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General Guidance on Emergency Communication Strategies for Buildings, 2nd Edition

Erica D. Kuligowski
Hidemi Omori

National Institute of Standards and Technology
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Erica D. Kuligowski
Hidemi Omori
Fire Research Division
Engineering Laboratory

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- June Ballew, Cooper Notification
- Don Bliss, NI^2 Center for Infrastructure Expertise (NH)
- Bob Boyer, UTC Edwards
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Executive Summary

When a building emergency occurs, it is not always sufficient to simply initiate audible alarm signals. Individuals may not know what the alarm signal means and as a result may respond inappropriately to its sound. Many buildings have installed mass notification or emergency communication systems, based upon requirements provided in international codes and standards, that can be used to disseminate audible or visually-provided information in the event of an emergency. However, there is a lack of guidance on how to use current emergency communication systems in the most effective manner. For example, buildings often use these systems to disseminate pre-recorded, general emergency voice alarm messages that leave occupants wanting and needing further information before effectively responding. Especially as the use of newer technologies such as mobile devices or social networking tools grow, guidance on message content and dissemination becomes even more critical to ensure effective and safe response of building occupants during an emergency.

The purpose of this report is to provide guidance to system designers, building managers and/or building emergency personnel responsible for emergency communication on how to create and disseminate messages using basic communication modes (audible and/or visual technology), as well as guidance on how to test the effectiveness of these messages. The guidance provided here is based on the review of 162 literature sources from a variety of social science and engineering disciplines (Kuligowski et al. 2012) and the prioritization of the specific findings extracted from each literature source. This document describes the process in which people receive and interpret information in order to take action during emergencies. Then, the document presents guidance on how to create and disseminate emergency information in the face of rapid-onset disasters – providing guidance on the dissemination of alert signals, the creation of the warning message, the formatting of messages for both visual and audible means, and the dissemination of the warning message. The document also provides guidance on the ways to test the effectiveness of emergency messages – both from a comprehension perspective and an occupant-response perspective. In addition, the guidance document provides examples of emergency messages (i.e., message templates) for five different types of emergency scenarios. The document ends with a discussion of research questions still left unanswered and future efforts that are necessary to improve emergency message creation, dissemination, and testing for building disasters.

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1 Introduction

Until very recently, it was widely assumed that telling people about an emergency incident would lead to panic (Tierney 2003; Quarantelli and Dynes 1972). This assumption was commonplace, both with the lay population and with many emergency responders. The view that people would panic in response to an incident (and specifically to information describing the incident) influenced both the notification procedures and the language used to report the incident response behavior. This assumption influenced a difficult and harmful cycle consisting of the following steps: people report that they had panicked, emergency officials continue to believe that panic is a normal response, emergency information is withheld in the next disaster, human response is delayed and inefficient, the situation becomes more dire, and human response becomes more desperate.

It is now broadly accepted that depriving evacuees of information is more likely to lead to an inefficient and inappropriate response; e.g., misinterpreting the incident and the threat it poses, delaying their response, and ignoring safe egress routes (Mileti and Sorensen 1990). During an incident, people will seek information regarding the nature of the incident and what they should do in response to it. Unfortunately, this information may not always be easy to find, reliable, consistent or accurate.

At present, many buildings and building campuses in the United States are installing mass notification or emergency communication systems to improve communication between the building or emergency officials and the public. The National Fire Alarm and Signaling Code (NFPA 72), 2010 edition, provides requirements for the application, performance and installation of emergency communication (or mass notification) technology (NFPA 2010a). However, the 2010 edition of NFPA 72 provided little guidance on how to use these systems for effective emergency communication[1]. Additionally, many countries use British Standard BS 5839 -- Fire Detection and Fire Alarm Systems for Buildings – Part 8 (BS 5839-8:2008), in which chapters 20 and 21 discuss emergency messages and dissemination techniques.

In the United States, there is little guidance outside of the building codes regarding the content and dissemination strategies for emergency messages. The people providing the messages during an emergency may not have the necessary tools, techniques, guidance, and training to effectively provide information to the public when an emergency event is imminent or unfolding. This problem exists across all modes of notification, whether visual, audible, tactile, or social systems are employed. Irrespective of the mode used, it is necessary for emergency communication to be effective in order to facilitate the procedural measures employed and the desired response.

The purpose of this research project, which was funded by the U.S. Department of Homeland Security, Science and Technology Directorate, relates specifically to the effectiveness of emergency notification or communication. As a second edition, this document presents general guidance on emergency communication strategies to alert and warn building occupants of

[1] The newest edition of NFPA 72 (2013) provides guidance for message providers on message content, formatting, and dissemination based, in part, upon results from this project.

impending rapid-onset events in buildings and building campuses in the United States, including methods to test emergency messages and example message templates for use in specific types of emergencies and by certain types of dissemination technologies. This guidance is based on the review of 162 literature sources from a variety of social science and engineering disciplines published in Year 1 of this research project (Kuligowski et al. 2012), the prioritization of the specific findings extracted from each literature source, and consensus development of emergency message templates developed in Year 2. A future edition of this guidance document will be published only when there are significant advancements made in the emergency communications research/literature to warrant a new document.

2 Purpose of Guidance

This guidance document provides an understanding of human response to emergency communication and the ways in which to improve this response via more effective messages, message formatting, and message dissemination. This document begins by describing the ways in which people respond to emergency cues and information. Then the needs of message recipients are identified. Based upon these needs, this document provides general guidance to system designers, building managers, emergency personnel, alarm system manufacturers, codes/standards committees, or others responsible for emergency communication on how to create, format, and disseminate messages to all building occupants, regardless of abilities or disabilities, using basic communication modes (audible and visual technology)[2]. The document also provides guidance on the ways in which to test the effectiveness of emergency messages – both from a comprehension perspective and an occupant-response perspective – and examples of emergency messages (i.e., message templates) for five different types of emergency scenarios.

The focus of this guidance is rapid-onset emergencies, or those emergencies that occur with no or almost no (in the case of minutes) notice, rather than slow-onset events (i.e., emergencies in which the occurrence is known hours or even days in advance). Examples of rapid-onset events are included in Table 1. The events shown in Table 1 were selected from NFPA 1600, the *Standard on Disaster/Emergency Management and Business Continuity Programs* (NFPA 2010b), which lists hazards to be evaluated when planning for emergencies.

[2] Limited guidance is provided on the use of tactile systems due to the limited amount of research available on human response to these systems.

Table 1: Potential hazards categorized here as rapid-onset incidents.

Naturally occurring hazards	Human-caused events
• Geological hazards ▪ Earthquake ▪ Tsunami ▪ Volcano ▪ Landslide/mudslide • Meteorological hazards ▪ Flood, flash flood ▪ Fire (forest, range, urban, wildland, wildland urban interface) ▪ Avalanche ▪ Windstorm, cyclone, tornado, dust storm or sandstorm, water spout, derecho ▪ Lightning strike ▪ Geomagnetic storm	• Accidental hazards ▪ Hazardous material spill/release ▪ Explosion/fire ▪ Transportation accident ▪ Building/structure collapse ▪ Water control structure/dam/levee failure • Intentional hazards ▪ Terrorism (chemical, biological, radiological, nuclear, cyber, arson) ▪ Sabotage ▪ Civil disturbances ▪ Enemy attack, war ▪ Insurrection ▪ Physical or information security breach ▪ Workplace/school/university violence

In this guidance document, recommendations are provided based upon the summary report of the literature completed in the first phase of this project (Kuligowski et al. 2012) and additional research performed since the completion of that document on message comprehension. The summary report includes individual annotations of 162 sources from a variety of social science and engineering disciplines. Additionally, over 40 pages of findings and recommendations from each of the 162 sources are listed in the summary report. Each of these findings was reviewed and prioritized using a set of criteria to develop the final set of guidance that is included in this document (Section 5). A list of the criteria used to prioritize the summary report's findings is listed here:

- Is the finding relevant to buildings and building occupants?
- Does the finding relate to emergency conditions rather than normal/non-emergency conditions?
- Is the finding in agreement with theory and expert opinion on human behavior in emergencies?

There were findings that contradicted one another. The authors attempted to reconcile these contradictions by siding with findings that were most aligned with well-accepted social theory of human behavior in natural or technological disasters. Also, findings that originated from sources found in archival publications received higher priority, in cases of contradicting guidance. However, there were some contradictory findings in which consensus was not reached, and thus, were not included in this guidance document. Instead, they are discussed in Section 8 of this report, labeled as a discussion of the questions that are still left to answer.

There are also topics of interest that were included in the summary report (Kuligowski et al. 2012) that were deemed outside of the scope of this guidance document. The first topic that was deemed outside of the scope of this document was the mechanics of visual lighting systems for

signage. Secondly, any guidance provided on the volume necessary for audible alert and warning systems was also deemed outside of the scope of this document. Both of these topics can increase the perception (i.e., hearing or seeing) of the alert or warning message, and they have been covered in some detail in codes/standards on mass notification systems (e.g., NFPA 72 [2013]).

This document does not provide a detailed discussion of alerting and warning technology, and does not advocate for the use of one type of technology over another. The summary report (Kuligowski et al. 2012) provides a categorization of current mass notification technology, the primary senses affected by each technology, and the pros and cons of these systems for emergency communication purposes. Therefore, it was not necessary to provide additional discussion of this topic. Additionally, since the focus of this document is to provide general guidance on the creation of the messages themselves and general dissemination techniques, the identification of any one type of technology was not required.

As part of Year 3 of this project, this guidance document represents the second edition of the document published as part of Year 2 (Kuligowski 2013). In addition to guidance on message creation and dissemination, this document (i.e., the second edition) provides guidance on the ways in which to test the effectiveness of emergency messages for specific buildings (Section 6) and examples of message templates for five types of rapid-onset emergencies (Section 7).

Finally, this document does not provide specific guidance on the development of graphics to accompany alerts or warning messages. There are standards available, via NFPA (2012a), ANSI (ANSI/NEMA A535 2011), and ISO (2011; 2007; 2004), especially ANSI/NEMA Z535.3 Criteria for Safety Symbols (ANSI 2011), that provide guidance on the development of graphics for static or dynamic signage. The main focus of this guidance document is the textual message content; thus interested parties developing a pictogram or symbol for emergency communication should seek guidance from the standards listed above.

3 Human Response to Emergency Warning

In contrast to the panic model previously assumed, the response of an individual during an incident can be better characterized as a decision-making process in which people receive information from their environment, interpret that information, and respond based upon their interpretations (Lindell and Perry 2004). Understanding this process and the factors that influence certain interpretations can aid in the development of better guidance on emergency messages and dissemination systems.

Over the last 50 years, numerous empirical studies have sought to systematically chart the social processes involved in human responses to emergency incidents (Tierney, Lindell and Perry 2001; Mileti and Sorensen 1990; Drabek 1986; Drabek 1969). Of these, the Protective Action Decision Model (PADM) is selected here to structure the guidance offered (Lindell and Perry 2004). The PADM provides a framework that describes the information flow and decision-making that influences protective actions taken in response to natural and technological disasters (Lindell and

Perry 2004), and has been recently used to analyze behavioral response to the 2001 World Trade Center disaster (Kuligowski 2011).

Specific to public warnings and emergency information, the PADM asserts that the process of decision-making begins when people are first presented with cues, e.g., warning messages. The introduction of these messages initiates a series of processes that must occur in order for the individual to perform protective actions, split into pre-decisional processes (PRE-DEC, which determine whether a decision-making process commences), and decisional processes (DEC – the key components of the decision-making process itself). A simplified version of this process is presented below

- PRE-DEC_1: the individual must perceive or receive the cue(s); e.g., a visual signal must be seen.
- PRE-DEC_2: the individual must pay attention to the cue(s); i.e., given that it is possible for the signal to be seen, the occupant actually takes note of the signal.
- PRE-DEC_3: the individual must comprehend the cue(s) and the information that is being conveyed; i.e., given that the signal is noted, that the information is understood.
- DEC_1: the individual must feel that the incident suggested by the cues and/or information is a credible threat.
- DEC_2: the individual must personalize the threat (i.e., feel that the incident is a threat to them) and feel that protective action is required; i.e., something needs to be done.
- DEC_3: the individual searches for what this action might be and establishes options.
- DEC_4: the options identified are assessed (given the information available) and a final action selected.
- DEC_5: the individual determines whether the protective action needs to be performed immediately.

Initially, the individual needs to receive a cue, pay attention to it, and comprehend the meaning associated with the cue (i.e., that it indicates an event or response to an event). These represent the three pre-decisional stages of the PADM (PRE-DEC1-3) – the stages that determine whether external information is processed such that it can inform the decision-making process (Lindell and Perry 2004). Given that this information is processed, it then needs to be assessed to determine whether the information provided is credible (DEC_1). At this stage, the individual decides if there is actually something occurring that may require action, sometimes referred to as warning belief (Mileti 1974). If the individual's answer is yes, then he or she is said to believe the threat, and subsequently moves on to consider the next question in the process.

The individual next tries to determine whether the threat is relevant to him/her (DEC_2), known as personalizing the threat (or risk). Research has shown that a person's perception of personal risk, or "the individual's expectation of personal exposure to death, injury, or property damage," is highly correlated with his/her response to the disaster (Lindell and Perry 2004:51). In this stage, also known as personalizing risk (Mileti and Sorensen 1990), the individual determines the likelihood of personal consequences that could result from the threat and asks the following: "Do I need to take protective action?" Essentially, at this point, which is also discussed in human factors research as "situation awareness" (Groner 2009), the individual tries to gain insight into

the potential outcomes of the disaster and what those potential outcomes mean to his or her safety. The more certain, severe, and immediate the risk is perceived to be, the more likely the individual is to perform protective actions (Perry, Lindell and Greene 1981). If the cues are deemed to relate to him/her, the individual then determines whether it is relevant and pressing. This then requires the individual to determine the nature of the response required at that point in time.

At this stage, the individual engages in a decision-making process to identify 1) what can be done to achieve protection, and 2) the best available method for achieving protection. This consists of a search for protective actions (DEC_3), and the outcome of this stage is a set of possible protective actions from which to choose. After establishing at least one protective action option, an individual engages in protective action assessment (DEC_4). This involves assessment of the potential option(s), evaluating the option(s) in comparison with taking no action and continuing with normal activities, and selecting the best method of protective action.

Passage through these stages is often problematic. For example, information received can be incomplete, ambiguous, or contradictory, causing uncertainty in what is going on and what to do about it. If at any stage the individual is uncertain about the answer to a question, s/he engages in additional information-seeking actions. The greater the ambiguity involved in the situation, the more likely that individuals will search for additional information that can guide their actions, delaying protective action/behavior.

4 Barriers to Effective Emergency Response

In addition to the possible lack of appropriate emergency information, there are additional barriers that can interrupt each stage of this process, delaying protective action. These barriers will be described here, organized by the stage in the decision-making process in which they introduce difficulty.

4.1 Perception

In the first stage of the decision-making process, occupants need to perceive the warning information before they decide to take action. However, there are individual factors that can inhibit this process, including hearing impairments, visual impairments, and situational conditions (such as sleeping; especially for children, older adults or those who are drug/alcohol impaired) that can inhibit an individual from receiving emergency information (Gwynne 2007). The needs of these groups of individuals should be taken into account when designing an emergency communication system, so that the alerts and messages are received by the entire population, not just by those who are unimpaired and alert/awake. Additionally, all individuals, regardless of disability, can fall subject to disaster-induced factors, such as selective perception and stress (Timmons 2009; 2007). Selective perception is when an individual only perceives/receives certain elements of the environment, which can prohibit them from hearing or seeing emergency information. In a similar way, stress has been found to narrow an individual's field of perception so that they also may miss important emergency information.

Environmental factors can also inhibit individuals from perceiving emergency information. Visual and audible "pollution", including physical obstacles (e.g., non-emergency signage) or competing sounds or noises, may cause individuals to miss messaging. Additionally, environmental cues from the emergency (i.e., smoke or flames from a fire, loud sounds, or a chemical agent that affects vision), dust, glare, veiling reflections, and ambient illumination may also negatively affect perception of emergency information.

4.2 Attention

The second step in the decision-making process is that individuals must pay attention to the information that they receive. There are certain states in which individuals may find themselves at the time of an emergency that can hinder their ability to pay attention, including drug/alcohol impairment, cognitive impairment and sleep deprivation. Additionally, individuals may be so involved or committed to certain pre-emergency activities that they may miss cues indicating an emergency is taking place. Similarly, if they are part of a larger group, they can be less likely to pay attention to their external environment.

The environment itself can introduce factors that hinder attention. The building may be equipped with audible and/or visual distractions, making it difficult to distinguish a new cue (to which they must pay attention) from all others. This can be especially difficult for individuals who have become habituated to their environment and the cues around them.

Similar to perception, disaster-induced factors can inhibit attention paid to emergency information. Stress and anxiety brought on by the emergency can narrow an individual's focus on certain details, and once the focus is narrowed, unexpected features are simply not noticed (known as inattentional deafness or blindness) (Timmons 2009; 2007).

4.3 Comprehension

The third step in the decision-making process is comprehension, or understanding the information provided by the emergency communication system. Individual factors that can inhibit comprehension include untrained or unprimed individuals, age (children), non-native speakers (especially those who do not speak the native language at all), individuals with a cognitive impairment, and individuals from different cultural backgrounds than the United States. Even more complicated is the influence of stress (induced by the emergency) on the general public's ability to understand emergency information. Verbal comprehension has been found to drop an average of four grade levels at high levels of stimulation, stress, and distraction (all factors that are possible during a building emergency) (Chandler 2010).

4.4 Belief in Information

In the fourth step, individuals are required to believe the information before they are able to act upon it. One of the main barriers to belief is normalcy bias (Drabek 1986; Okabe and Mikami 1982). Normalcy bias is the belief or assumption that nothing is happening to place the individual at risk. Regardless of the intensity of cues or information received from an emergency, the frequent initial assumption by building occupants is that nothing is going wrong.

Additionally, the more people who believe this assumption, and in turn, do not act or take protection, the less likely others around them will take protection as well.

The source of the information is important in providing credibility to the emergency information. However, trusted sources for the majority of a building population may not be effective for minority or sub-group populations. One example of this is the distrust by minorities of government agencies during community disasters. These same inhibitions of credibility may be found in building emergencies as well.

Finally, the prevalence of false or unwanted alarms/messages in a building may inhibit response in the next building emergency. The alarm/warning system may lose credibility if it has initiated multiple times in instances when no emergency has materialized or occurred.

4.5 Personalization of Information

Once building occupants perceive credibility associated with an event, they must personalize the risk to themselves before taking action. The main barrier to this step is optimism (or optimistic) bias (Kunreuther 1991). In this case, individuals are inclined to believe that even though an event may be happening in their building, no danger or harm will happen to them. Most individuals, especially after initial awareness, consider this bias as reality.

Additionally, the lack of information regarding the emergency can hinder personalization of risk. For instance, if individuals do not understand or know what is going on in the building, i.e., the extent of the emergency, they are unable to develop a sense or perception of risk. Similarly, if they are not told or advised of the negative ways in which the emergency could affect them, they are again unable to develop an understanding of the dangers the emergency poses to them.

4.6 Protective Action

Once occupants have gone through the pre-decisional and decisional processes of the emergency decision-making process, they consider options for action, choose one, and decide when to act. However, like all other stages, there are factors that inhibit this process as well.

First, individual factors can inhibit the actions that building occupants consider and then eventually decide to take. These individual factors can include physical impairments, economic restrictions (e.g., lost pay due to missing work), and lack of training or understanding of the procedure (Lindell and Perry 2004).

Certain elements in the environment can also inhibit action. Occupants are likely to make action-based decisions based upon the environment. For example, if routes are blocked due to environmental conditions, that may inhibit protective action decisions. Additionally, if others in the environment are not taking action, this may influence others to follow suit (even though they may wish to act). Fear of social embarrassment has been found to influence protective action in various types of research settings (e.g., Latane and Darley 1970).

Finally, disaster-induced factors can inhibit action. In very serious conditions, building occupants may be injured, which affects their ability to take protection during an emergency.

There are ways, however, to overcome these barriers to effective response in emergencies. The next section will provide guidance on emergency communication strategies to improve occupant response in building emergencies.

5 Guidance on Emergency Communication Strategies for Buildings

The main way to overcome barriers in taking protective action is to improve emergency communication in building emergencies so that it will prompt safe and effective occupant response in disasters. This section provides guidance for building managers, emergency personnel, alarm system manufacturers, codes/standards committees, or others responsible for emergency communication on the ways in which alerts and warning messages should be created, formatted, and disseminated. This guidance is based on a consensus of the emergency warning literature as well as social theory and expert opinion on human response to emergency information in disasters. This section is divided into two main parts: guidance on alerts and guidance on warning messages. Although these two parts often get confused, it is important to distinguish between the purpose of an alert and a warning message. An alert is meant to grab peoples' attention that an emergency is taking place and there is important information that will be provided to them. The purpose of a warning message is to give that important information to building occupants. Guidance on both alerts and warnings is provided here.

5.1 Alerts

Overall, the literature suggests that it is imperative to disseminate an alert to let building occupants know that a warning message will follow. Regardless of whether the warning message is provided audibly, visually, or via tactile means, an alert is necessary to gain people's attention and should be provided separately from the warning message.

An alert in a building can take many forms. For audible messages, a sound or series of sounds can be provided[3]. Additionally, a word or series of words can be audibly provided. In either case, the important aspects of alerts are that they significantly differ from ambient sounds (Edworthy 1998). Additionally, the building should reduce background noise when initiating audible alerts, and especially eliminate competing voices when disseminating audible alert messages (e.g., Mayhorn 2005; Edworthy 1998).

There are many examples in the literature of audible alerts. Research has identified specific signals that work in different situations/circumstances. For example, the traffic research literature

[3] NOTE: No guidance is provided in this document on the sound levels for audible alerts. NFPA 72 (2013) provides requirements on the sound levels for audible alerts, including the sound levels for waking people up and the appropriate location of these audible alerts systems within the building to achieve an appropriate sound level result.

has identified an attention-demanding signal that consists of modulation between 1 Hz and 3 Hz. In this example, the signal should be no longer than five seconds in duration, followed by 0.5 seconds of silence, before the warning message begins (Dudek et al. 1978). Other research advises the use of pulses that not only can achieve attention, but also achieve a perception of urgency (Haas and Edworthy 1996; Haas and Casali 1995). The purpose of this document is not to suggest that one audible alert type is better than another. The examples provided come from different fields, none of which have been tested in building-wide, rapid-onset emergencies. Some fire researchers have also advocated for the use of a temporal three alarm signal (to serve as both the alert and the warning signal in case of fire emergencies) (e.g., Ball and Bruck 2004). If the building manager chooses an audible alert system for the building, it should be tested for its success in getting occupants' attention in the event of an emergency (See Section 6 of this document). Additionally, the building's alert system (in addition to the warning system) should be used as part of the building-wide training, so that the occupants are familiar with its sounds and, in turn, its meaning.

Visual alerts can also be provided. The literature has reached consensus on two main ways in which to provide a visual alert before disseminating a warning message. First, a signal word (e.g., "Alert") can be displayed to let occupants know that a visual warning message is to follow (Dudek et al. 1978). The same research suggests that the signal word, as part of a visual warning message, can be displayed in a different color (than the warning message and any other non-emergency messages posted prior) to attract attention and ensure that occupants read that signal word before any other information.

Additionally, a large amount of research in both fire and other types of emergencies have found that flashing lights, as opposed to static lighting, can attract people's attention to an emergency (Nilsson and Frantzich 2004; Jin 2002). Currently, many buildings are equipped with strobe lights to attract people's attention to a fire emergency in the building. Strobe lights are especially useful for individuals who are hearing impaired and/or cannot hear the fire alarm or voice communication system. Flashing lights can also attract attention to visual signs used to display emergency warning messages throughout the building or building campus (i.e., outdoor signage) (Wogalter, Conzola and Smith-Jackson 2002). However, much debate exists around the appropriate color of the flashing lights. Green flashing lights, possibly due to the color of European exit signs and their meaning of safety, have been found to be successful in leading occupants to exits in wayfinding experiments in Sweden (Nilsson, Frantzich, and Saunders 2009). This guidance document does not suggest one color over another for flashing lights near visual signage due to contradictions in the research and factors that may cloud color interpretation (e.g., Mayhorn 2005), including color-blindness, old age, and cultural differences related to color meaning. The important suggestion here is the use of flashing rather than static lights, preferably one standard color for all buildings, to gain attention to visual warning messages.

Finally, there are additional methods (other than audible and visual means) to alert building occupants to an emergency. Depending upon the occupancy, it will be important for building managers and emergency personnel to aid in the disruption of routine activities, so that building occupants are able to pay attention to the warning to follow. Examples are provided here as ways to disrupt building activities: turning up the lights; cutting power to the television, internet, or

computer screens; ending group activities (such as a movie or play/show); and terminating visual or audible distractions. Technology has also been invented for waking the hearing impaired (Thomas and Bruck 2008; National Association of the Deaf, n.d.), including various types of pillow or bed shakers, since nighttime sleeping reduces visual capabilities. Finally, social networks or face-to-face alerts (by fire wardens, for example) can provide additional means to alert people of an emergency.

No matter how successful an alert signal (e.g., alarm, alert sound, strobe light) is in gaining people's attention, the signal should not serve as the warning message. Alert signals are meant only to grab occupants' attention and notify them that a warning message is about to be provided. Some technologies are better at delivering alert signals and others are better at delivering warning messages (National Research Council 2011). For example, 90-character short message service (SMS) text messages have been used to alert building occupants and community residents of an emergency (National Research Council 2011). However, 90 characters provide only a limited amount of text to warn individuals of the emergency, and thus have been considered more like an alert, than a warning. In this case, text alerts would still need to be accompanied by a follow-up warning message or provide a place where building occupants could go for more information on the emergency at hand. One option is providing additional information on a website, but there is a possibility of overloading the site when building occupants attempt access simultaneously. Overall, it is important that each alert signal, regardless of dissemination mechanism, is accompanied by a clear, consistent, concise, and candid warning message. The guidance on warning messages is provided in the following section.

5.2 Warnings

Warning messages are meant to provide information to the building occupants on the state of the emergency and what they are supposed to do in response to this emergency. Warning messages should be provided after an alert signal is given and can be provided via visual or audible means. However, before such guidance on message format for visual and audible messages can be provided, it is vital to provide guidance on the content of the warning message itself.

5.2.1 The Message

Regardless of the method used to disseminate the warning message, there are certain characteristics that are required of an effective warning message. Whereas demographic factors, such as gender or age, and environmental factors (such as physical cues or group dynamics) have been found to influence occupant response to an emergency, social science disaster research has shown that these factors become less influential when a warning message contains certain important characteristics (Mileti and Sorensen 1990).

5.2.1.1 Message Content

An effective warning message is one that is specific, consistent (with cues from the event as well as other messages disseminated about the emergency), certain, clear, and accurate (Mileti and Sorensen 1990). Also, a warning message should contain five important topics to ensure that building occupants have sufficient information to respond with little or no additional delay and information seeking (Chandler 2010; National Council on Disability 2009; Centers for Disease Control and Prevention 2002; Mileti and Sorensen 1990). These five topics, labeled here as the five W's of any effective warning message, are as follows:

1. Who is providing the message? (i.e., the source of the message)
2. What should people do? (i.e., what actions occupants should take in response to the emergency and if necessary, how to take these actions)
3. When do people need to act? (in rapid-onset events, the "when" is likely to be "immediately")
4. Where is the emergency taking place? (i.e., who needs to act and who does not)
5. Why do people need to act? (including a description of the hazard and its dangers/consequences).

While the research record shows that all five topics are important to include in an emergency message, recent research suggests that information on "what should people do" and "why do people need to act" are more important, relatively speaking, than the three other topics (START 2013). Therefore, if using a communication mode that significantly limits message length, message writers should at least provide information initially on what actions occupants should take and why these actions are necessary. Information on the other three topics (i.e., the message source, when people should act, and the location of the emergency) should be provided as well, through either the same message (if possible), a follow-up message, or via a location where individuals can go for additional information.

Whereas topics two through five discuss the emergency and what people should do in response to it, the first topic states that the message should identify the source. In other words, who is providing the message to the building occupants? It is important that the source of the message be someone who is perceived as credible by the building population; i.e., someone to which the occupants can relate or someone who is highly respected (Chandler 2010; Mileti and Sorensen 1990)[4]. Examples of possible credible sources for buildings in the United States include the local fire chief, the building manager (if known), the fire safety director, or other emergency personnel for the building (if known). Additionally, a credible source for one part of the building population may not be a credible source for others within the same population (Phillips and Morrow 2007). Building managers and emergency personnel should understand the building population and from this understanding, develop a database of possible, trusted sources (as well as backup sources). The building population could also be surveyed to identify, in their own words, possible message providers within the building.

[4] There is no one single source that is credible for all members of a diverse warning recipient population. However, since a message provider is required to choose one credible source for a message, local and familiar sources work best. Firefighters, e.g., the local fire chief, are the most credible source in America regardless of hazard type (Kano et al. 2008)

5.2.1.2 Message Structure

Research has been conducted that can provide guidance on the organizational structure of an emergency message. In reference to message topic ordering, traffic research on visual signage suggests that message providers present the problem at the top (the "why"), the location of the problem on the second line (the "where"), and the recommended action (or the "what") on the third line (Ullman, Dudek and Ullman 2005). (The message source – the "who" – and the time for action – the "when" – are not included in traffic signage, since these are understood by context.) However, research in information recall suggests that the most important pieces of the message should be listed first (Covello, Minamyer and Clayton 2007; Conrad 1989), which in disaster emergencies is often the "what" or the actions that people should take in response to the emergency and how they should take these actions.

Recent research in disaster response suggests guidance on the order of alert and warning message content based upon public perception and response outcomes (START 2013). This research finds that the optimized ordering of content is different for short messages (for example 90-character messages) than for longer messages (for example, up to 1,380 characters long messages). Preliminary results show that the optimized order for short messages is: (1) the source, (2) guidance on what to do (the "what"), (3) a description of the hazard and its consequences (the "why"), (4) the location of where the emergency is taking place (the "where"), and (5) the time for action (or "when"). Whereas the optimized order for longer messages seems to be: (1) source, (2) hazard, (3) location, (4) guidance, and (5) time.

There may be instances where the message consists of a series of steps; e.g., the "what" involves a process that is required of the public or building occupants. If there are multiple steps involved in a process, a list can be used to help chronologically organize those steps (Plain Language 2011). Additionally, message writers should consider using numbers to suggest the order of the steps.

There may be instances in which the type of technology used to issue warnings can limit the content of the message. Examples of these types of technology are SMS texts via cell phones, Twitter feeds (140-character limit for each tweet), smaller visual signage, pagers, and tone alert radios (i.e., the display itself). As mentioned earlier, these types of technologies can be used as alerts that lead people to other types of technology in which more information (i.e., the warning message) can be provided. In situations where the technology provides only limited message capabilities but there is no time to obtain additional information, the message writer can draft the message in a bulleted form (Wogalter, Conzola and Smith-Jackson 2002). Bulleted warnings have been found to be effective for conveying warning message information when space is limited. Each of the five topics in the warning (i.e., the 5 W's) should be separated as its own bullet point (Wogalter 2006).

An additional point is to make sure to address distinct audiences separately within the message (Plain Language 2011). When material is mixed and therefore intended for different audiences, it confuses readers. For example, a confusing plural message would be: "Employees and students should report to their respective locations in the building." To avoid this, message writers can separate their audiences into subparts, shown here:

"*Instructions for Faculty Members"*
[Followed by message for faculty members]

"Instructions for Students"
[Followed by message for students]

Using this format, an example of a clearer singular message is the following: "If you are an employee, you should report to the main lobby," and "If you are a student, you should report to the basement of the building."

5.2.1.3 Message Language (or Wording)

Research has also been conducted that can provide guidance on the language structure of an emergency message. First, message writers should use short, simple words in emergency messages, as well as omit unnecessary words. Word choice is an important part of communicating clearly, and if the writer presents the reader with long, flowery language, the message may be overwhelming (Plain Language 2011). Additional guidance on message wording is provided here to aid with message comprehension and clarity:

- **Use the active voice**. In other words, the person or item that is acting is the subject of the sentence. To check if passive voice is used in the message, the writer can look for and replace words such as: "to be," "are," "was," "were," and "could be." Another general feature in passive voice is the use of "ed" at the end of words.
- **Use the simplest form of verbs, which is usually present tense**. Switching between past, present, and future tense in the message can confuse the reader.
- **Avoid hidden verbs**. Hidden verbs are verbs that change into nouns. Examples of some hidden verbs are those that end in *-ment, -sion, -tion,* and *–ance.* Other hidden verbs link with verbs such as *achieve, affect, give, have, make, reach,* and *take.*
- **Use the word "must" to indicate requirements**. The word "must" provides more of a sense of urgency than other words, such as "shall."
- **Use contractions when appropriate**. A useful rule when composing the message is to "write as you talk."

Messages should also be written with short, simple, and clear sentences. When sentences are overloaded with multiple ideas, they may be confusing to the reader. Writers should break up ideas into separate parts, with each one a subject of its own sentence. Additional guidance is provided here on the sentence structure to enhance emergency message clarity (Plain Language 2011):

- **Avoid double negatives and exceptions to exceptions**. Since two negatives cancel each other out, the sentence may sound negative but is actually positive. Double negatives are often mistaken for their true meaning. Exceptions to exceptions are similar to double negatives and are confusing as well, especially in times of emergency.
- **Place the main idea before exceptions and conditions.** Writers should place the main idea first so that readers can focus on the important content of the message. Conditions

should be placed after the main idea, and should include the word "if." For example, a message that states: "If you are located on the east wing of the building, you must exit to the evacuation meeting area" should be rewritten as follows: "You must exit to the evacuation meeting area, if you are located on the east wing of the building".

Overall, emergency messages should be written at a 6th grade reading level or lower (Chandler 2010). Writing at a 6th grade reading level increases the possibility that a U.S. population can understand the emergency message, since the U.S. population currently reads at an average grade level of 10, which is often decreased by four grade levels in times of stress (Chandler 2010). Second, emergency messages should be written without the use of jargon, abbreviations, and false cognates (i.e., words that are similar in another language, but mean different things) (Plain Language 2011; Broersma 2009; Mayhorn 2005). Finally, the words that are used to describe the emergency can elicit different types of response – i.e., words matter. There are certain types of words that can convey urgency. The use of words, like "deadly" and "danger" have been found to prompt a perception of urgency among the public (e.g., Hellier et al. 1002; Edworthy, Clift-Matthews and Crowther 1998). Additionally, the National Weather Service is testing a new framework in which they make use of certain "urgent words", such as "immediate" and "threatens", to understand their influence on community-based sheltering response in tornadoes. It will be important to monitor the results of this study and others to determine the appropriate use of urgent words in various types of emergency situations[5].

5.2.1.4 Multiple Messages

Building managers and emergency personnel should anticipate the need to write more than one emergency message throughout a building disaster. Subsequent warning messages can be disseminated to provide feedback to building occupants, for example, if they are not following instructions previously given or if they become confused as to the appropriate actions to take in the emergency. One can envisage situations in which occupants follow others' actions, which may not necessarily be the appropriate actions. Closed-circuit television (CCTV) cameras or fire wardens/monitors can be used to observe evacuee behavior, and, if necessary, updated messages can help to correct inappropriate response behavior. Warning messages can also be used to update previous warning messages in situations where conditions have changed. For example, a fire can spread to other floors where evacuees were originally told to stay in place. Warning messages in this situation can be used to alter previous instructions to align with the current, most up-to-date situation. In this instance, however, it is important to tell building occupants *why* the action instructions (i.e., what to do in the emergency) have changed, so that they view the new message as credible.

One message type that is often forgotten in an emergency is the feedback message(s) that should be disseminated following an emergency. For rapid-onset events, there is often little time to detect the emergency and provide information about its current state (which leads to instructions on what to do). Therefore, there may be situations, for example in the case of tornadoes, where

[5] It should be noted that the use of "urgent words" in emergency messages should not be used for every emergency situation produced in the building. If these "urgent words" are overused in cases when an emergency does not occur or a less severe (than expected) emergency occurs, building occupants are likely to dismiss rather than perceive urgency in the next disaster (when these words are used).

alert signals and warning messages are provided and then the emergency does not materialize. There is also the possibility that the emergency for which building occupants were warned was not as severe as originally predicted. Experts suspect that these situations, and others like it, could lead to "cry wolf" syndrome, or the possibility that building occupants would dismiss the threat of the next disaster and not follow the advised protective actions (e.g., Wang and Kapucu 2008). Even though research does not reach a consensus on the validity of "cry wolf syndrome" (Baker 1991), there are easy ways to ensure that inaction in the next disaster does not occur. One way to combat this syndrome is to provide feedback messages after the "non-event" to inform building occupants that the alert signal and warning system operated and worked as planned and the reasons why the event that was originally predicted did not occur (Mileti and Sorenson 1990). This way, the alert signal and warning system will more likely maintain credibility when the next rapid-onset disaster occurs.

Regardless of the type of message, and especially given the lack of consensus on message ordering, it is important for building managers and emergency personnel to test emergency messages with the building population (or a representative group of building occupants) before they are used. There are specific methods that one can follow to engage in message testing for building emergencies, which are provided in Section 6 of this document.

5.2.2 Visual Warnings

As messages are written, following the guidance provided above, another important factor in the creation of messages is the method in which they are formatted and displayed. Messages that are displayed visually will have different capabilities and limitations than those disseminated audibly. Message creators should consider different factors and make different types of decisions based upon the dissemination method. The first consideration is the type of visual technology that will be used to disseminate the messages, which can include textual visual displays, SMS text messages, computer pop-ups, email, internet websites, news (TV broadcast) or streaming broadcast over the web. Depending upon the technology chosen to display visual warning messages, guidance is provided here on message displays to enable occupants to see or notice the displayed warning, understand the warning, perceive warning credibility and risk, and respond appropriately.

5.2.2.1 Noticing and Reading the Warning

Most guidance pertaining to visual warnings is formulated based on how to improve people's perception and attention of a visual signage display in buildings. Much of the guidance is from the traffic literature as well as human factors and ergonomics, and it focuses on ways in which to improve an individual's awareness of a sign and ability to read the information presented on the sign.

Line of Sight

Since buildings are complicated structures, it is important to place an emergency sign in a location where people will notice it and be able to read it from their original (pre-emergency) location. One reference was found on the importance of sign placement and positioning, noting that signs will be reliably conspicuous within 15° of the direct line of sight (Creak 1997). The best position for signage, however, is one in which individuals can see and read it head-on (i.e., 0° from the direct line of sight).

Font and Size

Other important factors in the ability to read the text on a sign are the text font and size. First, the literature suggests a mixture of upper and lower case letters rather than the use of all capitals (Sanders and McCormick 1993), which makes the text easier to read. Secondly, several equations are provided for the relationship between letter height and viewing distance. Overall, the relationship between letter height and viewing distance is as follows:

D = 100 (to 250) * h,

where "h" is the height of the letter and "D" is the viewing distance (Rousseau, Lamson and Rogers 1998; Creak 1997). The recommended relationship for older adults with lower visual acuity is D = 100 * h, providing a more conservative result, and ensuring that a larger population will be able to read the emergency message provided by the sign for all types of building occupancies and populations. Finally, the literature provides suggestions on stroke-to-width ratios of the letters, specifically 1:5 (generally), with a ratio of 1:7 suggested for lighter letters on a darker background (Kuhn, Garvey and Pietrucha 1997). With various literature sources available on this topic, it is important for the building manager or emergency personnel to consult the ADA Standards for Accessible Design (U.S. Department of Justice 2010) for additional requirements on signage, including raised characters (for tactile warnings), font proportions, stroke thickness, character/line spacing, character height, glare, and signage location.

Color and Contrast

Color may be an important component of visual signage and some colors have been more successful than others at grabbing people's attention. For example, green or yellow text has been found to be brighter than red text on visual signage (Rea, Ouellette and Clark 1985). However, more important than color is the contrast between the text and the background of the sign. Research has shown that the contrast between the text and the background should be at least 30 % (Dudek et al. 1978), although recommended values could be as high as 60 % or more (Hablamos Juntos 2007). Finally, the use of pictorials (in lieu of or in addition to text) can also bring attention to the sign (Young 1991).

Presentation

When presenting warnings via television or other visual means, including visual signage, one basic piece of guidance is required to allow viewers to see and notice emergency information. Specific care should be taken by message providers to ensure that emergency information is not blocked by other signs or information. An important example is the use of closed-captioning on television and the use of emergency crawlers on the top or bottom of a screen when regularly

scheduled programming is not interrupted. Captions and crawlers are often located in the same place on the television screen, making it almost impossible for the hearing impaired (i.e., those most likely to use closed-captioning features) to receive emergency information (National Council on Disability 2009). What seems like such an obvious recommendation is not always heeded in reality.

5.2.2.2 Comprehending the Pictorial/Graphic, if used

The main ways to improve message comprehension involve the development of the message itself, including crafting the message at a 6th grade reading level and neglecting the use of jargon and false cognates. However, specific guidance can be provided on ways to improve comprehension when using pictorials or graphics to present a visual warning. As an overall measure, printed text should accompany symbols or pictorials used in visual warnings (e.g., Jaynes and Boles 1990). Although some research has found that accompanying text does not provide any additional help in comprehension (e.g., Burt, Henningsen and Consedine 1999), no research was found showing that the provision of text hinders response. Research does suggest that a minimum number of words should be used to accompany graphics (Caird et al. 1997; Schmidt and Kysor 1987). Also, if applicable, diagrams that display a series of sequential steps (that are numbered) are more successful in comprehension of a process than one single graphic (Burt, Henningsen and Consedine 1999; Caird et al. 1997).

5.2.2.3 Perception of Credibility and Risk of the Visual Warning

The literature reviewed in the previous document (Kuligowski et al. 2012) did not provide many recommendations on visual warnings to improve the credibility and risk assessment phases of the decision-making process. The literature mentions that red can be synonymous with danger and green with safety (Nilsson, Frantzich and Saunders 2005). However, the interpretation of hazard-related colors, and words, for that matter, is not consistent across different cultures and may possibly vary within different populations of buildings within the United States. What is likely more effective is the assignment of a different color to a word or phrase that is more important than the rest of the message. This color-contrasted word or statement will likely be read first and will be perceived as more urgent than the rest (at least in messages where color has not already been used for another purpose, e.g., bilingual messages) (Dudek et al. 1978). Since expert opinion suggests that the "what" or action portion of an emergency message is the most important, the "action" phrase should be contrasted with color, if any.

Additionally, a warning message can increase in perceived credibility and risk if occupants are shown that others are also responding (Latane and Darley 1970). This can be done, for example, by providing streaming video of the evacuation or sheltering events. A video of responding building occupants can increase trust in the warning and decrease fear or concern that they are the only ones responding. Similarly, providing updates on the emergency situation, also in the form of video (i.e., showing a video of the tornado approaching), can increase perceived credibility and risk.

5.2.2.4 Responding to the Visual Message

Methods can be taken by creators of visual warnings to decrease response time of the greater building population. Suggestions are made here for visual signage. Simultaneously displayed text (discrete messages), rather than a sequentially displayed message, should be used, if possible, in rapid-onset events. Simultaneously displayed messages on visual displays that are written for comprehension reduce the time that occupants take to respond, which is most important in rapid-onset emergencies (Wang and Cao 2005). If warranted by the population, simultaneously displayed text can also be used for bilingual messages, since no difference was found in comprehension or response when presenting the bilingual message as an alternating message or a simultaneous display (of both languages). However, comprehension and response improves with simultaneously displayed bilingual messages if care is taken to differentiate the text of one language from the text of the other language. This can be done by using two different types of fonts or colors (Jamson, Tate and Jamson 2005). In either case, the use of flashing words should be limited on visual message displays, since the presence of flashing words has been shown to increase response time (Dudek and Ullman 2001).

5.2.3 Audible Warnings

The literature also provides guidance on the most effective ways to format audible warnings. There are specific warning technologies that only (or primarily) affect the aural sense; including public address systems (voice notification systems), automated voice dialing, satellite/AM/FM radio broadcasts, satellite/off-air television broadcasts, and tone alert radios. Whereas visual technologies can limit message length, audible warnings are often limited only by the attention capabilities of the audience. In other words, an audible message can play for long periods of time with these technology types, and the message creator and source must be careful to provide all important information in an appropriate length of time.

Similar to the organization of Section 5.2.2 on visual warnings, this section will also be organized based upon the phases of the decision-making process. First, guidance will be given for methods to increase the likelihood that an individual will perceive, or hear, the message. Then, guidance will be provided that can increase comprehension of the message for audible messages. Finally, guidance will be provided on the ways in which to increase credibility and risk assessment of the event when the warning is presented audibly.

5.2.3.1 Hearing/Receiving the Audible Warning

The literature provides some guidance on ways to improve perception of audible warnings. Similar to guidance given for audible alerts, it is important to reduce or eliminate competing voices when presenting an audible warning message. Audible messages can be provided via computerized (or synthesized) voice, pre-recorded human voice, or a live human voice. Therefore, the reduction or elimination of other voices in the background helps individuals hear the warning message. Additionally, research suggests that any voice announcements also be accompanied by simultaneous visual text (Stout, Heppner and Brick 2004). For example, in buildings, a voice announcement can be provided at the same time as an email or text message is

received. This allows for a larger number of building occupants, including the hearing impaired and the visually impaired, to receive the warning message at the same time.

5.2.3.2 Comprehending the Audible Warning

Guidance is also suggested to improve occupants' comprehension of audible messages. As discussed in Section 5.2.1, focus should be placed on message wording and creation to improve comprehension. Specific recommendations can also be made on format. First, some parts of the English language are more difficult to identify in speech than others. Research has shown that letters are more difficult to identify in speech than numbers, which are more difficult than colors (Cooke, Garcia Lecumberri and Barker 2008). Therefore, labeling building exits (e.g., stairs or elevators) with numbers or colors rather than letters, especially if exit designations are included within the emergency message, may increase message comprehension. Additionally, message speakers (or sources) should not be heavily accented and should speak at a rate of approximately 175 words per minute (Dudek et al. 1978). Traffic research has shown that speaking rates of 110 words per minute or less are considered too slow and are perceived by the listening audience as unimportant (Dudek et al. 1978).

5.2.3.3 Perception of Credibility and Risk of the Audible Warning

Audible messages provide additional opportunities to influence credibility and risk perception. To increase the credibility of the message and the emergency discussed within the message, audible warnings should be delivered using a live voice. The consensus within the gathered research is that believability is more difficult to achieve with a synthesized voice warning (Hellier et al. 2002). Since people often assign higher credibility to a live voice, building managers may wish to use pre-recorded messages only as an alert or introduction to the live warning messages that follow. In this case, it is important to have the live voice message provided by a credible source who introduces him/herself within the message, and it is less important to assign a credible source to the pre-recorded alert message. However, in cases when only pre-recorded voice messages are given in the building, the message should be recorded by a credible message source. One note of caution: if the same recorded message plays too often in building events where no emergency occurs, the credibility attributed to this recording (and the message source) may decrease over time.

Credibility is not the only benefit offered by live voice messages. Live messages can be updated with new information and can be used to convey an appropriate level of urgency, if necessary (Proulx 2001). Urgency can be achieved via a voice message either by increasing the speech rate (which contradicts the earlier recommendation to speak at a normally-paced speech rate for comprehension purposes) or by projecting a higher-pitched voice. Gender matters less here than the pitch of the voice; however, in most cases women have voices that are higher in pitch.

One further note should be made about conveying urgency in audible messages. The literature from a variety of disciplines provides insight on the various methods that can be used to convey urgency in alerts and warnings. As mentioned earlier, for example, urgency can be conveyed in alert signals through the use of quick pulses. Additionally, warnings given in a higher-pitched voice or at a faster speech rate, or crafted using certain words, colors or graphics, can also

convey urgency levels. However, there is little mention in the disaster/fire research literature on whether it is appropriate to convey urgency in emergency messaging. The human factors and ergonomics literature suggests that warnings and alarms should convey the level of urgency of the situation (Edworthy 1998); however, other disciplines remain silent on the issue. Since overuse of urgency may lead to non-response in future disasters, especially in situations where emergencies are downgraded or do not materialize, urgency measures should be used selectively to emphasize more dangerous, immediate, life-threatening situations.

5.2.4 Dissemination of the Warning Message

Research has shown that individuals are information seekers in times of disaster. Therefore, it is important to ensure that the entire population receives (and pays attention to) the alerts and warning messages as soon as possible.

5.2.4.1 Multiple Channels

One way to reach the entire population of the building or building campus is to use multiple channels to disseminate the warning message – including visual means, audible means, and tactile means. Examples of tactile means include vibrating pagers and text messages for the hearing impaired and raised characters or Braille on building signage for the visually impaired. It is important for message providers to understand the messaging needs of their occupants in order to design an emergency communication system with the appropriate technology and credible message sources to reach all sub-groups within the building. The use of multiple channels can also facilitate occupants' needs to confirm a message (by seeking additional, consistent information), which would reduce delay time in initiating the recommended protective action(s) (Mileti and Sorensen 1990).

5.2.4.2 Message Repetition

Another way to reach the entire building population is through message repetition. A warning message should be repeated at least once, with some research advocating for message repetition of at least two times (Dudek et al. 1978; Huchingson, Koppa and Dudek 1978). Additionally, messages should be stated, in full, and then repeated, in full – rather than repeating statements within the same message. Research has found that people are more successful in recalling the message when the entire message is repeated over again, multiple times (Huchingson, Koppa and Dudek 1978). Finally, warning messages should be repeated at intervals, rather than consecutively (Melton 1970). The second (or third message), provided some interval of time later, may catch a different population who were either busy or distracted during the time period when the first warning message was issued.

5.2.4.3 Timing

Warning messages should also be disseminated as early as possible. This way, building occupants are provided with enough time to take protection before untenable conditions occur.

Also, face-to-face communication should accompany other audible or visual technologies, due to its success in prompting occupant response during emergencies.

5.2.4.4 Communication Type

The last point related to dissemination of warnings refers to the operation of warning technology. Guidance suggests that messages should be disseminated using a combination of both push and pull technologies (Chandler 2010). Push technologies are those that do not require individuals to take extra effort to receive the alert or warning message (e.g., public address systems or text messages), whereas pull technologies require the individual to seek additional information to acquire the alert/message (e.g., internet websites). Push communication is most important to use for alert signals as well as initial warning messages, since building occupants often require awareness of the incident in its initial stages. Then, once initial information is made available via push communication, additional information can be provided by both push and pull technologies.

5.3 Summary of Guidance

Table 2 provides a summary of the guidance offered above on both alerts and warning messages. The guidance is organized by the type of emergency communication (alert versus warnings) and then by the main topics that were used for organization, above.

Table 2: Summary of guidance on alerts and warning messages

Communication Topic	Section of Report	Guidance statement
Alerts		
	5.1	Alerts should be significantly different from ambient sounds
		Buildings should reduce background noise when initiating audible alerts
		If selected, an alert should be tested for its success in getting occupants' attention in the event of an emergency and used as part of the building-wide training
		Flashing, rather than static lights, preferably one standard color for all buildings, can be used to gain attention to visual warning messages
		There are additional methods to alert building occupants to an emergency: disruption of routine activities, tactile methods, social networks, face-to-face
		An alert signal should be accompanied by a clear, consistent, concise, and candid warning message
Warnings – The message		
	5.2.1.1	A warning message should contain five important topics to ensure that building occupants have sufficient information to respond 1. Who is providing the message? (i.e., the source of the message) 2. What should people do? (i.e., what actions occupants should take in response to the emergency and if necessary, how to take these actions) 3. When do people need to act? (in rapid-onset events, the "when" is likely to be "immediately") 4. Where is the emergency taking place? (i.e., who needs to act and who does not) 5. Why do people need to act? (including a description of the hazard and its dangers/consequences)
		The source of the message should be someone who is perceived as credible by the building population
		Building managers and emergency personnel should understand the building population and, from this understanding, develop a database of possible trusted sources (as well as backup sources)
	5.2.1.2	Message order for short messages (e.g., 90-characters) should be the following: (1) source, (2) guidance on what people should do, (3) hazard (why), (4) location (where), and (5) time. Message order for longer messages should be: (1) source, (2) hazard, (3) location, (4) guidance, and (5) time.
		Numbered lists can help to chronologically organize multiple steps in a process
		For limited message length, message writers could draft the message in a bulleted form; each of the five topics in the warning should be separated as its own bullet point
		Distinct audiences should be addressed separately in the message (or multiple messages)
	5.2.1.3	Messages should be written using short, simple words, omitting unnecessary words or phrases
		Messages should be written using active voice, present tense; avoiding hidden verbs
		Messages should be written using short, simple and clear sentences – avoiding double negatives and exceptions to exceptions; main ideas should be placed before exceptions and conditions
		Emergency messages should be written at a 6^{th} grade reading level or lower
		Emergency messages should be written without the use of jargon and false cognates

Communication Topic	Section of Report	Guidance statement
Warnings – The message, continued		
	5.2.1.4	Building managers and emergency personnel should anticipate the need to write more than one emergency message throughout a building disaster, including feedback messages or updates
		In update messages, tell building occupants *why* the information has changed, so that the new message is viewed as credible
		Provide feedback messages after a "non-event" to inform building occupants that the alert signal and warning system operated and worked as planned and the reasons why the event did not occur
		Building managers and emergency personnel should test emergency messages with the building population
Warnings – Visual		
	5.2.2.1 (Line of sight)	Place the emergency sign in a location where people will notice it and be able to read it from their original (pre-emergency) location
		Signs will be reliably conspicuous within 15 degrees of the direct line of sight
	(Font and size)	Text is easier to read when written with a mixture of upper and lower case letters rather than the use of all capitals
		The recommended relationship for older adults with lower visual acuity is D = 100 * h, providing a more conservative result, and ensuring that a larger population will be able to read the emergency message
		A stroke-to-width ratio of the letters is suggested as 1:5 (generally), with a ratio of 1:7 suggested for lighter letters on a darker background
		Building managers or emergency personnel should consult the ADA Standards for Accessible Design (U.S. Department of Justice 2010) for additional requirements on signage
	(Color and contrast)	Contrast between the text and the background should be at least 30 %, although recommended values could be as high as at least 60 %
		The use of pictorials (in lieu of or in addition to text) can also bring attention to the sign
	(Presentation)	Message providers should ensure that emergency information is not blocked by other signs or information
	5.2.2.2	Printed text should accompany symbols or pictorials used in visual warnings; a minimum number of words should be used to accompany graphics
		Diagrams that display a series of sequential steps are more successful for comprehension of a process than one single graphic
	5.2.2.3	Use a color-contrasted word or statement for text that should be read first and/or be perceived as more urgent than the rest, unless color is used for other reasons (e.g., bilingual text)
		A warning message can increase in perceived credibility and risk if occupants are shown that others are also responding
	5.2.2.4	Simultaneously displayed text (discrete messages) should be used, rather than a sequentially displayed message
		Simultaneously displayed text can also be used for bilingual messages, especially if care is taken to differentiate the text of one language from the text of the other language
		Limit the use of flashing words on visual message displays

Communication Topic	Section of Report	Guidance statement
Warnings – Audible		
	5.2.3.1	Other, non-alert/warning voices in the background should be reduced or eliminated
		Any voice announcements should also be accompanied by simultaneous visual text
	5.2.3.2	Letters are more difficult to identify in speech than numbers, which are more difficult than colors
		Message speakers (or sources) should not be heavily accented and should speak with a rate of approximately 175 words per minute
		Audible warnings should be delivered using a live voice
		Other benefits are provided by a live voice method: messages can be updated with new information and can be used to convey an appropriate level of urgency, if necessary
		Urgency measures should be used selectively to emphasize the more dangerous, immediate, life-threatening situations (since overuse may lead to non-response in future disasters)
Warnings – Dissemination		
	5.2.4.1	Use multiple channels to disseminate the warning message – including visual means, audible means, and tactile means
	5.2.4.2	A warning message should be repeated at least once, with some research advocating for message repetition of at least two times
		Messages should be stated in full, and then repeated in full – rather than repeating statements within the same message
		Warning messages should be repeated at intervals, rather than consecutively
	5.2.4.3	Warning messages should also be disseminated as early as possible
		Face-to-face communication should accompany other audible or visual technologies
	5.2.4.4	Messages should be disseminated using a combination of both push and pull technologies
		Push communication is most important to use for alert signals as well as initial warning messages

6 Guidance on Emergency Communication/Message Testing

Testing emergency messages plays a prominent role in determining their effectiveness. There are tests available for building owners and/or managers to test the effectiveness of their emergency communication/messages. These tests should be conducted before any message is disseminated to the building occupants to allow time for revision if the message does not meet certain standards. The purpose of this section is to provide a review of available methods that can be used to test for message effectiveness. These tests can be applied to electronic as well as non-electronic messages (Plain Language 2011).

6.1 Language Testing

The first way to evaluate the effectiveness of emergency messages is through language testing. Language testing is used to evaluate whether a participant understands and/or can correctly interpret the meaning conveyed by the message. The two language tests or methods described here are the following: paraphrase testing and usability testing (Plain Language 2011).

6.1.1 Paraphrase Testing

Paraphrase testing determines how the reader interprets the message, allowing the tester to compare the reader's interpretation with the actual meaning of the message. The tester should conduct six to nine interviews on each message.

First, to conduct an interview, the tester must divide the message into sections, depending upon message length. Then, the reader will be asked to identify, in his or her own words, what each section of the message means.

Secondly, the tester should ask additional, open-ended questions, rather than "yes" or "no" questions. Good examples of questions to ask readers are the following:

- What would you do if you got this message?
- What do you think the writer was trying to do with this message?
- Thinking of other people you know who might receive this message:
    - What about the message might work for them?
    - What about the message might cause them problems?

6.1.2 Usability Testing

Usability tests provide an alternative way to test whether the individual understands the information provided in the message. A suggested number of participants for usability tests is three, although this is no requirement. These tests should take place one-at-a-time.

Usability test sessions contain the following parts:

- Introduction: The tester should make the participant comfortable, explain what will happen, and ask a few questions about the person to understand his/her background.
- Scenarios: Next, the tester should give the participant a scenario in which s/he would receive the message, and then watch and listen as s/he reads and interprets the message. The tester should ask the individual to "think aloud" when reading or listening to the message, in order to hear how the participant understands what s/he read.
- Debriefing: Last, the tester should ask neutral questions about his/her experience reading the message, and follow up about any specific words or phrases used by the participant.

There are variations of the usability test, in comparison to the process previously described. These variations are described below:

- Together, two participants are asked to "think aloud" about the message at the same time.
- Several participants located in separate locations are asked to work independently at the same time. This works well if there are several usability test note-takers available to

ensure that someone is watching and listening to each participant at all times. After the participants have completed their individual sessions, all participants are brought together for a group-wide discussion on the message.

- The tester and the participant work together remotely (i.e., the tester is in one physical location and the participant is in another), and they perform the usability study using web-based tools.

6.2 Readability Testing

Another method to test the effectiveness of emergency communication messages is readability testing. A readability test can be used to measure the reading level of any written work using computed formulas. These tests are usually used to estimate the number of years of education an individual must have in order to read and comprehend the written material ("Test Documents Readability" 2013). Since the suggested reading level for emergency messages is the 6th grade level (on average), it is important to use a readability test to ensure that the messages created by the building managers or emergency personnel do not score above that level.

When conducting a readability test, the entire message or a sample of the message can be tested. The use of polysyllabic words and complex sentences usually raises the minimum education level required to read messages ("Test Documents Readability" 2013). Therefore, readability tests can help when deciding to alter, remove, or replace certain text/words, if necessary.

There are different types of readability tests that are created by experts, each of which utilizes different formulas that calculate the level of reading. One readability test is called the Flesch-Kincaid Readability Test. Another is the Automated Readability Index. Both tests are relatively simple to calculate, and can easily be applied to emergency messages such as text message alerts, email alerts, or even messages portrayed on announcement screens. These two tests will be described in the following sections.

6.2.1 Flesch-Kincaid Readability Test

The Flesch-Kincaid Readability Test uses a formula that calculates a score based on the number of words, syllables, and sentences in a given piece of text. The higher the score, the easier the message is to read. For emergency messages, the score to aim for is 60 or higher (Anderson 2012).

The specific mathematical formula for the Flesch-Kincaid Readability Test is as follows (My Byline Media 2013):

(0.39 * Average number of words per sentence) + (11.8 * Average number of syllables per word) - 15.59 = Readability score.

6.2.2 Automated Readability Index

Another readability test is called the Automated Readability Index, which analyzes the number of characters, words, and sentences in a given message text. From there, the reading score corresponds to the grade level expected to be able to read and comprehend the message. Specifically, the formula for the Automated Readability Index is shown below:

(4.71 * Average number of characters per word) + (0.5 * Average number of words per sentence) – 21.43 = Grade level

The result of the formula above is the minimum grade level required to read the message. For example, an output of the Automated Readability Index of 10.6 would round up to 11, corresponding to an 11^{th} grade reading level ("The Automated Readability Index" 2013).

6.3 Response Testing

Response testing involves the testing of emergency messages via full-scale or real world exercises. These exercises can take the form of an actual emergency situation or a practice drill. In these exercises, building occupants are not necessarily aware that a test is going on; however, it will be important to make participants aware of this test after the event is over. The purpose of response testing is to collect data on how the participants respond to an emergency message (either in the event of an actual emergency or under the guise of an actual emergency).

A few cautionary notes should be provided on the use of response testing. First, response testing should be performed after a paraphrase or usability test and a readability test have already been completed on each message. Second, in cases where messages are tested during a drill or test-setting, it is essential to follow these studies with information to the participants that a drill/test took place. Additionally, the participants should then be provided with the actual emergency message that was chosen as appropriate (as a result of the response test), so that they know what to expect in an actual emergency scenario.

Two examples of response tests are discussed below. These include controlled comparative studies and evacuation drills for buildings (for fires and other types of rapid-onset emergencies).

6.3.1 Controlled Comparative Studies

A controlled comparative study (CCS) involves the collection of quantitative data on how well the general public responds to a message in a test-scenario (i.e., a drill) or an actual emergency scenario. Public response can be measured by how many clarifications are requested or how many errors (e.g., in response) resulted from a particular message. Different versions of a message can be disseminated to different sections of a population to assess whether one version of the message is more successful than another.

6.3.2 Fire Evacuation Drills for Buildings

Another way to test the effectiveness of emergency messages is through the performance of fire evacuation drills, as specified by NFPA's Life Safety Code (National Fire Protection Association 2012b), depending upon occupancy type. In general, emergency egress and relocation drills should be conducted with sufficient frequency to familiarize occupants with the drill procedure.

After each emergency egress or relocation drill, emergency coordinators should produce a written report of the drill to be submitted to designated authorities or at the next county safety meeting. The purpose of this step is to document the information and results of the fire drill. The report should include details such as the date, time, participants, location, and results of the drill. This can be a way to test message effectiveness, whether the message is textual, audible, or visual.

The frequency and methods of the emergency evacuation drills are different based upon the occupancy type of the building (National Fire Protection Association 2012b). Fire drills for various occupancy types are discussed below.

Ambulatory health care occupancies: Ambulatory health care occupancies are typically buildings that are emergency care centers. These buildings receive patients that are, for example, unconscious from an accident or unable to move due to a sudden illness.

Buildings that are considered ambulatory health care occupancies should conduct drills quarterly on both morning and night shifts. Only staff members participate, and occupants are not moved during evacuation drills. This is so that staff members can familiarize themselves with the signals and actions required under varying emergency conditions.

Assembly occupancies: Assembly occupancies are buildings that typically hold 50 or more occupants in a specified location at a time. Examples of such occupancies include assembly halls, bowling lanes, college classrooms with 50 people or over, courtrooms, drinking establishments, gymnasiums, mortuary chapels, museums, places of religious worship, skating rinks, and theaters.

Since assembly occupancies are a broader category of building type, there are no NFPA requirements for the frequency of fire drills. However, emergency evacuation and relocation drills must be conducted as frequently as required by the corresponding authority having jurisdiction of the building.

Business occupancies: Business occupancies are those used for the transaction of business other than mercantile. Examples of such occupancies include office buildings, city halls, courthouses, doctors' offices, and outpatient clinics.

Similar to assembly occupancy buildings, business occupancies do not have a specified drill frequency as required by NFPA. If a business occupancy building holds more than 500 people total or more than 100 people above or below the street level, emergency coordinators must conduct drills as frequently as practicable. Additionally, these drills should be held at both unexpected and expected times and under varying conditions, to simulate the unusual conditions that may happen during an emergency.

Day-care occupancies: Examples of buildings that are considered day-care occupancies include child day-cares, adult day-cares, and nursery schools. Some half-day kindergarten classes that offer full-day care are also considered day-care occupancies.

Emergency egress and relocation drills should be conducted once every month that the facility is in session. All occupants of the building must participate in these drills. However, there are some caveats to the general rule for day-care occupancies. If the day-care occupancy is newly opened, two drills must be conducted during the first month instead of one within the first 30 days of operation. If the weather is severe, the evacuation or relocation drill may be postponed. No additional details are provided as to when the drill would need to be performed after postponement occurs.

Detention and correctional occupancies: Examples of buildings that are considered detention and correctional occupancies include adult and juvenile work camps, adult correctional institutions, juvenile community residential centers, and juvenile training schools. Similar to assembly and business occupancies, there is no drill frequency requirement. Under the Life Safety Code, all employees should be instructed and drilled with respect to their duties under the emergency evacuation plan (National Fire Protection Association 2012b).

Educational occupancies: Educational occupancies include academies, kindergartens, and schools. Colleges and university classrooms are considered assembly and business occupancies, depending on the occupant load. Educational occupancies differ from assembly occupancies in that educational occupancies have the same people present daily.

Emergency evacuation and relocation drills must be conducted at least once per month. All building occupants must participate in this drill. If the building is newly opened, two drills must be conducted within the first 30 days of operation.

Health care occupancies: Health care occupancies include hospitals, limited care facilities, and nursing homes. During evacuation or relocation drills, infirm or bedridden patients are not required to be moved.

Similar to ambulatory health care occupancies, drills should be conducted quarterly for both day and night shifts. They should also be conducted under varying emergency conditions to familiarize the staff members with specific signals and actions during an emergency.

Hotels and dormitories: Both extended-stay and general hotels are classified as hotels because they are potentially subject to the same transient occupancy. Examples of dormitories include college dormitories and fraternity and sorority houses.

Emergency evacuation drills should be conducted by the corresponding authority having jurisdiction of the building. Drills should be conducted frequently enough so that occupants are familiar with the evacuation or relocation plan.

Mercantile occupancies: Examples of buildings that are categorized as mercantile occupancies include department stores, restaurants with fewer than 50 people, and supermarkets. Restaurants with over 50 people would be considered as assembly occupancies. Office, storage, and service facilities that sell merchandise are also considered mercantile occupancies.

All employees should be periodically trained in how to respond in emergencies; however, there is no drill frequency requirement.

Residential board and care occupancies: Examples of residential board and care occupancies include group housing for people who are physically or mentally handicapped, facilities for rehabilitation, and other group housing arrangements that provide personal care services.

Emergency egress and relocation drills should be conducted at least six times a year on a bimonthly basis. At least two of these drills must be conducted during the nighttime when residents are sleeping. These drills should involve the actual evacuation of all residents. This provides residents with experience in evacuating through all exit ways and means of egress.

6.3.3 Practice/Drills for Non-fire Emergencies

Earthquake and Tsunami Safety: The Federal Emergency Management Agency (FEMA) provides guidance on how to train occupants on earthquake and tsunami emergency procedures (U.S. Department of Homeland Security, Earthquake Safety at School 2013; Vertical Evacuation from Tsunamis 2013). According to this guidance, drills should be held in schools as well as workplaces. However, in both cases, there is no specific requirement on how often to conduct drills.

Tornado Safety: The National Oceanic and Atmospheric Administration (NOAA) provides guidance on tornado safety. Safety tips before the storm include conducting frequent “shelter-in-place” drills and listening to the radio or television for additional information. The frequency of drills is not specified, but practice drills should be conducted enough so that the population is familiar with emergency procedures. NOAA recommends that families, organizations, etc. develop and practice a tornado emergency plan together for a particular building (National Weather Service 2013).

7 Emergency Message Templates

Rapid-onset emergencies often come with little warning and can have a major impact on communities. In order to provide clear, effective instructions for a threatened population, it is important to create message templates ahead of time for a variety of different emergencies.

This section provides examples of message templates for five types of emergency, using various forms of emergency communication technology. Each template follows the guidance presented in this document.

A panel of experts from the fire safety community developed the set of message templates presented in this document. The templates were developed during an Emergency Messages Workshop held at the 16th annual Suppression, Detection and Signaling Research and Applications Symposium (SUPDET 2012) in Phoenix, Arizona. Panel experts were divided into 10 groups. Each group received one of five different emergency scenarios for which they were instructed to develop emergency messages. Since five scenarios were given to 10 groups, two groups developed emergency messages for each scenario. This allowed for comparison between the two groups. The scenarios consisted of a brief description of the emergency situation, the protective actions that the occupants were expected to perform (based upon the building or community's emergency plan), and the type of technology that would be used to disseminate the message. The five scenarios provided to the 10 groups were the following:

Scenario 1:

Scenario 1 is a fire in a 20-story building. The fire is located on the 10th floor of the building. Individuals are unable to use elevators in this scenario, except for those who are unable to negotiate the stairs, in which case building staff or fire fighters will assist them using the freight elevator(s).

Protective actions: Occupants on floors 9-11 are told to evacuate to the 8th floor (2 floors below the fire floor). All other occupants are provided with a message to remain on their floor. Therefore, in this scenario, two different types of messages are required to be provided simultaneously to occupants, depending upon the floor on which they are located: one message will be disseminated to floors 9, 10 and 11, and then at the same time, a different message will be disseminated to all other floors.

Technology used to disseminate the message: The building-wide public address system that can provide different messages to different floors (using a live voice).

Scenario 2:

Scenario 2 is a fire in a 20-story building. The fire is located on the 2nd floor and smoke is traveling up the building's air-conditioning/venting system, causing the need for a full-building evacuation. Individuals are unable to use elevators in this scenario, except for those who are

unable to negotiate the stairs, in which case building staff or fire fighters will assist them using the freight elevator(s).

Protective actions: Occupants on all floors are requested to evacuate the building, known as a full building evacuation.

Technologies used to disseminate the message: The building-wide public address system that can provide different messages to different floors (using a live voice). Also, a 90-character text message alert to cell phone users in the building.

Scenario 3:

Scenario 3 is a tornado imminent on a college campus.

Protective actions: The individuals on the college campus are instructed to "shelter in place". Additionally, the National Weather Service provides examples of protective actions (included below):

Example 1: "TAKE COVER NOW. FOR YOUR PROTECTION MOVE TO AN INTERIOR ROOM ON THE LOWEST FLOOR OF A STURDY BUILDING."

Example 2: "TAKE COVER NOW. MOVE TO AN INTERIOR ROOM ON THE LOWEST FLOOR OF A STURDY BUILDING. AVOID WINDOWS. IF IN A MOBILE HOME...A VEHICLE OR OUTDOORS...MOVE TO THE CLOSEST SUBSTANTIAL SHELTER AND PROTECT YOURSELF FROM FLYING DEBRIS."

Example 3: "THE SAFEST PLACE TO BE DURING A TORNADO IS IN A BASEMENT. GET UNDER A WORKBENCH OR OTHER PIECE OF STURDY FURNITURE. IF NO BASEMENT IS AVAILABLE...SEEK SHELTER ON THE LOWEST FLOOR OF THE BUILDING IN AN INTERIOR HALLWAY OR ROOM SUCH AS A CLOSET. USE BLANKETS OR PILLOWS TO COVER YOUR BODY AND ALWAYS STAY AWAY FROM WINDOWS.

IF IN MOBILE HOMES OR VEHICLES...EVACUATE THEM AND GET INSIDE A SUBSTANTIAL SHELTER. IF NO SHELTER IS AVAILABLE...LIE FLAT IN THE NEAREST DITCH OR OTHER LOW SPOT AND COVER YOUR HEAD WITH YOUR HANDS."

(Examples found here: http://www.nws.noaa.gov/view/validProds.php?prod=TOR)

Technologies used to disseminate the message: A campus-wide siren system with audible messaging capabilities. Also, a 140-character Twitter message should be disseminated as well for this emergency.

Scenario 4:

Scenario 4 is a chemical spill in a 40-story office building. The event was an accident and occurred on the 1st floor of the building. There is the possibility of the chemical negatively affecting individuals on the lower floors of the building. Individuals are unable to use elevators in this scenario. For those who are unable to negotiate the stairs, only one freight elevator will be used with fire fighter assistance.

Protective actions: Occupants are advised to perform different actions based upon the floor on which they are located. First, occupants on the first floor are advised to evacuate the building. At the same time, occupants on floors 2-10 are advised to travel to locations higher in the building – preferably to floors 20-30. Also at the same time, occupants on floors 11 and above are advised to remain in place. Therefore, in this scenario, three different types of messages are required to be provided simultaneously to occupants, depending upon the floor on which they are located: one message will be disseminated to the first floor, one message will be disseminated to floors 2 through 10, and a third message will be disseminated to all other floors.

Technologies used to disseminate the message: The building public address system that can provide different message to different floors (using a live voice). Also, an email message (through the company's email system) should be disseminated to employees on floors 2-10 to relocate to a higher floor. [*Note: Do not worry about an email to other employees, although in an actual emergency, that would be necessary.*]

Scenario 5:

The fifth scenario is a violent event. Specially, the emergency involves an active shooter that has been identified in a major U.S. airport.

Example protective action: Occupants should evacuate the airport through all accessible doors, including doors from the gate waiting areas onto the tarmac area.

Technologies used to disseminate the message (along with example character limits that can be typical for these types of technologies): A 90-character text message alert to individuals' phones within the airport. Also, airport-wide visual messaging screens (limit message to 60 words or less) can be used to alert individuals in terminals where the shooter is NOT located.

During the workshop, each group worked together to develop templates for their particular emergency and dissemination technology. Then, each group presented their messages to the larger group of workshop participants for comments and critiques. Next, the leader of the workshop (an author of this guidance document) took all comments, critiques, and the guidance presented in this document to further develop each template. Finally, after revision, the templates

went through additional review by the members of the FPRP's Advisory Committee on this project, who had the opportunity to comment and offer additional critiques before this document was published. All "final" templates are presented here, organized by scenario, and accompanied by the Flesch-Kincaid Reading Ease Grade Level (calculated by a feature in document/word processing software).

Scenario 1 (fire): Phased evacuation

Message 1a (building-wide announcement to Floors 9, 10 and 11): "Attention [Floors 9, 10, and 11]. This is your Building Safety Officer, Joe Smith. A fire has been reported on the 10th floor of the building. Everyone on the 9th, 10th, and 11th floors should move to the 8th floor to be protected from heat and smoke, since heat and smoke can creep into nearby floors during a fire. Use the stairs immediately. Do not use the elevators. Those who need help getting to the 8th floor, please wait inside the stairwell [or go to the freight elevator lobby]."
Reading level: 5.8

Message 1b (building-wide announcement to all other floors): "Attention. This is your Building Safety Officer, Joe Smith. A fire has been reported on the 10th floor of the building. Please wait on your floor. At this time, you are safer remaining on your floor than leaving the building, because this building is designed to confine the fire [e.g., locally OR to the 10th floor only]. Do not use the elevators for any reason. We will give you further instructions, if the situation changes."
Reading level: 5.8

Scenario 2 (fire): Full building evacuation

Message 2a (building-wide public address system): "Attention. This is Chief Smith from the Springfield Fire Department. A fire has been reported on the second floor of the building. Everyone must leave the building now to avoid contact with the fire's heat and smoke. Go NOW to your closest stair and leave the building. People who cannot use the stairs should go to the freight elevator lobby for help."
Reading level: 4.6

Message 2b (cell phone text message (90 characters*)): "Evacuate building now. It is on fire. Go to freight elevator if you need help."
Reading level: 2.8

**Note: A description of the hazard (a more detailed "why" statement) is not included in this message due to character limits. Also, the source is not listed. It is possible that the source will already be identified in the "From" or "FRM" line of the text message. If message contents are limited, there is always the option to send a follow-up text message that provides more information or that continues the previous message. Also remember that some phones (i.e., non-smart phones) may display longer text messages in reverse chronological order.*

Scenario 3 (tornado):

Message 3a (campus-wide audible messaging system): *Alert tone precedes message* [siren]. "This is Joan Smith, Chief of Campus Police. A tornado has been sighted on the ground at [20th Street and Mockingbird Lane]. The tornado is strong and is moving toward the college campus at high speeds (with winds over 160 mph). High winds and large, flying debris can flatten a building in a storm of this magnitude. Take shelter now. Get inside now, go to the lowest level, and get away from windows. Stay there until further instructions."
Reading level: 5.3

Message 3b (Twitter message (140 characters**)): "Take shelter inside a building NOW. Go to the lowest level, get away from windows. Strong tornado near campus." [Include hashtag in 140 characters]
Reading level: 4.8

***Note: The source of the message is not included in this Twitter message since the source will be evident from the Twitter message layout.*

Scenario 4 (chemical spill):

Message 4a (Building-wide public address system): [First floor occupants] "This is your [Building Manager], Joe Smith. A dangerous chemical has spilled on the first floor. The chemical makes it difficult to see and can cause trouble breathing. Evacuate immediately."
Reading level: 6.6

Message 4b (Building-wide public address system): [Floors 2 through 10] "This is your [Building Manager], Joe Smith. A dangerous chemical has spilled on the first floor. The chemical makes it difficult to see and can cause trouble breathing. Immediately use the stairs to relocate to the 20th through 30th floors and then wait for further instructions. If you can't use the stairs on your own, go to the freight elevator and wait for help. Relocate now."
Reading level: 5.6

Message 4c (Building-wide public address system): [Floors 11 and above] "This is your [Building Manager], Joe Smith. A dangerous chemical has spilled on the first floor. The chemical makes it difficult to see and can cause trouble breathing. People on floors 1-10 are being evacuated. Please stay on your floor. You are safer remaining where you are than if you try to leave the building. The chemical will not reach people on floors 11 and above. You would possibly be exposed to the chemical if you tried to leave the building. Do not use the elevators for any reason. We will give you further instructions if the situation changes."
Reading level: 5.5

Note: Provide emails with the same messages as listed above

Scenario 5 (violent event):

Message 5a (airport-wide visual messaging screens): "This is Los Angeles Police. Evacuate the terminal NOW. Follow directions from airport security. Shots have been fired near 'Gate 22'."
Reading level: 6.6

Message 5b (cell phone text message (90 characters***)): "Leave NOW. Follow airport security. **Shots fired!** Police report: Shooter in Terminal A."
Reading level: 6.5

****Note: A description of the hazard (a more detailed "why" statement) is not included in this message due to character limits. If message contents are limited, there is always the option to send a follow-up text message that provides more information or that continues the previous message. Also remember that some phones (i.e., non-smart phones) may display longer text messages in reverse chronological order.*

8 Questions Left Unanswered

As mentioned in Section 2, the development of this guidance document has shed light on research findings that are either conflicting (between or within disciplines) or areas of the field that remain unexplored. This section represents a discussion of "the things we know we do not know."

Conflicting research and guidance exist on the appropriate length of emergency messages. Some findings state that messages should be no more than 30 words long, a total of three sentences and last for approximately 9 seconds (Chandler 2010; Centers for Disease Control and Prevention 2002). However, this guidance is often offered for events where the audience is not already paying attention, and in a disaster event, once people are made aware that something is going on, they are likely to stay tuned to information sources to find out more information. Recent research shows that messages that are 1,380 character in length appear to produce optimized response outcomes in comparison to shorter messages (i.e., 90- and 140-characters in length), which appear less effective at guiding people toward taking protective action (START 2013).

With that said, there is no additional guidance on a maximum message length for disaster-related warning information provided in building emergencies, especially for technologies where there is no fixed limit on message length (e.g., email, public address systems). There is also no additional guidance on the appropriate length of audibly-provided pre-recorded messages versus live messages, although the guidance document does state the benefits of using live voice messages over a pre-recorded voice. Overall, messages should not be so long that they delay occupants taking protective action, but should be long enough to convey the appropriate information necessary to prompt response (i.e., the five topics listed in 5.2.1.1).

Based on the literature, no consensus was reached on the appropriate number of repetitions required for the emergency warning message. Most studies reported on the number of repetitions that would aid in recall. In a disaster, however, recall is less important than ensuring that the message is received (and paid attention to) by as many occupants in the building as possible. This guidance document

suggests that the message be repeated at least one time, on an interval basis (rather than successive) in order to increase the number of individuals in the building who receive the message. More research is needed on the effect of message repetition on response.

Finally, one finding on alerts warrants discussion: alerts should sound different for different types of emergencies (U.S. Department of Justice 2010). This finding is not included in the guidance document because of the unnecessary burden this places on building occupants. Designing a communication system that sounds different for each building emergency would require occupants to learn and remember a potentially complicated alert system. Using the alert/warning system described in Section 5, a building should use one consistent alert signal to get people's attention to a building emergency situation, which should then be followed by an expertly crafted and tested warning message specific to the emergency. Currently, in buildings without a voice communication system, the fire alarm serves as both the alert and the warning system, and for this reason, fire researchers have advocated for a standardized fire alarm signal so that individuals from building to building understand what that signal means. However, if the building uses an alert system followed by an appropriate warning message, this is an even better way to get individuals to respond safely and effectively to the building emergency.

9 Conclusions

The purpose of this report is to provide guidance to system designers, building managers and building emergency personnel responsible for emergency communication on how to create and disseminate effective messages using basic communication modes (audible vs. visual technology), as well as guidance on how to test the effectiveness of these messages. This guidance document also provides examples of emergency messages (message templates) for five different types of emergency scenarios. As with any document, there are gaps in the research that hinder the ability to provide guidance on certain topics, including message length, ordering, and repetition. This guidance document focuses specifically on textual message creation, creating room for additional guidance on the development and testing of visual symbols that could be used instead of or in addition to textual emergency messages. In the future, as research gaps are addressed, additional editions of this document would be useful to enhance the findings and guidance provided here.

10 References

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