Evacuation Planning

This training video focuses on planning for community-level evacuations that involve the movement of large numbers of people. This training uses research conducted on evacuations from a variety of events, both natural and technological, and experts from around the country to lay out a foundation for evacuation planning. It discusses human behavior in evacuations including the timing of departures, compliance with evacuation orders, how people respond to warnings to evacuate, evacuation destinations, evacuation rates, and the impact of false alarms. It also covers planning for vulnerable and special needs populations such as the disabled, elderly or those with other constraints to evacuate. In addition, it discusses evacuation management issues such as traffic control, contra-flow or reverse-lane traffic, coordinating evacuations from institutional facilities, and the use of evacuation models. The target audience for this video includes emergency planners, elected officials, public information personnel, and others who may need to plan and direct emergency evacuations of communities.

Student Guide

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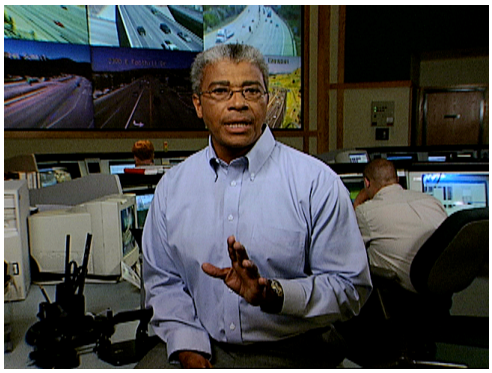
Introduction

Narrator:

Planning for and taking protective actions in emergencies to reduce harm to both people and property is needed for all disaster events – earthquakes, floods, hurricanes, wildfires or other natural phenomenon as well as chemical releases, terrorist actions or some other human-caused event.



Evacuation and sheltering are two protective actions used in emergencies, sometimes in combination, sometimes alone. Some communities with large industrial complexes advise residents to shelter immediately when hearing an alert siren and then listening for further instructions to either continue sheltering or to evacuate. Evacuation is generally preferred and provides more protection than sheltering when it can be completed before the actual threat arrives. Sheltering-in-place is preferred when evacuation puts people at greater risk such as during storms producing tornados or when a fast-moving chemical release means people could be evacuating in a toxic cloud.

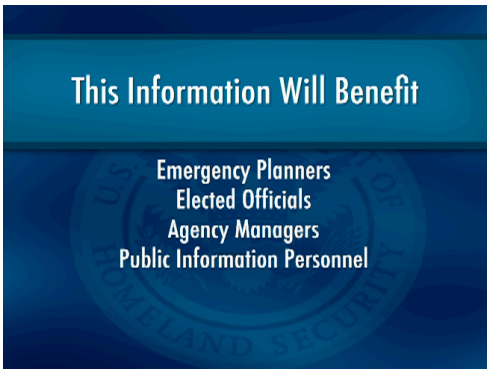
When the recommended protective action is evacuation of an entire geographic area - especially if it is a large urban or densely populated area - emergency management officials and planners must coordinate their efforts with law enforcement, fire and hazardous materials personnel, transportation engineers, special needs experts, search and recovery teams, and multiple local, state and federal agencies.

Given today's changing world, planners and emergency officials must identify partners to aid in developing evacuation plans. They should be prepared for normal hazards as well as those that have very little probability of occurring, but could result in great loss of life and property if they did occur. Having a plan to acquire additional resources to handle such events is critical. This aspect of planning may be difficult for emergency managers but is needed for catastrophic events.

Over the years, evacuation has been an area of considerable multi-disciplinary study and much has been learned about what makes an

evacuation effective, and what areas need improvement. Because evacuation for hazards has been well researched, this training focuses on evacuation timing, transportation strategies, destinations, behavioral issues, and constraints to evacuating. We also will discuss how people respond to warnings, issues related to non-compliance and planning for vulnerable and special-needs populations, transportation strategies that include including estimating and modeling evacuation times, and the impact of false alarms on future hazards. Given America's increasing urbanization, the discussion focuses on community-level evacuations that involve a large number of diverse population groups.

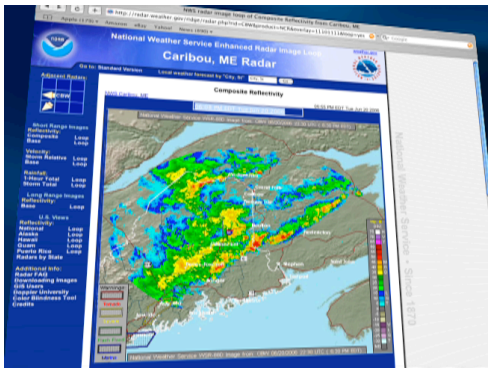
In this video we will talk with some of the leaders in evacuation research within their respective fields. This information will help emergency planners, elected officials, agency managers, public information personnel, and others who may need to plan and direct emergency evacuations. Armed with information contained in this video, these same people may find it easier to discuss the rational for preparedness and for recommended protective actions-with constituents, stakeholders or people with special needs.



The training material also may be used to initiate discussion with small focus groups or to enhance evacuation strategies after an event. Often there is a window of opportunity to incorporate lessons learned and innovative ideas into emergency plans following a major evacuation.

Once the need for an evacuation is determined, officials must warn people at risk in time for them to take the necessary actions to evacuate. While radio and television are still obvious choices, improvements in communications and warning technologies have increased options to alert and notify residents of a potential threat such as the reverse 911 automated dial-ups. The Specific Area Message Encoder - or SAME - technology has permitted NOAA weather forecasters to

issue warnings to specific counties reducing false alarms. Warnings are also issued using the Internet to IP addressed devices such as computers, cell phones, and pagers. As technologies change and become widely-adopted, planners should consider how they might aid in alert and notification efforts. And then planners need to consider the people technology does not reach.



Planners - and residents - should also factor into their plans that outside resources may not arrive until as much as 72 hours after an event occurs. Households should prepare emergency plans and a disaster supply kit including sufficient food and water for all household members, including animals, to last 3 days. Public information specialists and media outlets should be involved in planning to disseminate critical information on what resources will be available to residents prior to and immediately following an event. These efforts should be supported by a pre-disaster public education program on preparedness for emergencies. The messages should include requests for those with special needs to identify themselves and their needs.

An effective warning system that gets people to evacuate is both an engineering and organizational process. Warning systems are more than technology, involving human communication, management and decision-making, and coordination. As demonstrated by experiences of survivors of the 2001World Trade Center disaster, warning systems also extend far beyond “official systems” as most of the evacuees in the second building to be hit started to evacuate before they were told to by the building's public address system - which occurred one minute prior to impact by the second plane.

Planning for an emergency starts with an assessment of community's risks. A thorough vulnerability analysis will determine where facilities and infrastructure are sited that may present risks to residents if an accident occurred or hazards that may impact the community at large. Planners should also think of disastrous combinations that would result in residents and businesses being evacuated. For example, major

chemical facilities or refineries may be clustered in an industrial park outside town that are serviced by a railroad running next to new housing developments. An earthen dam upstream of a community may not be safe in an earthquake or major flooding. A wildfire may occur near a large seasonal recreational resort that is reached by a single-lane road.

Mike, Lindell, a psychologist with the Hazard Reduction and Recovery Center at Texas A&M University, knows different populations respond differently to threats and evacuation orders.

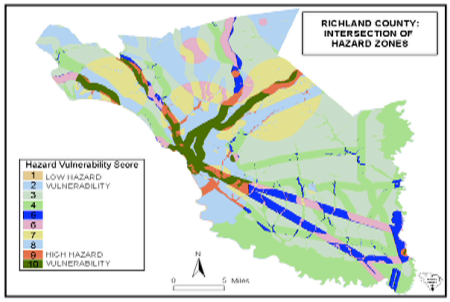
Once you've identified the areas that are exposed, then you need to go on to the next step of identifying the kinds of population segments that are in those vulnerable zones and the kinds of facilities that are there. Coming back to the issue of ethnicity, is it primarily African American is it primarily Hispanic is it primarily Caucasian groups? what's the income level? what's the education level? That's only one part of the concern. Another is the special facilities, what kinds of schools, hospitals, nursing homes, jails and other kinds of facilities are located in those vulnerable zones so that you know how to communicate with those people as well. if you've got parks there that bring in people from out of the area, they might not know about the HAZMAT facilities and protective actions and so you need to deal with those kinds of issues ahead of time. Think them through and figure out ways to post information for people who are picnicking or camping or boating.

Public Law 106-190, the Disaster Mitigation Act of 2000, amends the original Robert T. Stafford Relief and Emergency Act that provided disaster relief to communities. The amended Stafford Act requires that the community identify potential hazards to the health, safety and well being of its residents and identify and prioritize actions that can be taken by the community to mitigate those hazard before disaster strikes. For communities to remain eligible for hazard mitigation assistance from the federal government, they must first prepare a hazard mitigation plan.

Susan Cutter, Director of the Hazard Research

Laboratory at the University of South Carolina.

Under the disaster mitigation act of 2000, all communities are required to have a hazard vulnerability assessment of their communities. And these hazard assessments look at the type of exposure the community faces from a variety of natural and technological events and so the good ones really are place specific and look at where you have concentrations of chemical facilities where you have your floodplains where you might have low lying areas subject to storm surge inundation and these sorts of things and these hazard vulnerability assessments actually provide the basis for disaster mitigation plans that all communities are supposed to do. All zoning is local and all land use is local and so those communities that are doing a good job are those that are looking at these sorts of hazard zones and they're looking at local land use decisions to keep people out of these hazard zones. The communities that aren't doing such a good job are the ones that are oftentimes experiencing loss because they're allowing people to build in these high-risk areas and this could be right along the shoreline, could be right along floodplains, could be potentially adjacent to major industrial facilities. There's some things that the federal government can mandate in developing these kind of risk based hazard vulnerability assessments but ultimately it's at the local level - the community makes the decision on where people can live and where facilities can be located.



The final step is to facilitate the movement of people out of the area using the most coordinated and comprehensive evacuation plans possible.

<u>Evacuation and Response</u>

Narrator:

Evacuation generally means leaving an area of potential threat for a safer location. Usually this is a round-trip process, but sometimes when a structure or area is severely damaged or destroyed - or cannot be decontaminated effectively - return may be delayed for months, years or permanently. The anthrax-contaminated American Media building in Boca Raton, Florida, took several years and substantial private

investment to become habitable again as office space. Areas in Florida and Louisiana devastated by hurricanes and floods have been slow to recover.

Most evacuations are precautionary, especially for events with long lead times, such as hurricanes or major floods. Other evacuations are reactionary and take place after an event occurs, such as after a train derails and a hazardous chemical is released from a tank car.

Some people will evacuate in response to invitations from family, friends and others offering temporary refuge. Most evacuees prefer to stay at hotels, motels or with friends or family.

Some people evacuate by default when they are kept from returning to a residence or workplace in an area that was evacuated while they were away. Often those evacuated by default do not have any emergency supplies or other necessities with them. This type of evacuation can stress the community's emergency response capacity for providing relief and other support such as caring for animals left unattended.

Few communities have the physical or legal capacity to force people to leave. Even when officially mandated, some individuals will remain in the evacuation zone either because they cannot or choose not to leave. Evacuation plans should recognize that some people will have to shelter and emergency officials need to provide services to them if at all possible as soon as the danger has passed.

Betty Hearn-Morrow, Professor Emeritus, Florida International University...

The factors associated with leaving typically are income, people who have higher incomes are more apt to evacuate. Evacuation is expensive, you know the gasoline, the food, lodging if you need it, so that's an important factor. We found that if people live in an evacuation zone and know they do, they're more apt to evacuate. You know people tend to make rational decisions if they're given the information in a clear way. If they know that an evacuation order has been

given for the community and that gets us into the whole issue of warning messages that we have to be very clear in warning messages exactly personalize it - exactly who are we talking about here, you know, that needs to evacuate - what areas and geographical locations and so forth. that's important to get people to evacuate. Men in general are less apt to evacuate if they're making the

How do people respond to warnings to evacuate? When people hear a warning they generally try to find out more about the threat and check to make sure the warning is credible. People consult with family members, friends, co-workers, turn to a news channel or the Internet. After confirming the threat as real and they are at risk, they make choices concerning their personal safety. Some gather possessions and leave, others will delay their decision, and still others elect not to leave.

Mike Lindell,

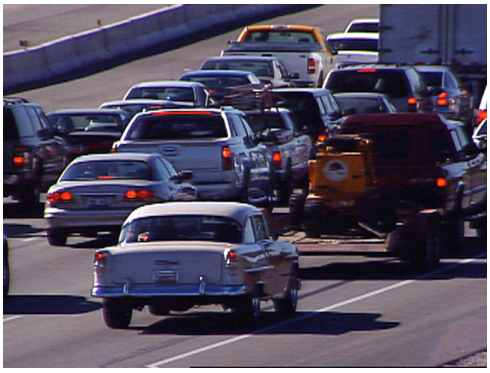
It's important to understand that there are lots of different variables involved that you have to understand what is the community's perception of the emergency manager and other public safety officials as an information source. You have to understand what are the advantages and disadvantages of different kinds of communication channels. You have to understand how to construct effective warning messages and you have to understand how it is that the different segments of the community will interpret the warning messages that they get and the different kinds circumstances they're in that will influence their ability to evacuate or whatever other protective action you want them to take. And it's also important to provide a feedback loop so that if people are unclear about the message or unclear about the hazard unclear about the protective action that what they can do is call in to a hotline or that they can log in to a website or that they can turn on a particular radio station or particular television station that there's some place that they can go to confirm the warning message and get additional information. all of those aspects are important and how the warning system gets designed for any given community is going to depend upon all those different

characteristics - the sources, the channels, the messages, the receivers and the feedback loop.

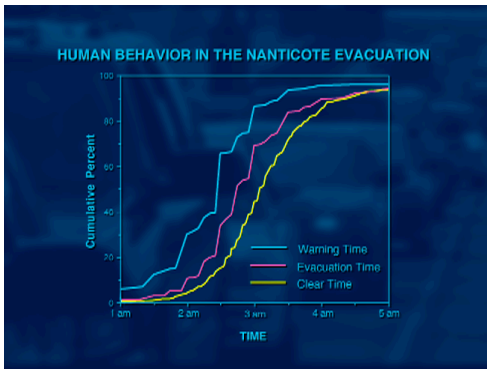
Evacuations usually take place in a group context. Families will try to reunite to evacuate as a group. However, they may not travel in a single vehicle if two or more vehicles are owned and there is a prospect of severe damage from an event. In business settings, co-workers typically evacuate in groups.

Susan Cutter

.....increasingly we have more and more wealth moving to the coastal areas and one of the large problems with evacuations that we've seen based on some of our work here in South Carolina is people are reluctant to leave expensive automobiles. So instead of piling the family in to one automobile - we know families evacuate as units - people will take as many cars as they have drivers and so instead of having 3 people per car, you have 3 cars with one person in each and that adds to the amount of traffic on the transportation routes out of harm's way, and so you have increasing volume of traffic as you have potentially increasing wealth in some of these communities and that's going to increase the amount of time it's going to take to clear these areas and so I think emergency management is starting to think about these sorts of things but I think - more work needs to be done and more thought given to how many people are actually going to leave and how many cars are they going to take and what do we do about these populations that don't have the kind of resources to get out of harm's way.



How fast do people mobilize?
Mobilization time is measured from when people hear the first warning until exit behavior begins. It's important to remember that not all people can leave immediately when advised.



Researchers have found that the timing of evacuation departure resembles an s-shaped or logistic curve. The shape of the curve is largely determined by the amount of time available to evacuate before the threat is present. In very fast-moving events such as a flash flood or hazardous material release the curve is very

steep. In slow-moving events such as hurricanes, the curve is flatter and may be influenced by the time of day – people are less likely to evacuate at night.

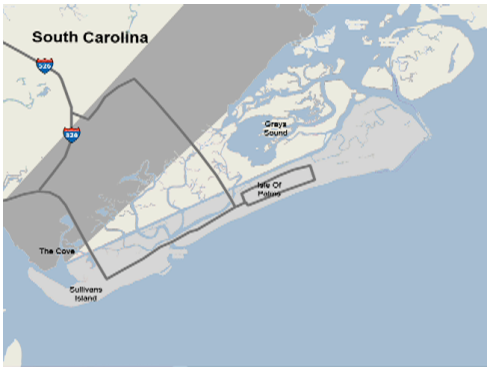
Again Betty Hearn:

if that's over a weekend, they'll have more time to prepare and get ready but if it happens quickly, a fast moving event such as other hazards, spills and so forth, that's a whole different situation. With these long events, people will weigh it, they'll take their time, but if it should happen at night, very few people evacuate their homes at night - that's pretty rare. Maybe in the case of sirens with tornadoes, we may have a little bit of that but in general people aren't watching the news, they aren't paying attention and we don't have sirens in most communities, we sort of did away with that particular mode of warning people that maybe we shouldn't have because nighttime is an issue - that's every emergency manager's horror to have something that happens fast and happens at night.

Disaster researchers have studied issues associated with official orders to evacuate or not to evacuate, known as compliance. An evacuation compliance rate is the portion of the population who receive an official order to evacuate that leaves the area at risk within the specified time period. Evacuations rates may vary depending on whether the evacuation is mandatory or only be recommended by officials.

Studies have examined evacuation rates in different events, "shadow" evacuation, "early" or "spontaneous" evacuation and "cry-wolf" effects.

Susan Cutter:
A shadow evacuation is a phenomena that occurs when you have a targeted population that you're trying to get out of harm's way and you're advising them to evacuate and people not in that targeted area actually leave as well. So, you have, geographically an area that you're trying to move people out of harm's way, let's say a barrier island, for example, but not only do people on the barrier island evacuate but people living inland evacuate and what we might think of is it creates a shadow.



One of the interesting things about the shadow evacuation is it seems to be more prominent with what we might call technological events such as chemical spills, train derailments, nuclear power accident than what we see with natural disasters like hurricanes. so that's an interesting phenomena that you get with this larger shadow evacuation being produced by more technological kinds of events.

In most evacuations, not everyone at risk participates in the evacuation. Reasons for non-compliance include not having access to transportation, being mobility impaired, not being able to afford to evacuate, needing to work or provide care for others, or thinking one's location is safe. Some individuals don't evacuate because of a concern for looting. Many of these reasons accounted for the non-compliance with evacuation orders in New Orleans during Hurricane Katrina in 2005. Others that may not be able to evacuate are individuals temporarily incapacitated by illness or people who have livestock, numerous pets, or highly valued animals.

Betty Hearn-Morrow:

Well certainly if you're talking about evacuation, there are going to be some populations that are not only perhaps more at risk but they're going to have a much more difficult time securing either their home or evacuating. And for those people, they tend to be people who, for whatever reason, aren't maybe a part of the mainstream society in terms of being incorporated into the community. They're likely to live alone. We're talking about people who are poor that may not have resources, elderly people who often are very reluctant to leave home even if they should and have the resources, people with special needs. And so it behooves emergency managers and public officials to try to know as much about where these people live as possible so almost every community will have some sort of a special needs registry that's usually now today GIS coded to their vulnerability assessment so they know where these people are but of course that means also that you need to have plans as to how they're going to get to them in an emergency.

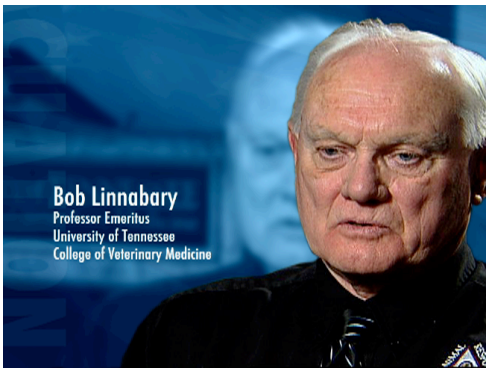
Spontaneous evacuation occurs in many situations when risk information is reaching the public before officials have made a decision on a protective action. In some instances it helps facilitate "official" evacuation orders. In one study of a hazardous material accident, plant workers and first responders at the scene contacted friends and relatives thought to be at potential risk before the evacuation order was given by emergency officials.

Susan Cutter:

A spontaneous evacuation occurs when groups of individuals decide on their own to leave without any official advisory or mandatory order from emergency officials. Oftentimes spontaneous evacuations precede an advisory. People decide they don't want to wait for the official advisory to come out and, therefore, make their own arrangements to get out of harm's way. Oftentimes, spontaneous evacuations occur because people have been through evacuations before and they're anticipating a mandatory advisory coming out. Other times, spontaneous evacuations occur because people have a very heightened sense of the risk of the threat source and fear and so what they want to do is put distance between themselves and the source of the threat.

Many people evacuate with pets. Data suggests up to 25% of evacuating families will have animals. While residents can be urged to pre-arrange shelters for animals, most planners will have to facilitate such arrangements. This may include working with local veterinarians and humane societies to arrange accommodations.

Bob Linnabary, Professor Emeritus of the University of Tennessee College of Veterinary Medicine, says:



People are always first. Regardless of the disaster, the people are always first but you also have to consider the emotion level of the person where if they're not going to evacuate because of their animal, then you do have to have that component in there to make the evacuation sooner. One of the problems we had with Katrina was the fact that the people were not going to

evacuate without their animals and they didn't provide the evacuation methods to evacuate the people and animals and it was a logical thing… they wanted to take care of the people first and the responders didn't have the knowledge or the capability of evacuating both the person and the animal. The people I've worked with have learned that this is part of their plan because if the people aren't satisfied their animals are going to be taken care of, they're not going to be leaving and they don't want to leave and they can't force them to leave. And one of the things we try to encourage the emergency management to do is to use the plan and to get the people out and to assure the people that those animals are going to be taken care of.

Both the American Veterinary Medical Association and FEMA recommend evacuees take animals with them but Red Cross shelters are not pet-friendly except for certified working companion animals. Urging evacuees to have identification on animals, including rabies and license tags, name, home address and phone number where the owner can be reached facilitates reuniting evacuees with lost or rescued animals. Owners also should be encouraged to keep proof of ownership, including photos, of all current animals.

Again, Bob Linnabary:

We do what we call a resource assessment. In any community, we try to have the people who are setting up a response plan to make sure that all the people have been invited to participate. The motels, a number of times we've gone through an area and in telephone canvassing asked who would receive the dogs with the people if they're allowed to stay, under what special conditions, how long they're able to stay and a number of things like that. They were very accommodating, most of the motels I've worked with have been very accommodating. They usually have a no pet policy but they're willing to wave that in the face of a disaster. The other thing is knowing where critical food supplies are - human and animal, and whether we have an understanding with suppliers that we can access food as we need it. We also have things like the university here that a lot of communities don't have this but they also have veterinary hospitals and making sure they're

with them on the plan.

Evacuation rates - the percentage of people who comply with evacuation orders - vary for different hazards. Evacuation rates depend on the timing of impact of the hazard, the individual's perceived severity of the hazard's impact and their susceptibility, and anticipated cost of evacuating. Evacuation rates are very high for most hazardous material accidents where compliance may be in the 90% range. Evacuation rates are typically low for slow onset events such as flooding along major rivers.

In hurricanes, studies show that evacuation rates vary depending on the strength of the storm, how fast it is moving and where the residence is located. In high-hazard storm surge areas, evacuation rates may be as high as 90% when a major storm is forecast. Evacuation rates are much lower for smaller hurricanes and in zones of lower risk further inland.

Susan Cutter:
You have to, from an emergency management perspective, you have to have some sense of what the sources of threat are in your community and some sense of the population at risk from those threat sources. In addition to that, I think you need to understand a little bit of how people might behave if an evacuation order is given and that's going to be a function of the type of the threat, the experience that people have had with that type of hazard or risk, it will be a function of their individual perception of the risk and it'll be a function of the warning information that they're given and their perception of how credible of that warning information is as well. So you have to have a fairly good handle on your community and the people who live there in order to get a good compliance with evacuation and that's what the bottom line is. If you're going to order an evacuation as an emergency manager, you want to get as close to 100% as you can out of that area and for some hazards we know, you're going to get a very good compliance, this is particularly true around nuclear power plant accidents and chemical emergencies because of factors that we've talked about such as the perception of the risk and proximity. In other instances, like for

hurricanes, compliance with hurricane orders is quite variable and that compliance can go from really low, 20% or so to relatively high but there's so many other factors that come into play along the hurricane coasts that influences that.

Protecting the public while building and keeping their trust is of utmost importance in dispersing emergency information. This is especially important because often evacuations are precautionary and either no event occurs or the event impacts another area. Some officials fear that false alarms will adversely affect people's responses to future evacuation warnings but studies show that is not generally true.

Two issues regarding false alarms are important. The first concerns a false alarm that leads to the people unnecessarily evacuating. In this case, if the basis for the warning and reasons for the "miss" are explained to the public and understood by them, people's trust in the integrity of the warning system will continue. Contrary to popular belief, studies of hurricane evacuations indicate that false alarms do not stop people from evacuating in the future if they feel there was a reasonable explanation for the previous false alarms.

The second issue is termed the "cry wolf" or "warning fatigue" syndrome that may happen after repeated activation of a warning signal. If such false alarms occur and no attempt is made to explain why they were false, there could be a negative effect on public response to a warning in a real emergency. This is particularly true if sirens sound frequently because of malfunctioning or are used for other purposes such as to signal a shift change at an industrial site.

Jay Baker of Florida State University who has studied hurricane evacuations for many years says:

Emergency management officials sometimes worry more than they need to about some things and less than they need to about other things. The sorts of things

that I have in mind that are legitimate concerns but they worry too much about are crying wolf, which means telling people to leave and the event misses, and then they're afraid that people won't leave next time. Something called evacuation fatigue, which is a new term that came up a couple of years ago when people had to evacuate multiple times in one year in Florida and the concern was that they got so tired of evacuating that they refused to evacuate in subsequent hurricanes and there's, in fact, very little evidence of that. In subsequent hurricanes that year, among people who said in the later season hurricanes that they were told to evacuate, they evacuated in just as large a number as people who evacuated in earlier hurricanes who said they had been told to evacuate. The big difference was whether or not officials were successful in reaching everyone with the evacuation notice.

<u>Transportation</u>
Narrator:
In most evacuations vehicles are the main modes of transportation for evacuees with access to a personal vehicle. In major urban areas people will likely use other means of transport. During the September 11, 2001, evacuations of Manhattan, New York and Washington, DC, many people walked while others used buses, subways, and trains. In New York, boats - both commercial and private - were used to evacuate a large number of people from lower Manhattan to New Jersey.

Two measures - persons per vehicle and vehicles per household - are used to determine vehicle use and occupancy during evacuations. Vehicle use is greater during daytime evacuations, for slow-onset events and for events that may damage or destroy vehicles."

Jay Baker

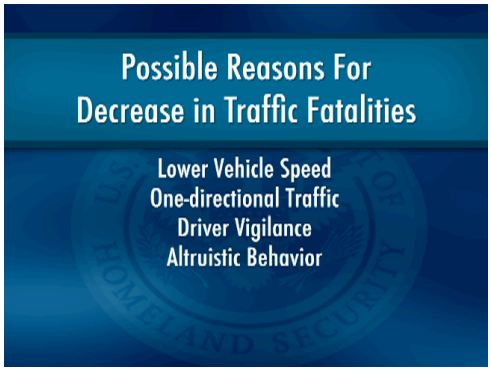
It's amazingly consistent in hurricane evacuations in about 90 percent of the cases between 65 and 75 percent of the vehicles that are available to a household are used in the evacuation. Now that doesn't mean much on a per household basis but it means that for a community if you take the total

number of vehicles that are available and add it up all over the households and you take the number of vehicles that were used in the evacuation. In almost all evacuations it ranges between 65 and 75 percent of all of those that were available

People without vehicles must rely on transportation supplied by others, including emergency officials or institutional managers who may have to order commercial or school buses to facilitate evacuation. Some nursing homes rely on rental trucks to move equipment and supplies for dependent-care evacuees. Others who don't drive include the frail elderly, the handicapped, or those with severely limited incomes. Most tend to rely on neighbors or relatives or public transportation but may need busing in a disaster. Busing strategies are largely untested in rapid moving events, except for clients in special facilities.

Coordinated planning between agencies and local and state jurisdictions is essential to ensure every resident has the means to evacuate and that resources can be quickly geared up to accommodate everyone's needs. In events of great magnitude or which cascade into other disasters - such as occurred with Hurricane Katrina - transportation systems, both public and private, can be quickly overwhelmed, stranding people in harm's way and complicating subsequent search and rescue operations.

Once the exit trip begins, the time to reach a destination or a safe distance from the hazard is called the clearance time. It can be measured for individual vehicles or aggregated for an area. Most calculations involve evacuation time estimation models. Clearance times are not necessarily related to the size of population evacuated because populated areas have greater infrastructure to facilitate movement. Clearance times, however, can be lengthy for densely populated urban areas with limited egress routes or for barrier islands with large seasonal tourist populations connected by bridges to the mainland.



Traffic accident rates actually diminish in evacuations with rates as much as 10 times lower than normal. Direct traffic fatalities are also rare. Possible

explanations include lower vehicle speeds, one-directional traffic movement, increased driver vigilance, and altruistic behavior. The fatalities associated directly with evacuations are generally related to drivers being caught in floodwaters and drowning.

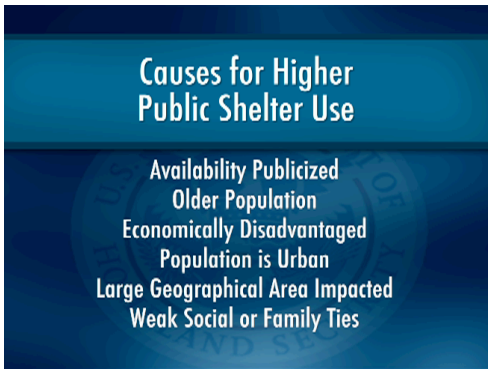
How are evacuation routes chosen? In some locations emergency management agencies have conducted studies to determine the quickest and safest routes for people to use and then marked them with permanent signs. This is particularly useful for people and visitors unfamiliar with the area.

Studies show that residents tend to select evacuation routes they normally would use in everyday travel and will not necessarily follow designed routes if those do not conform to those routes. People will seek alternatives if routes are blocked or congested, or may give up the evacuation process altogether.

Susan Cutter:

We did a very nice study of hurricane Floyd in South Carolina. One of the things we found in people coming out from Charleston was people's situational and locational awareness was not very good and they only knew how to get out of Charleston one way, which was on the interstate. even though there are parallel roads that they could've taken even though they had maps with them, they didn't use them and so a trip that normally takes two hours was taking people 8 to 10 hours for people to get from Charleston here to Columbia because they did not bother to get off the interstate and take the alternative routes

Where do people go when they evacuate? Destinations vary by event and individual characteristics of the evacuee. Most people do not go to official shelters preferring to stay with friends and relatives - even those out-of-state and at significant distances. Some stay in hotels or motels. Higher public shelter use occurs when shelter availability is publicized, there is an older population, when residents ordered to leave are economically disadvantaged and cannot afford to evacuate, the population is urban, and a large



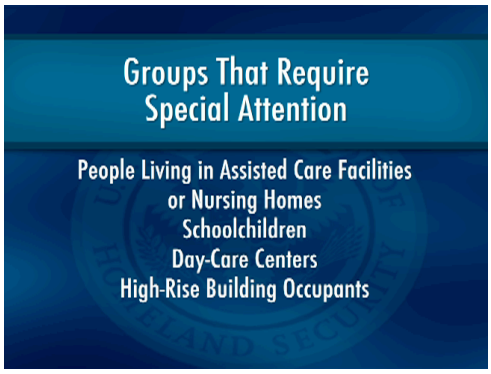
geographical area is expected to be impacted. Studies also show that people with weak social or family ties, such as an elderly person living alone, may also choose to evacuate to a public shelter.

These attributes worked well to define the large urban population that used the Superdome in New Orleans as refuge during Hurricane Katrina in 2005. What is critical is for evacuation planners is to have all the necessary resources available for immediate deployment at the shelters as well as security forces to ensure evacuees are protected in the unfamiliar situation.

Evacuees with Special Needs

Narrator:

In the last two decades there has been a greater focus on the various groups that require special attention from emergency planners in events involving evacuations. These include people living in assisted care facilities or nursing homes, schoolchildren, day-care centers, or high-rise building occupants.



Within the emergency management field "special needs" is defined in a variety of ways, often focusing on groups such as the elderly and children, or people with disabilities. Important groups often overlooked are people with disabilities that are not as evident, such as those with mental illnesses or impairments, people with visual, hearing or mobility limitations, or those who may have difficulty going outside the home.

It's important to consider those with special needs because some evacuees may need assistance in physically moving up or down stairs or boarding buses for transport. Those dependent on respiratory devices, wheelchairs, or walkers will need to have vehicles that can accommodate their equipment. The mentally impaired may need to be assigned a caretaker because they may not understand the warning to evacuate or how to orient themselves at a shelter. Security may have to be provided to ensure such evacuees are not harassed or exploited at shelters

People with special needs may be congregated in a facility or dispersed throughout the community.

Health-care facilities may need help both in planning for evacuations and in physically helping clients evacuate during an emergency. Those facilities should have realistic and customized plans - not boilerplate - that include prior arrangements for transportation and care commensurate with client needs. Evacuation plans should be exercised regularly to acquaint staff and residents with evacuation procedures. Remember that shelters chosen for special-needs adults should not have stairs or child-sized furniture. Planners can help facility managers by examining all evacuation plans to ensure they do not rely on the same resources when evacuating.

Managers of health-care facilities might plan to use a special-needs shelter or medical-needs shelter instead of a general population shelter for their clients. Such a shelter can provide a higher level of care and more support services than the minimal first-aid care provided in general shelters.

Most schools have plans to evacuate children in a community emergency. Two planning strategies most frequently used by schools include early dismissal, with children who will not have a caretaker at home sheltered at the school, or busing, where the entire school population is relocated to a pre-designated shelter. Relocation may be the only option in fast-moving events but may create problems in reuniting children with families or caretakers later on if the information on where children were taken is not well publicized.

In emergencies where the time to impact is fairly long, some parents will likely attempt to pick up students at school. This rarely interferes with the evacuation process. In rapid-moving events children are evacuated before parents have the opportunity to pick up children. Exercises suggest that schools can evacuate in 10 to 20 minutes following the decision to move students out of harms way.

Understanding how vulnerability affects people's ability to evacuate is also important in planning. Vulnerability refers to the characteristics of a person's or group's situation that influence their capacity to

anticipate, cope with, resist and recover from the impact of a hazardous event. Frequently a disadvantaged socioeconomic situation can place a person in an unsafe living or work situation and can impact their ability to take a protective action. Terms like fragile, unsafe and hazardous refer to livelihoods, buildings, settlement locations, or infrastructure, not people.

Betty Hearn-Morrow:

I think women tend to be at some disadvantage throughout the process but certainly some women are much more vulnerable than others. You know, poor women, minority women, recent immigrant women, elderly women, women with disabilities. You know these kinds of risk or vulnerability factors are often compounded so that you have people who are very vulnerable at the bottom of the scale.

Institutionalized populations and special-needs facilities frequently are frequently considered homogeneous when in reality they exhibit many characteristics that differ by physical or geographical constraints. For example, prison populations vary widely by age, physical ability and education while residing in a secured environment. As individuals they cannot respond directly to evacuation warnings even though they may not have any physical constraints.

Tourist populations and temporary visitors such as day workers or travelers in vehicles through an area at risk should not be overlooked. They may not be familiar with community hazards and ignore or misunderstand warning messages. Foreign speaking individuals may not understand what evacuation means while those raised in other cultures may not respond as officials recommend.

It is recommended that emergency officials and planners provide information materials in foreign languages when a segment of the population exceeds one percent of the total population. The Red Cross translated many of their brochures on protective actions into several languages that are available from local Red Cross chapters or on the Internet. Understanding the

types of foreign languages spoken in a community ensures those groups will be adequately informed in an emergency.

Individuals with special needs who are dispersed among the general population may be unknown to emergency planners or social agencies unless they self-identify. Developing a database of such individuals is difficult because the information must constantly be updated. Privacy concerns forbid such information being routinely collected by agencies so much of the information is on a self-report basis. Another problem is the single elderly resident who may shun interaction with others and remain isolated even with the best of agency efforts. Planners should make every effort to reach these individuals with appropriate information that meets their specific need.

Some people will always lag behind or refuse to evacuate from a sense of powerlessness, a feeling of social isolation, or from a perception the event doesn't warrant the effort. This can place later rescue workers at risk if the impacts are severe. Planners can minimize this type of behavior with good emergency information that is timely and detailed.

<u>Evacuation Planning and Management</u>
Narrator:
Managing evacuations involves the use of traffic control strategies, being prepared for spontaneous evacuation, routing traffic effectively, and monitoring traffic flows to control bottlenecks. Where people are located varies over the course of the day and will help determine how quickly vehicles load onto transportation networks. Census data only provides reasonable approximations of locations of nighttime populations. Special census and surveys may be needed to provide detailed data for daytime populations and to identify geographical features or physical infrastructure that could constrain evacuation flow.

Tom Cova from the Geography Department at the University of Utah

If I was charged with emergency planning and evacuation planning in my jurisdiction or community I'd

look at a variety of scenarios for fire. Fire possibly from one of 8 different directions. Historic winds, seasonal winds. I'd look at the type of fuel. I'd map the fuel in the area. I'd map the houses. I'd try to enlist as many people in the community as possible in helping in the emergency planning effort. Which homes are defensible? Which are not? Where are the shelters? Where are the potential safe zones? What are the primary evacuation routes for each neighborhood? What are the alternatives if that evacuation route or routes are not available? How will the community be notified? How many message channels will I have available to me? Who is likely to be in charge of ordering an evacuation? What options do they have? Mandatory, voluntary, recommended. When is shelter the best recommendation? How many vehicles? What's the vehicle ownership in some of these canyons? How does that vary by time of day? So is there a canyon that is employing a lot of people in construction? A lot of transients who aren't necessarily familiar with all the ways out? How would they be notified? What is the daily working pattern of some of the people that work in these areas? What's the estimate of a canyon's population say at noon versus 7pm versus 8am? And how can I educate people in those areas about the options they might have available to them in the scenarios they might have to deal with? So that I'm not trying to march an army that doesn't know it's in the army? The better trained the citizens are the easier it's going to be for me to tell them what to do. Ideally I could say we're
say we're dealing with scenario number 4, you've lost your primary exit, proceed to the golf course in an orderly fashion and wait there until we can tell you what to do.

Traffic control may include adjusted signaling, traffic guides, signs, roadblocks, and lane reversal or expansion. Multiple methods can be employed to facilitate evacuation movement. If bottlenecks occur at intersections signals can be adjusted to favor major egress routes. Options to use when signals constrain traffic include dispatching a controller to manually operate the signal or disabling and using no control with or without a traffic guide.

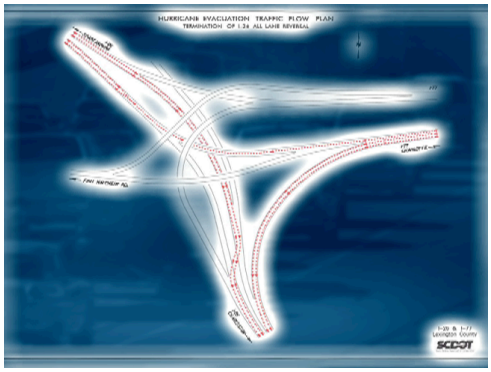
Traffic guides can be people, signs, or roadblocks. Official personnel are the most effective , directional or instructional signs the least effective. Sometimes traffic guides materialize without official sanction as people often assume this role if the need is apparent. Roadblocks may or may not be staffed. Staffed roadblocks are the most effective since unmanned stations may be ignored if counterintuitive to public perception of routing efficiency. Other control measures such as tape and portable barriers or cones are not very effective because they are easily moved if not manned.

Contra-flow lanes - traffic lane reversal - have been used with some success during large urban evacuations. One issue with contra-flow lanes is maintaining lanes for emergency vehicles - such as keeping shoulders of roads open. The lanes must be manned to remain effective, especially in mass evacuations where slow-moving traffic may cause vehicle break-downs. Other issues associated with lane reversal include decisions on timing and closure of reversed lanes.

Brian Wolshon, a transportation engineer at Louisiana State University

People often look at contraflow as being the silver bullet the magical solution to all the evacuation problems because it seems so simple. All you do is reverse the flow in the inbound lanes to get people moving in the outbound direction and the concept is simple but there are some very complicating issues that accompany that. Number one, we look at when we're using the inbound lanes for outbound flow we're not able to get say emergency service vehicles back into that area, we're not able to get the type of circulation that we would normally get using those routes so people aren't able to come into the threat area, say, to pick up relatives or to close property or to secure buildings and things like that. Another problem from an operational standpoint can be the safety issues where you have to go and close the inbound lanes, make sure it's clear and make sure you're keeping state police or some sort of enforcement presence from coming into those inbound lanes. Some of the more subtle things that people are not aware of and should

be is that the contraflow segments are only as good as the designer or the initiation configuration and the termination configuration and what I mean by that if you look at the contraflow segment as a big pipe if you cannot fully fill that pipe with an evacuation stream of traffic then what happens is you cause congestion prior to that contraflow segment. That's what we saw in New Orleans, where we didn't get a full utilization of the contraflow segment because it wasn't able to load properly. Then if we look on the downstream end at the termination point if we don't get a split or a decrease in traffic such that we can bring those lanes together then what happens is we end up causing more congestion throughout the segment. So the congestion would either happen prior to without a full utilization or on the downstream end we would get congestion caused by an improper departure of that traffic from the contraflow segment and that's an issue that we've seen through research modeling. We've been able to identify that and because of that a number of plans around the southeast United States and gulf coast have been changed which was good to see.



In determining where to route traffic, planners should designate evacuation routes that reflect everyday traffic patterns. Such routes should not be counterintuitive or place people at increased risk. Although analyses using evacuation models can help identify optimum routing, there still may be a need for traffic control to achieve that routing. Monitoring traffic movement during the evacuation either visually by spotters or remote video cameras at critical intersections or through automated real time road sensors is essential to prevent unforeseen bottlenecks.

Usually evacuation planning begins with a risk vulnerability analysis and then developing an evacuation time estimate or ETE. An ETE can first be used to determine the time it takes to evacuate an area or clearance time. An ETE developed with the assistance of an evacuation simulation model can be used to determine the feasibility of evacuation without detailed route and control planning. The model can also identify potential bottlenecks and assess the effects of different control and evacuation strategies. Finally, a model-based ETE can be used to estimate traffic speed

and queuing times on different evacuation routes.

Evacuation strategies may include phased or sector evacuation, keyhole evacuation and selective evacuation. Phased evacuation is defined as the sequential movement of people from defined zones. It is often used after sheltering-in-place. Officials may choose to evacuate zones nearest the hazard first and expand the evacuation zone as the event progresses, or evacuate only nearby zones and shelter the more distance zones, or shelter nearby zones and evacuate the more distant zones.

Betty Hearn-Morrow:

The real fear is a total bottleneck where no one gets out or very few so most of those communities have gone to, at least in their planning, a phased evacuation system which there's debate in the community how much this is really going to work but I know for example in the Florida keys it has seemed to work. We've studied several like hurricane Georges for example in the keys there was a good phased evacuation. First, the people the furthest away down in Key West, they're given a time block when they are supposed to leave. if they don't leave in that time block, that road is closed off for them so that the next group can go and so forth and so the keys are very experienced evacuators and so constantly that seems to work pretty well there but it requires a great deal of organization and most evacuations today are regional evacuations so it requires several different jurisdictions to be able to work together in planning this and a regional approach to - it's complex.

Sector, keyhole and selective evacuation strategies involve only portions of the public. Criteria for defining the zones can be risk or hazard based, determined by geographic features, or geometrically defined - such as using quadrants or concentric circles. Some emergency planning zones around fixed chemical facilities divide their planning zones into sub-zones using major highways and streets as well as geographical features such as streams or rivers.

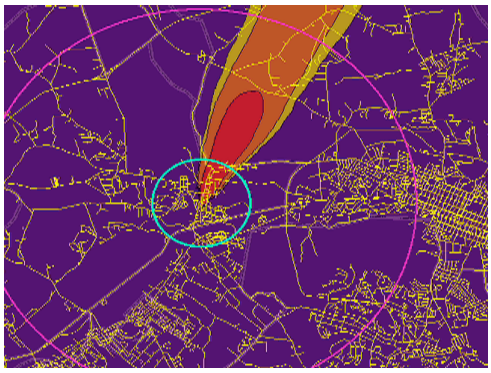
When an emergency involves a release of chemicals or

other hazardous substances, officials may consider weather conditions in evacuating people. In a wedge evacuation strategy a 30 to 45 degree arc is over-laid on a map based on wind direction and all sub-zones touching the wedge are evacuated.

Jerry Mitchell, geographer from the University of South Carolina:

Graniteville was a chlorine release resulting from a train accident in Graniteville south Carolina which is about 10 miles from the south Carolina Georgia border, January 6, 2005. As a result of that release there were 9 fatalities. Some of those fatalities were people operating the train, etc, they went directly from the chlorine release but there were 9 fatalities and about 500 or so people who sought medical treatment as a result of the spill. The majority of the spill took place and was released within 2 hours, 60 tons of chlorine was dissipated within about 2 or 3 hours after the event so the evacuation came much later but that notice, as well, simply told people that if you're in one mile of the accident evacuate. It still did not tell you where the accident was. So how do you know from what? How am I going to determine that? People are notoriously bad at estimating distances. So even if you did tell them exactly where the spot is, do I know if I'm in one mile or not. And we had people tell us that. We had one family that literally sat at the kitchen table with a map and a ruler and was trying to figure out whether they should stay or go. and in the threat of a potential chlorine cloud, you don't need to be making that kind of decision, you should be able to decide immediately, so if some simple geography was put into those messages that all those people within one mile within this street, this street, this street, adding in some of that local knowledge that people would've latched onto, people could've made a better decision as to whether it applied to them or not and then been able to go from there. In terms of ordering evacuations whether it be from a fixed chemical release or a mobile one, there are some significant geographical issues one has to deal with which significantly clouds up and muddies the issue here. For the example with Graniteville, in terms of the evacuation, if you want to, based upon risk, you're calling for a one mile

evacuation perfectly circular buffer around that site which is contrary to the physical realities of the plume itself which is going to be wind based and going to be going a particular direction. The fact that it was a certain chemical chlorine which was heavier than ambient air meant that lower lying areas were going to deal with that issue differently than higher areas so you had to take topography into consideration.



Keyhole evacuation is similar to the wedge sector evacuation but an area upwind of the facility is evacuated as well. In general all people within a specified radius - usually 2 miles in the case of a nuclear power plant - are evacuated and only those in the wedge further out are evacuated.

It is critical that local and state jurisdictions, including adjacent states, coordinate their evacuation transportation plans to ensure evacuees understand the reasons for phasing evacuations and how public officials are coordinating traffic flows to enhance the evacuation process.

Special Considerations

Narrator:

Media accounts of evacuations often focus on behaviors or events that are extremely rare, but typically are sensationalized. Some evacuation myths include panic, looting, fear of overloading the public with information, and multiple traffic accidents because of traffic volume.

People rarely panic in evacuations. Panic involves anti-social behavior against others when people attempt to evacuate when a clear threat is present and the avenues of escape are limited or blocked. Elevated stress or rapid movement away from a danger is not panic but people's normal reactions to flee from a hazard. Panic has never occurred in evacuations due to natural or technological disasters, but has taken place in fires in confined structures when egress is limited.

Susan Cutter:

Panic and chaos during evacuations is one of the great myths that the media perpetrates on the American

public. Oftentimes, people are very orderly. They get frustrated in evacuations because they're stopped on the road, their tempers flare, but generally they're very orderly and you don't see this panic you see in the Hollywood movies or the media thinks is going on so it's one of these fabulous myths that there's absolutely no social science proof to support it.

Looting and criminal activities are uncommon in evacuations. Looting is more likely in locations where a strong class differential exists. Altruistic or helping behavior is much more prevalent in emergencies.

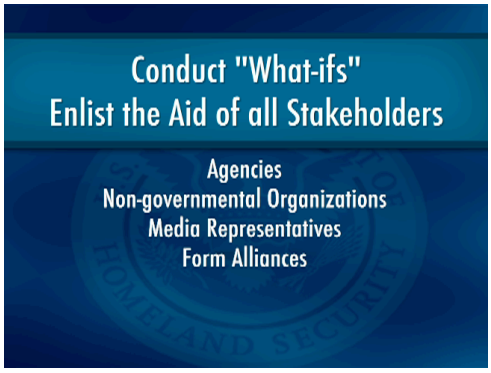
One cannot provide too much information in evacuations. Forget the notion that people will be confused with the facts. People want to be informed with detailed and relevant information and will seek to confirm information.

Mike Lindell:

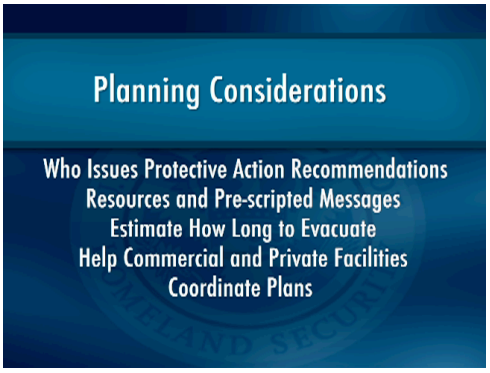
Most people go through their entire lives without having to experience a major disaster and so when one does occur to them then it's entirely logical for them to say I can't believe this is happening. If it's information from a social source they would say well maybe they misunderstood and so they look for confirmation of the warning especially if it's from a source that's likely to have gotten it wrong. If they first hear from a relative or friend then they're much more likely to question it than if they hear a warning over the news media especially one that is very clear about what is the area that is going to be affected or and the research has shown this if they're warned by a public safety official. if you have a police officer or firefighter in uniform come to the door and tell you that there has been a chlorine leak and you need to evacuate right away, people are most likely to believe that kind of a source with a very specific message and also with a very specific recommendation for what action to take if they say evacuate don't pack anything you just need to get out right now there's not enough time to pack people do that.

We've discussed some of the considerations that should be taken into account when developing an evacuation

plan for a community. Remember to know your community - what hazards citizens may be threatened with, the risks involved, and where people are located both day and night. Encourage individuals with special needs to identify themselves and their needs to emergency officials if they will require specific aid in an evacuation.



Conduct "what-ifs" when developing plans, enlist the aid of all stakeholders, agencies, non-governmental organizations, and media representatives, and form alliances. Know whose responsibility it is to issue protective actions recommendations and evacuation orders. Determine what resources and pre-scripted messages will be needed to effectively warn all segments of the community, including non-residents. Develop estimates to judge how long it will take to evacuate people from areas at risk. Planners can offer help to commercial and private facilities in developing evacuation plans, especially for institutions with special-needs populations, and coordinate plans to ensure speedy compliance with official evacuation orders.



In summary -- evacuation is the protective action option preferred by most emergency officials although in some situations sheltering is the best option. A large body of knowledge exists on emergency evacuations and planning principles are well understood and there are models and simulations that can help evacuation traffic from congested areas.

Evacuation is both physically and mentally exhausting for evacuees. Facilitating the process to provide a safe and uneventful trip for those involved should be the aim of all good evacuation planning and preparation.