles per hour great structural damage may occur. Providing shelter to tornado victims is important and many things need to be considered when designing a tornado shelter for victims. An example of a possible tabletop exercise is presented below on what should be considered when developing a community tornado shelter.

Master Task List for MSEL

1. Initiate collaborative partnerships with local area hospitals and other public health facilities
2. Perform a rapid tornado shelter survey
3. Conduct initial assessment to determine which shelters can accept “special needs” victims
4. Conduct an inventory assessment of medical supplies, equipment, food, and water
5. Ensure that staff are adequately qualified to care for all victims
6. Educate shelter staff on how to handle the most common injuries associated with tornados
7. Conduct a risk assessment of potential communicable diseases.
8. Determine communicable disease control methods
9. Conduct epidemiological surveillance of communicable diseases
10. Evaluate if medical needs are being met
11. Initiate collaborative partnerships with local area hospitals and other public health facilities
12. Perform a rapid tornado shelter survey
13. Conduct initial assessment to determine which shelters can accept “special needs” victims
14. Conduct an inventory assessment of medical supplies, equipment, food, and water
15. Ensure that staff are adequately qualified to care for all victims
16. Educate shelter staff on how to handle the most common injuries associated with tornados
17. Conduct a risk assessment of potential communicable diseases.
18. Determine communicable disease control methods
19. Conduct epidemiological surveillance of communicable diseases
20. Evaluate if medical needs are being met

Objectives

For this particular table top exercise, four possible objectives were decided on. These include addressing communicable diseases and epidemiological surveillance, taking into consideration certain variables that may aid in the maximization of protection, addressing possible medical

needs that may be presented to shelter staff, and ensuring that basic amenities are provided to shelter victims.

Objective 1: Communicable Diseases and Epidemiological Surveillance at Tornado Shelter

Health problems are only one, and often the most important, aspect of a complex situation. In disasters, confusion, if not actual chaos, and a lack of objective health information and unsubstantiated rumors, make up the general background from which vital and far-reaching decisions have to be determined.

Objective: To ensure that the staff members are well equipped with the risk of increased incidence of diseases following a tornado and conduct an epidemiological surveillance and propose appropriate control measures.

Measurement: A surveillance guide for communicable diseases is used to provide potentially useful baseline information about the numbers of people with communicable diseases. This information can assist the medical staff and public health community at the tornado shelter in assessing the needs of people with communicable diseases and in planning relief efforts.

Risk Factors for Increased Incidence of Communicable Diseases:

The initial step of the staff is to assess the risk factors associated with increased incidence of the communicable diseases in a tornado shelter.

- Crowded living conditions.
- Wound infections due to the tornado.
- Chronic medical conditions e.g.: diabetes and hypertension.
- Mental health state.
- Malnutrition.
- Lack of effective prior immunizations.
- Vectors in the camping crowd. E.g. lice
- Sanitation and administration problems.

Type of infectious diseases:

While these infections had little potential for serious complications, they reflect the living conditions of a tornado shelter and illustrate the importance of hygiene in preventing the spread of disease.

- Diarrhea and vomiting. E.g. V.cholerae and S.typhi
- Conjunctivitis.
- Respiratory infections. E.g. Pneumonias and Pulmonary TB
- Wound infections. E.g. S.aureus and Clostridium.
- Mosquito borne infections. E.g. West Nile virus
- Vaccine preventable disease. E.g. Varicella, Measles, Mumps and Rubella.

Epidemiological Surveillance:

Epidemiology surveillance at the tornado shelter by the staff members helps in identifying the dynamics of health phenomena with a view to proposing the most effective control measures. Its

usefulness can range from the surveillance of communicable diseases at the shelter place to the study of the surge of medical emergencies, the occurrence of mental disturbances, etc.

- Identification of the diseases.
- Symptom or syndrome based reporting
- Sending of disease reports on a frequent basis (daily) to the central level.
- Investigation of rumors of an epidemic outbreak.
- Investigation of nature and magnitude of a true epidemic outbreak at the shelter.
- Circulation of epidemiological information and use of the results.
- Surveying environmental and medical measures by the staff to prevent communicable diseases.
- Disease surveillance based on syndromic surveillance.

Communicable Disease Control Methods:

Prevention and control of communicable diseases at the shelter place provide major opportunity to reduce suffering and death.

- Proper site and shelter planning
- Proper water and sanitation provisions.
- Immunization implementation at the shelter place.
- Proper vector control measures.
- Chronic illness case management.

Objective 2: Consideration of Variables Needed to Maximize Protection During a Tornado

Given the unpredictable nature of tornados emergency staff has little time to warn the public or select a shelter location. In the event of severe weather it is important that emergency have the capacity to quickly select an appropriate shelter site for those that can be forewarned. Emergency staff can assist in moving individuals to a shelter area or by providing rapid, basic instructions so that individuals can select an appropriate shelter.

Objective: To ensure that members of the emergency staff have adequate knowledge of the variables needed (preexisting structures) to maximize protection during a tornado. Variables that will need to be considered are location, construction material, and space required for an adequate shelter.

Measurement: Staff will be monitored for their ability to perform a rapid primary tornado shelter survey. Assessment will be made based upon the verbalization by the staff of the criteria needed in an adequate shelter. For the purpose of this exercise we will focus on structures that have not been designed specifically as a tornado shelter (this is based upon the assumption that specifically designed tornado shelters are structurally sound)

Selection Criteria-

A rapid primary survey for a tornado shelter selection site can begin with the exterior features of the structure. Specific features to assess are as follows (4):

1. Potential missiles (site equipment, nearby buildings, debris, etc.)
2. Ground embankment against the building.
3. Mechanical equipment on roof.
4. Electric service entrance.
5. High building elements (chimneys, higher portions of the building.)

After the exterior survey is complete an interior assessment can be performed. There are certain features that are generally desirable in a shelter. These include (4):

1. Lowest floor (preferably a basement)
2. Interior spaces. These are spaces that have no walls on the outside of the building.
3. Short spans. Several smaller spaces may be required so that all occupants can fit adequately.
4. Areas with structural frames (steel, concrete, wood).
5. Adequate space (6 sq ft for each adult, 4 sq ft per child)
6. Ensure that space is accessible by special needs population.

Undesirable attributes in a tornado shelter include:

1. Avoid spaces that are opposite doorways or openings (especially windows) into rooms.
2. Locations that contain glass
3. Interior locations under or near skylights.
4. Locations where interior doors swing.
5. Avoid spaces within the falling radius of higher building elements (such as chimneys, etc).

Objective 3: Medical Concerns that Need to be Addressed at Tornado Shelters

Objective: To ensure that shelter staff are equipped to handle medical emergencies that they maybe presented with after a tornado. These medical emergencies include the most frequent injuries that occur as the result of a tornado and medical emergencies of special needs individuals.

Measurement: Will be a process measurement. This will include observing how well shelter staff are able to provide aid to injured individuals and/or special needs individuals. This will also include assessing if the shelter has the proper medical supplies and equipment available for these particular injuries.

Types of injuries

The first step to ensure that shelter staff are equip to handle medical emergencies that may arise after a tornado is educating them on what to expect. This includes knowing what types of injuries are possible due to the direct impact of the tornado and the possible secondary injuries/ infections that might occur. The most common type of injuries that result from tornados are due to flying debris or as the result of people being thrown by the high winds (6). These injuries may be presented as head injuries, soft tissue injuries, puncture wounds, or even crushed bones.

Knowing how to respond to these types of injuries is important to limit possible secondary infections. Treatment may involve stopping bleeding to control possible hemorrhage; this may require knowing how to use a tourniquets, examination of wounds for possible gross contamination or foreign objects, how to properly clean wounds with soap and water, and being vigilant for less obvious wounds (7).

Not only should the shelter staff be able to aid in the treatment of physical injuries, but they should also be aware of mental and emotional issues that may also arise. Several mental health issues that may develop as a result of experiencing the trauma of surviving through a tornado include anxiety, neuroses, depression and stress (8). Protocols should be in place to offer comfort for these individuals.

Individuals with special needs

Establishment of a clear contractual agreement and local memorandums of understanding with the American Red Cross that “details obligations to accept members of the aging and disabled community into mass shelters” is very important (9). This can be accomplished by ensuring that shelters are equip to address the needs of people with disabilities is also important. For example, many shelters do not have refrigerators to store medication or back-up generators for individuals that rely on electricity for medical equipment (9). Before a disaster strikes, shelters that are equipped to handle individuals with special needs need to be identified as priority basis for the disabled needing these services. Identifying which shelters will most likely receive disabled community members can also be helpful. Other areas of concern that need to be addressed include providing information for blind or visually impaired and deaf or hearing impaired individuals. Acknowledging that people with disabilities may be feeling extra vulnerable due to their loss of individuality is also important (8).

Other issues that need to be considered

Ensuring that shelters have the proper medical equipment to handle the above mentioned injuries should also be taken into consideration when planning a shelter. This can be accomplished by developing partnerships with local area hospitals and other health care facilities. Also, it should be noted that there maybe the possibility that the local area hospitals may have severe damage and that the local shelter may be the only source of medical care until outside assistance can arrive. Therefore, the local shelter should have the capacity to provide services for a large number of individuals on a short-term basis.

Process Measurement

To determine how well shelters are at performing in regard to medical care, observation can be made. Monitoring the rate of secondary infections, ensuring that the needs of special needs population are being met and if there is an adequate medical supply on hand are all important (10).

Objective 4: Providing Basic Amenities at Tornado Shelters

Objective: To ensure that the tornado shelter can provide the basic amenities needed until additional supplies and personnel arrive. Among the basic amenities to be provided include: adequate food supplies, adequate water supplies, waste disposal systems/basic sanitary facilities, and indoor temperature regulation for a minimum of 3 days duration for 250 people.

Measurement: Primarily be evaluated by looking at outcome measures such as number of meals provided to each individual per day, number of drinks provided to each individual per day, number of emergency generators functioning per day, temperature variation from set baseline of 72degrees F, etc. In addition, process measurements will also be made. Among these observations will include: did someone register all evacuees, were workers available to address the concerns of the evacuees within a reasonable amount of time, were there enough bathroom facilities available to meet demand, were diabetics and other special needs populations' dietetic needs addressed by workers, were workers washing their hands before preparing and distributing food and drinks, etc.

FEMA's Mass Care Annex for General Provisions to be Considered at all Shelters:

A mass care annex describes the provisions that have been made to ensure disaster victims receive the appropriate services when at a mass care facility. Local government is responsible for the development of a capability to provide mass care services for its citizens in the event of an emergency and should be prepared, if necessary, to receive and care for people evacuated from the area directly impacted by a disaster. The requirements for services vary depending upon the nature and phase of the emergency. Local officials must be ready to provide different types of support in response to the unique nature of the situation. Prior to onset, facilities (e.g., schools, churches, nonessential government buildings, etc.) are needed to register, shelter, feed, protect, and provide for other human needs of an evacuated population. During the emergency phase, these facilities may be used to provide evacuees physical protection from the effects (e.g., water and wind associated with storms, earthquake aftershocks, radiological contamination from a nuclear power plant accident, etc.) of a disaster. During the post-disaster period these facilities may be used on a long-term basis to feed, care for, and provide temporary housing to the disaster victims whose homes have been severely damaged or destroyed or cannot return to their homes because of damage to or debris on roads and bridges. Other long-term post-disaster mass care options may include: kitchens to feed people; water supply stations; first aid stations; temporary housing in rental units, tents, hotels/motels, and mobile homes; hygiene facilities (portable toilets and showers); mail service, etc. (11)

Some salient points to be remembered...

Food

Carefully ration everyone's food except that of children and pregnant women. Most people in a shelter can get along with about half as much food as usual and can survive without food at all for several days, if necessary. (12)

If your water supply is limited try to avoid foods that are high in fat and protein, since they will make you thirsty. Try to eat salt-free crackers, whole grain cereals and canned foods with high liquid content. (12)

Keep food in covered containers. (12)

Keep cooking and eating utensils clean. (12)

Canned food can be eaten right out of the can without warming. If you heat it in the can, be sure to open the can and remove the label first. (12)

Ensure proper hand-washing of the workers prior to serving food to the evacuees.

Water

Water is critical for survival. It should be saved for drinking and medical emergencies. (12)

Allow people to drink according to their need. Each person's need will vary depending on age, physical activity, physical condition and time of year. (12)

The average person should drink between two and two-and-one half quarts of water or other liquids per day, but many people need more. Plan to need one gallon of water per person per day. Under no circumstances should individuals drink less than one quart of water each day. It is better to use whatever water is available, in the hope of finding more, than it is to deprive people of what they need for survival by rationing it. (12)

Ensure adequate facilities/equipment for purification methods as a contingency if the water supply is lost or contaminated. The first three methods boiling, chlorination and purification tablets - will kill microbes but will not remove other contaminants such as heavy metals, salts, most other chemicals and radioactive fallout. The final method - distillation -will remove microbes as well as other contaminants including radioactive fallout. (12)

Waste Disposal and Basic Sanitary Facilities

Keep all garbage in a closed container and dispose of it outside the home when it is safe to go outside. If possible, bury it. Avoid letting garbage or trash accumulate inside the shelter, both for fire and sanitation reasons. (12)

Toilets separated for women and men

Ratio of 1 toilet: 25 persons – supplement with portable toilets (ten) as a contingency

Air Quality:

- No fumes or noxious odors are present (i.e. paint fumes, cleaning solutions).
- Smoking is restricted to designated areas.
- A source of fresh air is available (i.e. there are windows and doors that open).

- The ventilation system is functional.
- If there is no automatic H-VAC system, windows and/or doors are left open for 10-15 minutes several times per day to provide air exchange. (13)

Maintenance:

- Indoor and outdoor environments are clean and free of debris.
- Floors are washed daily and carpeted areas vacuumed daily.
- Floors are cleaned immediately after any spills.
- There are enough trash cans available for clients and staff so that trash is easily disposed of and cans are not overflowing. Garbage cans are lined with a plastic bag and have covers.
- Garbage (biodegradable matter such as food) & trash (paper/plastic/refuse) are removed daily.
- Janitorial equipment and supplies are in good repair and have a designated storage space. Cleaning supplies and chemicals are kept out of children's reach and separate from food.
- Pest control is done on regular basis. The premises are pest-free, to the extent possible. (13)

Kitchens and Bathrooms:

- Plumbing is in working order in the showers, sinks, and toilets.
- Kitchen, bathrooms, and common areas have posted cleaning schedules that are adhered to. Kitchen and bathrooms are cleaned at least twice daily, preferably after high-use periods.
- Sanitary napkins, tampons, disposable diapers are disposed of in specially provided containers that are lined with plastic bags and emptied daily.
- Signs are posted in the bathrooms/showers that discourage clients from sharing personal items. (13)

Environmental control – temperature regulation

Ensure that the shelter has an adequate back-up emergency electrical power system (storm protection and access, power rating, connection to needed circuits, reliability, fuel capacity, etc.), and that the system supports air conditioning of spaces occupied by evacuees. (14)

Ensure that the shelter can provide 60 sq.ft. per evacuee to ensure that capacities listed for the shelter can account for caregivers and other essential equipment and staff. (4)

Response agencies must sustain themselves during the first 24 hours of an emergency. (15) So, at a minimum, planning must be ensured to have the supplies and personnel needed to take care of sheltered victims for this minimum period of time. Our objective is to have our tornado shelter remain self-sufficient for 72 hours.

MASTER SCENARIO EVENTS LIST

TIME (min.)	MSSG #	MESSAGE SUMMARY	EXPECTED RESPONSE
-	1	Partnerships established (area hospitals, pub. health facilities, etc.)	
-	2	Ensure staff is adequately qualified	Establish stand-by tornado shelter staff (volunteers, health care professionals, etc.). Require pre-set training attendance.
-	3	Staff Education - common tornado injuries	
-	4	Assess risk for communicable diseases Determine communicable disease control methods	
-120	5	Tornado shelter check	Check for sites for tornado shelter Check for lowest floor Check on interior spaces Check structure Check on space Make sure location is accessible by special needs populations
-90	6	Tornado watch --> warning issued -->tornado sirens employed	Inventory check - med supplies, equipment, food, H ₂ O
0	7	Exercise start Tornado sighted on ground Major damage reported	
+5	8	Nearby trailer park is in direct path of tornado	Ready trailer park shelter (supplies, staff)

+7	9	Residents of trailer park begin to enter shelter	
+7	10	Nearby highway also in path of tornado - drivers urged to seek shelter immediately Motorists begin to seek shelter	Shelter staff ready to take in more tornado victims.
+10	11	Man enters shelter stating parapalegic wife is in car outside - needs assistance bringing her inside shelter	Staff executes plan for accomodating access to shelter for parapalegic woman.
+12	12	Nuclear family with 3 children under age of 10 enter shelter	Health care area set up
		Mother has open compound ulnar fracture One child has stepped on nail - deep puncture wound to foot	Mother's wounds/fracture adequately treated. Child's puncture wound adequately treated.
		Remaining two children and father have extreme anxiety, hysterics	Mental health concerns addressed.
+14	13	12 more people (generally healthy) walk in	Continue to meet individual & group needs
+15	14	Mother enters shelter with child with flu-like symptoms: vomiting & diarrhea x3 days,	Assure fluid/medical attn. to child. Consider communicable disease control measures
+16	15	18 more people walk in	Continue to meet individual & group needs
+25	16	15 more people trickle in over previous 9 minutes	Continue to meet individual & group needs
+35	17	Initial brunt of tornado has passed	Staff has communication system (weather radio, etc.) to verify all clear
+45	18	Tornado victims in shelter wish to leave to see damage	Staff has measures to verify their safety to do so
Periodic/Through-out	19	Surveillance of communicable diseases	
Periodic/Through-out	20	Evaluation of medical needs being met	
+45	21	Tornado victims return - their homes are completely gone	Staff able to host/care for tornado victims for up to 72 hours or until relieved.

References

1. Surveillance for illness and injury after hurricane Katrina—New Orleans, Louisiana, September 8–25, 2005. *MMWR Morbidity and Mortality Weekly Report* 2005; 54(40):1018–21.
2. Landesman L. *Public health management of disasters: the practice guide*. 2nd ed. Washington, DC: American Public Health Association; 2005.
3. <http://www.bt.cdc.gov/disasters/handhygiene.asp>
4. Seeking The Best Available Shelter Against Tornadoes and High Winds
<http://www.co.monroe.mi.us/monroe/default.aspx?PageId=346>
5. FEMA Facility and Community Tornado Shelters
www.fema.gov/news/newsrelease.fema?id=2553 - 14k
6. Public Health Responsibility
http://www.apha.org/preparedness/Chapter_01.qxd.pdf
7. Health Effects
http://www.paho.org/english/Ped/SP575/SP575_01.pdf
8. CDC. Tsunamis: Emergency Wound Management.
<http://www.cdc.gov>
9. Kailes JI. Center for Disability Issues and the Health Professions. Serving and Protecting All by Applying Lessons Learned—Improving Access to Disaster Services for People with Disabilities and seniors. 2005.
10. Frieden L. National Council on Disability. Newsroom. Saving Lives: Including people with disabilities in emergency planning. April 15, 2005.
www.ncd.gov/newsroom/publications/2005/saving_lives.htm
11. <http://www.fema.gov/pdf/plan/5-ch-f.pdf>
12. <http://www.co.monterey.ca.us/oes/shelters.htm>
13. <http://www.metrokc.gov/health/hchn/recommended-shelter.pdf>
14. http://www.floridadisaster.org/documents/SpNS_Report.pdf
15. <http://www.fema.gov/pdf/plan/5-ch-h.pdf>
16. <http://www.cliffsidesoftware.com/html/features.html>
17. <http://www.orav.gov/emi/exercisebuilder/step06.htm#03>

18 <http://www.osdfsnationalconference.org/Presentations/MarkWeimerskirch1CP.pdf>