Hazards and Protective Actions Sequence Matrix

Comprehensive Testing of Imminent Threat Public Messages for Mobile Devices

National Consortium for the Study of Terrorism and Responses to Terrorism
A Department of Homeland Security Science and Technology Center of Excellence
Based at the University of Maryland

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About START

The National Consortium for the Study of Terrorism and Responses to Terrorism (START) is supported in part by the Science and Technology Directorate of the U.S. Department of Homeland Security through a Center of Excellence program based at the University of Maryland. START uses state-of-the-art theories, methods and data from the social and behavioral sciences to improve understanding of the origins, dynamics and social and psychological impacts of terrorism. For more information, contact START at infostart@start.umd.edu or visit www.start.umd.edu.

Research Context and Purpose

In 2007 the Federal Emergency Management Agency (FEMA) established the Integrated Public Alert and Warning System (IPAWS) Program Management Office (PMO) in response to the 2006 Public Alert and Warning System Executive Order. IPAWS requires that the United States have "an effective, reliable, integrated, flexible, and comprehensive system to alert and warn the American people."[1] As part of that charge the federal government and wireless carries partnered to send geographically-targeted text-like messages through the Commercial Mobile Alert Service (CMAS) via IPAWS. These CMAS messages compliment the current generation of the nation's Emergency Alert System (EAS).

The purpose of this project is to determine the content and form of *optimized public alert and warning messages* of various lengths for distribution over new and emerging public alert and warning technologies. These technologies include the Commercial Mobile Alerting Service (CMAS) and the Integrate Public Alert and Warning System (IPAWS) – the current generation of the nation's Emergency Alert System (EAS). This report presents the **catalogue/matrix of messages** (before, during, and after events) across hazards and protective actions from a public messaging viewpoint to which the optimized public message lessons we produce could be applied.

Message Matrix Overview

We developed catalogues for: (a) threat/hazard types for which imminent threat public messages could be distributed; (b) public actions that could be part of a public message; and (c) possible sequences for public messages across time (before, during, and after) for each hazard. These catalogues are brought together in the Hazards and Protective Action Sequences Message Matrix presented in this report. **This matrix was developed so we could become familiar with the universe of possible public messages for imminent threat hazards before we began our message testing research.** The matrix may have other uses that are beyond the scope of the project.

Imminent threats/hazards. We catalogued almost five-dozen different hazards for which public message types could be issued. These hazards included natural hazards (both climate-related and geophysical), acts of terrorism, and technological events. Most, but not all, of the hazards in the matrix could pose imminent threats. This catalogue was developed by reviewing and integrating a variety of different hazard inventories. It is presented on the left side of the matrix.

Protective actions for messages by threats/hazards. We developed a catalogue of more than two dozen different actions that people could be asked to take in messages across time (before, during, and after an event). These included primary protective actions (e.g., evacuate, shelter in place, and more) as well as supplemental protective actions (e.g., decontaminate self, rearrange household items) and more. This catalogue was developed by reviewing federal and other emergency response planning and/or public message guidance and, in some cases, with conversations with experts. It is presented on the top of the matrix.

[1] FEMA (2012, June). *History of the Integrated Public Alert and Warning System*. Retrieved from http://www.fema.gov/history-integrated-public-alert-and-warning-system, paragraph 1.

Protective action sequences for messages by threats/hazards. We populated the cells of the matrix with message sequences. These hazard-specific sequences were developed by determining what protective action(s) would be in a first public message, what protective action(s) would be in a second message for the same event and so on. We developed message sequences for each hazard in the matrix. The sequences were developed as follows: (a) reviewing federal and other emergency planning and/or public message guidance; (b) considering the length limits for how much information can be contained in different message types; (c) estimating how much information a person can hear, understand and remember in one message; and (d) taking into account the likely time series character of different public actions over time for each hazard. The sequences we developed ranged from two messages per event up to six. Different event scenarios for the same hazard might produce different message sequences than those contained in the matrix. The message sequences in the matrix represent one possible message sequence per hazard. Footnotes and endnotes to the matrix provide information, where appropriate, for the event-specific scenario we had in mind when message sequences were constructed, refer to the published sources on which we relied, and indicate from whom we sought expert input where it was needed.

How we used the matrix. We used the matrix to provide a clear overview of the population of messages and different message types under investigation, variation in messages over time (before, during, after impact), and message variation in terms of hazard type and protective actions. These factors are relevant for us to consider when making choices about which messages to test and for generalizing future findings across hazards. This matrix may have uses that extend beyond the scope of this project.

Disclaimer. This matrix was developed by reviewing and interpreting federal and other emergency response planning and/or public message guidance and, in some cases, involved conversations with experts. Sources are listed in the associated endnotes. Although many of the source documents were prepared by federal agencies, this catalogue does not constitute formal guidance for response planning and/or public message writing. The views and conclusions contained in this catalogue should not be interpreted as necessarily representing the official policies, either expressed or implied, of the U.S. Department of Homeland Security or START.

Hazards and Protective Actions Sequences Matrix[2]

Hazard Type	Shelter: In place	Shelter: In another place	Evacuate: Leave area	Evacuate: Leave site	Evacuate: Leave building	Evacuate: Vertically	Protect breathing: While sheltering	Protect breathing: While evacuating	Decontaminate: Self	Decontaminate: Objects	Refrain: Do not evacuate	Refrain: Do not return after evacuation	Refrain: Do not pick up kids at school	Refrain: Do not use electrical, telephone, plumbing	Contain: Contaminated clothing	Contain: Other contaminated items	Obtain: Medication or treatment	Avoid: Do not enter area	Avoid: Do not enter site	Avoid: Do not enter building	Avoid: Do not eat or drink	Avoid: Other people or animals	Listen: For more information	Rearrange: Household items	All clear: Resume normal activities	Abandon area: Temporarily	Abandon area: Permanently
Natural																											
Avalanche: Watch/warning[1]	1	-	1	-	-	-	-	-	-	-	-	1	-	-	-	-	-	1	-	-	-	-	1	-	2	-	-
Blizzard[2]	2	-	-	-	-	-	2	-	-	-	2	-	-	2	-	-	-	2	-	-	-	-	1,2	2	3	-	-
Dust storm[3]	1	-	-	-	-	-	1	-	-	-	1	-	-	-	-	-	-	1	-	-	-	-	1	-	2	-	-
Earthquake: As foreshock[4]	1	1	-	-	1	-	-	-	-	-	1	-	-	-	-	-	-	-	-	1	-	-	1	1	2	-	-
Earthquake: Post initiation early warning[5]	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Earthquake: Secondary hazards[3,4]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Flood: Coastal storm surge watch/warning[6]	-	-	3	-	-	3	-	-	-	-	-	3	-	-	-	-	-	3	-	-	-	-	1,2, 3	2	4	-	-
Flood: Flash flood watch/warning[7]	-	-	1	-	-	1	-	-	-	-	-	1	-	-	-	-	-	1	-	-	-	-	1	-	2	-	-
Flood: River flood watch/warning[8]	-	-	2	-	-	2	-	-	-	-	-	2	-	-	-	-	-	2	-	-	-	-	1	1	3	-	-
Fog[9]	1	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	1	-	-	-	-	1	-	2	-	-

[2] The listed protective actions are extensive but not exhaustive. There are other possible protective actions, e.g., "protect yourself from debris" or "protect yourself from inundation."
[3] Sources are listed under specific secondary hazards.
[4] Secondary earthquake hazards may include chemical spills, dam failure, levee failure, etc.

Hazard Type	Shelter: In place	Shelter: In another place	Evacuate: Leave area	Evacuate: Leave site	Evacuate: Leave building	Evacuate: Vertically	Protect breathing: While sheltering	Protect breathing: While evacuating	Decontaminate: Self	Decontaminate: Objects	Refrain: Do not evacuate	Refrain: Do not return after evacuation	Refrain: Do not pick up kids at school	Refrain: Do not use electrical, telephone, plumbing	Contain: Contaminated clothing	Contain: Other contaminated items	Obtain: Medication or treatment	Avoid: Do not enter area	Avoid: Do not enter site	Avoid: Do not enter building	Avoid: Do not eat or drink	Avoid: Other people or animals	Listen: For more information	Rearrange: Household items	All clear: Resume normal activities	Abandon area: Temporarily	Abandon area: Permanently
Hail[10]	1	1	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	1	-	-	-	-	1	-	2	-	-
High wind: Watch/warning[11]	1	1	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	1	1	2	-	-
Hurricane/ tropical cyclone: Watch/warning[12]	4	4	3	-	-	-	-	-	-	-	4	3,4	-	4	-	-	-	3,4	-	-	-	-	1-4	2	5	-	-
Ice[13]	2	-	-	-	-	-	2	-	-	-	2	-	-	2	-	-	-	2	-	-	-	-	1,2	2	3	-	-
Landslide/ground failure: Coastal erosion[14]	-	-	2	-	-	-	-	-	-	-	-	2	-	-	-	-	-	2	-	-	-	-	1,2	-	3	-	-
Landslide/ground failure: Mud/debris flow[15]	-	-	2	-	-	-	-	-	-	-	-	2	-	-	-	-	-	2	-	-	-	-	1,2	-	3	-	-
Landslide/ground failure: Rock fall[16]	-	-	1	-	-	-	-	-	-	-	-	1	-	-	-	-	-	1	-	-	-	-	1	-	2	-	-
Landslide/ground failure: Sink hole[17]	-	-	1	-	-	-	-	-	-	-	-	1	-	-	-	-	-	1	-	-	-	-	1	-	2	-	-
Severe thunderstorm: Watch/warning[18]	2	-	-	-	-	-	-	-	-	-	2	-	-	2	-	-	-	2	-	-	-	-	1,2	2	3	-	-
Temperature: Extreme cold[19]	2	-	-	-	-	-	2	-	-	-	2	-	-	2	-	-	-	2	-	-	-	-	1,2	2	3	-	-
Temperature: Extreme heat[20]	1	1	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	1	-	2	-	-

Hazard Type	Shelter: In place	Shelter: In another place	Evacuate: Leave area	Evacuate: Leave site	Evacuate: Leave building	Evacuate: Vertically	Protect breathing: While sheltering	Protect breathing: While evacuating	Decontaminate: Self	Decontaminate: Objects	Refrain: Do not evacuate	Refrain: Do not return after evacuation	Refrain: Do not pick up kids at school	Refrain: Do not use electrical, telephone, plumbing	Contain: Contaminated clothing	Contain: Other contaminated items	Obtain: Medication or treatment	Avoid: Do not enter area	Avoid: Do not enter site	Avoid: Do not enter building	Avoid: Do not eat or drink	Avoid: Other people or animals	Listen: For more information	Rearrange: Household items	All clear: Resume normal activities	Abandon area: Temporarily	Abandon area: Permanently
Tornado: Watch/warning[21]	1	1	-	-	1	-	-	-	-	-	1	-	-	1	-	-	-	1	-	1	-	-	1	-	2	-	-
Tropical storm: Watch/warning[22]	4	4	3	-	-	-	-	-	-	-	4	3,4	-	4	-	-	-	3,4	-	-	-	-	1-4	2	5	-	-
Tsunami: Far field watch/warning[23]	-	-	2	-	-	3	-	-	-	-	-	2,3	-	-	-	-	-	2,3	-	-	-	-	1,2, 3	-	4	-	-
Tsunami: Intermediate field watch/warning[24]	-	-	1	-	-	1	-	-	-	-	-	1	-	-	-	-	-	1	-	-	-	-	1	-	2	-	-
Tsunami: Near field[25]	-	-	1	-	-	1	-	-	-	-	-	1	-	-	-	-	-	1	-	-	-	-	1	-	2	-	-
Volcanic Eruption[26]	3	-	2,3	-	-	-	3	3	-	-	-	2,3	-	-	-	-	-	2,3	-	-	-	-	1,2, 3	-	-	4	-
Wildfire: Urban wild land interface[27]	4	-	3	-	-	-	4	3	-	-	4	3,4	-	2,3, 4	-	-	-	2,3, 4	-	-	-	-	1,4	2	5	-	-
Wildfire: Wild land[28]	1	-	1	-	-	-	1	1	-	-	1	1	-	-	-	-	-	1	-	-	-	-	1	-	2	-	-
Winter storm: Watch/warning[29]	2	-	-	-	-	-	2	-	-	-	2	-	-	2	-	-	-	2	-	-	-	-	1,2	-	3	-	-
Terrorist																											
Armed assault[30]	1	1	1	1	1	-	-	-	-	-	1	2	-	-	-	-	-	1	1	1	-	-	1	-	3	-	-
Biological attack: Anthrax[31]	-	-	1	1	1	-	-	-	-	-	-	2	-	-	-	-	1	1	1	1	-	-	1	-	3	-	-
Biological attack: Botulism[32]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1	-	1	-	2	-	-

Hazard Type	Shelter: In place	Shelter: In another place	Evacuate: Leave area	Evacuate: Leave site	Evacuate: Leave building	Evacuate: Vertically	Protect breathing: While sheltering	Protect breathing: While evacuating	Decontaminate: Self	Decontaminate: Objects	Refrain: Do not evacuate	Refrain: Do not return after evacuation	Refrain: Do not pick up kids at school	Refrain: Do not use electrical, telephone, plumbing	Contain: Contaminated clothing	Contain: Other contaminated items	Obtain: Medication or treatment	Avoid: Do not enter area	Avoid: Do not enter site	Avoid: Do not enter building	Avoid: Do not eat or drink	Avoid: Other people or animals	Listen: For more information	Rearrange: Household items	All clear: Resume normal activities	Abandon area: Temporarily	Abandon area: Permanently
Biological attack: Plague[33]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	1	1	-	1	1	-	2	-	-
Biological attack: Smallpox[34]	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	1	-	-	-	-	1	1	-	2	-	-
Biological attack: Tularemia[35]	-	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-	1	-	-	-	1	-	1	-	2	-	-
Biological attack: Viral hemorrhagic fevers[36]	1	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	1	1	1	1	-	1	1	-	2	-	-
Chemical attack: General[37]	1	-	1	-	1	1	1	-	2	-	1	-	-	1	-	-	2	1	1	1	1	1	1	1	3	-	
Cyber attack[38]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	2	-	-
Hostage taking/assassination[39]	1	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	-	1	-	1	-	-
Improvised explosive device (IED): Infrastructure[40]	1	-	1	1	1	-	-	-	-	-	-	-	-	-	-	-	-	1	1	1	1	-	1	-	2	-	-
Improvised explosive device (IED): Non-infrastructure[41,5]	1	-	1	1	1	-	-	-	-	-	1	2	-	-	-	-	1	1	1	1	-	-	1	-	3	-	-

[5] E.g., suicide bomb.

Hazard Type	Shelter: In place	Shelter: In another place	Evacuate: Leave area	Evacuate: Leave site	Evacuate: Leave building	Evacuate: Vertically	Protect breathing: While sheltering	Protect breathing: While evacuating	Decontaminate: Self	Decontaminate: Objects	Refrain: Do not evacuate	Refrain: Do not return after evacuation	Refrain: Do not pick up kids at school	Refrain: Do not use electrical, telephone, plumbing	Contain: Contaminated clothing	Contain: Other contaminated items	Obtain: Medication or treatment	Avoid: Do not enter area	Avoid: Do not enter site	Avoid: Do not enter building	Avoid: Do not eat or drink	Avoid: Other people or animals	Listen: For more information	Rearrange: Household items	All clear: Resume normal activities	Abandon area: Temporarily	Abandon area: Permanently
Improvised nuclear device (IND)[42]	1, 2 3, 4	1, 2	3,4, 5	-	-	-	1, 2	3,4, 5	2, 3 4, 5	2,4, 5	1, 2 3, 4	3,4, 5	1, 3 4, 5	1,3 4,5	1, 2 4, 5	2,4, 5	3,4, 5	1,2, 3 4,5	-	-	1	-	1,2, 3 4,5	-	-	6	6
Maritime attack[6]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Radiological dispersion devices[43]	1, 2	-	3	-	-	-	1, 2	3	2, 4	4	-	-	-		2, 4	2,4	3,4	1,2 3,4	-	-	1, 2	-	1,2 3,4	-	5	-	-
Sabotage[7]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Technological																											
Blackout[44]	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	1	-	-	-	-
Explosion: Natural gas pipeline[45]	-	-	1	1	1	-	-	-	-	-	2	-	-	-	-	-	-	2	2	2	-	-	1,2	-	3	-	-
Fire: Building[46]	1	1	-	-	1	-	1	1	-	-	1	2	2	1	-	-	-	2	-	2	-	-	1,2	-	3	-	-
Fire: Industrial plant[47]	1	-	1	1	1	-	1	1	3	3	-	-	-	-	3	3	2,3	2	2	2	-	-	1,2, 3	-	4	-	-

[6] Although a maritime attack can be considered a terrorism hazard, appropriate public protective actions and sequences will depend upon the type of attack (maritime infrastructure, armed assault upon a cruise ship, ship-borne IED, etc.). For public warning purposes, associated protective actions and sequences are accounted for in the appropriate sections of this matrix.

[7] Although sabotage can be considered a terrorism hazard, appropriate protective actions and sequences will depend upon the type of infrastructure or object sabotaged. For public warning purposes, associated protective actions and sequences are accounted for in this matrix under "Technological Hazards."

Hazard Type	Shelter: In place	Shelter: In another place	Evacuate: Leave area	Evacuate: Leave site	Evacuate: Leave building	Evacuate: Vertically	Protect breathing: While sheltering	Protect breathing: While evacuating	Decontaminate: Self	Decontaminate: Objects	Refrain: Do not evacuate	Refrain: Do not return after evacuation	Refrain: Do not pick up kids at school	Refrain: Do not use electrical, telephone, plumbing	Contain: Contaminated clothing	Contain: Other contaminated items	Obtain: Medication or treatment	Avoid: Do not enter area	Avoid: Do not enter site	Avoid: Do not enter building	Avoid: Do not eat or drink	Avoid: Other people or animals	Listen: For more information	Rearrange: Household items	All clear: Resume normal activities	Abandon area: Temporarily	Abandon area: Permanently
Hazardous materials released: Fixed site[48,8]	1	1	1,2	1	1	-	1	1	3	3	2	2	-	-	3	3	2,3	2	2	-	2	-	1,2,3	-	4	-	-
Hazardous materials release: Transportation land[49]	1	1,2	1,2	1	-	-	1	1	3	3	2	2	-	-	3	3	2,3	1,2,3	1,2,3	-	2	-	1,2,3	-	4	-	-
Hazardous materials release: Transportation ocean[50]	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	2	-	1,2	-	3	-	-
Leak: Toxic fumes[51]	1	1,2	1,2	-	1,2	1	1,2	1,2	3	3	2	2	-	-	3	3	3	2	2	2	2	-	1,2,3	-	4	-	-
Nuclear power plant accident[52]	3	-	2,4,5	-	-	-	3	3,4	5	5	2,3,4	3,4	3,4	-	5	-	5	2,3 4	2,3,4,5	-	-	-	1,2,3,4	-	-	6	-
Structural failure: Bridge collapse[53]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	1,2	-	-	2	-
Structural failure: Building collapse[54]	-	-	-	-	1	-	-	1	-	-	-	2	-	-	-	-	-	2	2	2	-	-	1,2	-	-	3	-
Structural failure: Dam failure[55]	-	-	2	-	2	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	1,2	-	-	3	-
Structural failure: Levy failure[56]	-	-	2	-	2	-	-	-	-	-	-	2	-	-	-	-	-	2	-	-	-	-	1,2	-	-	3	-

[8] E.g., oil refinery, chemical plant.

[1] United States Forest Service (USFS) National Avalanche Center. (n.d.). The skills: Learn how to, http://www.fsavalanche.org/Default.aspx?ContentId=17&LinkId=73&ParentLinkId=3

[2] Federal Emergency Management Agency (FEMA). (n.d.). Winter storms & extreme cold, http://www.ready.gov/winter-weather/ See also: http://www.ready.gov/are-you-ready-guide

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[4] Interview with Dennis Mileti, University of Colorado Boulder, personal communication, September 18, 2012.

[5] Interview with Dennis Mileti, University of Colorado Boulder, personal communication, September 18, 2012.

[6] Federal Emergency Management Agency (FEMA). (n.d.). Floods, http://www.ready.gov/floods See also: http://www.ready.gov/are-you-ready-guide

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