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Developing an evaluation tool for disaster risk messages

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Abstract

Purpose – Risk communication is a critical component of individual health decision making and behavior. In disaster situations, it is crucial that risk-related messages are communicated accurately and that they reach and inform target audiences about the steps they can take to protect their health. Despite a global recognition of the importance of risk communication in responding to disasters, there remains a dearth of evidence on how to evaluate the effectiveness of risk communication messages. The purpose of this paper is to develop and assess a pilot tool to evaluate the effectiveness of disaster risk messages.
Design/methodology/approach – A pilot evaluation tool was developed using the existing risk communication literature. An expert assessment of the tool was conducted using an open-ended survey and a focus group discussion with 18 experts at the Public Health Agency of Canada in February 2013.
Findings – The tool measures content, reach, and comprehension of the message. It is intended to be a quick, internal evaluation tool for use during a disaster or emergency. The experts acknowledged the practicality of the tool, while also recognizing evaluation challenges.
Research limitations/implications – This pilot exploratory tool was assessed using a relatively small sample of experts.
Practical implications – This tool offers public health and disaster preparedness practitioners a promising approach for evaluating and improving the communication and management of future public health emergencies.
Originality/value – This is the first practical tool developed to evaluate risk communication messages in disaster situations.

Keywords Disaster preparedness, Risk management, Health communication, Public health practice
Paper type Research paper

Introduction

Having accurate and timely communication from credible organizations is crucial in times of disasters so that the public receives information about the health risks involved and actions they need to take (Bradley *et al.*, 2014; Glik, 2007). Public health agencies serve as authorities during emergencies and are responsible for communicating information to enable and empower communities to protect themselves (Gesser-Edelsburg *et al.*, 2014; Koskan *et al.*, 2012). Risk communication represents this exchange of information about the existence, form, and severity of risks

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(Glik, 2007; Health Canada, 2006; Weinstein, 1999). The term exchange is important as risk communication is an evolving, interactive, two-way process where both the authority on the matter and the public convey important information, opinions, and reactions about the situation (Bennett, 1999; Covello and Sandman, 2001; Frewer, 2004; Lang *et al.*, 2001; Lundgren and McMakin, 2009). The purpose of this dialogue is to help people make the best possible decisions during a disaster situation (Centers for Disease Control and Prevention, 2014; Covello and Allen, 1988; Glik, 2007; Health Canada, 2006; Palenchar and Heath, 2002).

Several factors can impede effective risk communication. Gaps in knowledge about the risks involved can cause uncertainty and lead to feelings of anxiety or fear about an issue (Covello and Sandman, 2001; Lundgren and McMakin, 2009; Palenchar and Heath, 2002). Disagreements among experts and lack of transparency can cause public distrust and loss of agency credibility (Lundgren and McMakin, 2009; Tierney *et al.*, 2001).

Risk communication can be improved by evaluating the messages that are communicated to the different target audiences. A literature review in PubMed and Google Scholar using the keywords "health," "risk," "emergency," "disaster," "communication," "evaluation," and "message" in various combinations revealed that the general evaluation of risk communication, although well described, can sometimes be cumbersome due to time constraints, planning, resources, skills, difficult approval processes, and limited cooperation between organizations (Fischhoff *et al.*, 2011; Lundgren and McMakin, 2009). This literature review also revealed that little progress has been made to evaluate risk communication messages. Federal agencies have developed manuals and frameworks on crisis and emergency risk communication and strategic risk communication, however, these documents do not focus on the evaluation of risk messages (Centers for Disease Control and Prevention, 2014; Health Canada, 2006; Agency for Toxic Substance and Disease Registry, 1997). Weinstein and Sandman (1993) published criteria to assess the risk message effectiveness. Other than these efforts, few studies provide a practical guide to evaluating disaster risk messages. Two decades later, this research complements Weinstein and Sandman's criteria by: first, developing a tool that evaluates the major components of disaster risk messages; and second, assessing the rigor and usefulness of the tool (see the Appendix).

Methods

A pilot evaluation tool was developed for the purposes of examining the effectiveness of disaster risk messages (Bradley *et al.*, 2014; Edwards and Elwyn, 1999; Fischhoff *et al.*, 2011). Effectiveness refers to whether the message had the intended effect of providing information and facilitating informed decision making among its target audiences (Fischhoff *et al.*, 2011).

Glik (2007) stated that three elements would determine whether or not the public would take appropriate steps to protect their health in an emergency: "characteristics of messages, how the warnings are communicated, and how the recipients process the information" (p. 38). Based on this study and a traditional review of the literature, three elements need to be considered in the evaluation of disaster risk messages: message content, message reach, and message comprehension.

Message content refers to how the disaster risk communication messages are constructed, framed, and presented (Palenchar and Heath, 2002). The content needs to clearly and accurately address the source and severity of the potential harm (Centers for Disease Control and Prevention, 2014; Glik, 2007; Lundgren and McMakin, 2009; Mileti and Peek, 2002), and also acknowledge any uncertainties (Agency for Toxic

Substances and Disease Registry, 1997). The message content helps to establish the agency's credibility and transparency (Gesser-Edelsburg *et al.*, 2014; Thomas *et al.*, 2008). Therefore, it needs to address evolving risk perceptions of the target audiences (Covello and Minamyer, 2007; Lundgren and McMakin, 2009). Having a good knowledge of the target audiences will help adjust the message to various numeracy and literacy levels (Covello and Minamyer, 2007; Eysenbach and Kohler, 2002; Lundgren and McMakin, 2009; Reyna *et al.*, 2009). Messages should be tailored to the diverse audiences they are intended to reach, and additional efforts should be made to target at-risk populations (e.g. individuals with disabilities or language barriers; Benavides, 2013; Benavides and Arlikatti, 2010; Centers for Disease Control and Prevention, 2014; Glik, 2007; Lundgren and McMakin, 2009; Meredith *et al.*, 2008; Reynolds, 2007; Sellnow and Vidoloff, 2009; Tierney, 2000). Message content also needs to mobilize the public to seek additional information and/or take action (Centers for Disease Control and Prevention, 2014; Eiser *et al.*, 2012; Glik, 2007; Mileti and Peek, 2002; Weinstein, 1999). While all these elements are necessary in the crafting of risk messages, messages are also expected to evolve as the situation becomes clearer and more information becomes available (Lundgren and McMakin, 2009).

Message reach refers to the target audience's exposure to the message (Centers for Disease Control and Prevention, 2014). Public health organizations can extend message reach by using asynchronous communication channels (e.g. streaming videos, web sites) which people can watch at a convenient location and time as well as synchronous real-time communication channels (e.g. radio announcements, public meetings). Using multiple channels and trusted messengers to communicate the message are key for making the process more transparent and making the information more accessible to a broader audience (Centers for Disease Control and Prevention, 2014; Mileti and Peek, 2002; Stephens *et al.*, 2013). Knowing the audiences' media consumption patterns including social media use is important for effective communication of the disaster risk message (Arlikatti *et al.*, 2014; Rutsaert *et al.*, 2013; Sellnow and Vidoloff, 2009). Sending timely, repeated, and consistent messages across channels, jurisdictions, and organizations has been shown to be more effective than single or inconsistent messages, and can also help extend the message's reach (Gesser-Edelsburg *et al.*, 2014; Glik, 2007; Rowel *et al.*, 2012; Thomas *et al.*, 2008). Finally, reach can be evaluated by assessing the target audiences' awareness of the message which can be obtained through public opinion research.

Public opinion research is a technique used to gather information on public perspectives, through formal quantitative or qualitative methods (Osborne and Rose, 1999; Price, 1992). Considering the interactive and participatory nature of risk communication, actively conducting research to obtain feedback from the public is crucial in the evaluation of disaster risk messages (Kasperson, 1986).

Message comprehension, which is the third key element of risk message evaluation and which can also be assessed using public opinion research, refers to how the content of the messages was interpreted and understood by the target audiences (Gesser-Edelsburg *et al.*, 2014; Lundgren and McMakin, 2009; Weinstein and Sandman, 1993). Sellnow and Vidoloff (2009) and Eiser *et al.* (2012) argue that a risk message may be interpreted differently according to culture, ethnicity, socioeconomic characteristics, personal feelings, preferences, and values, as well as previous experiences of the audience. Past experience with false alarms, for example, which are messages that forecast events which eventually do not occur, may cause "warning fatigue" and reduce the audience's willingness to respond to a risk message (Breznitz, 2013; Mackie, 2013;

Sharma and Patt, 2012). However, false alarms may also make people more vigilant in future warnings if they understand the content of the message and the reason for the warning (Barnes *et al.*, 2007; Janis, 1962). Previous emergency experiences including severity of the impact sustained, past evacuation experience, and past experience with false alarms all have an impact on the audience's interpretation of a risk message and their actual response (Sharma and Patt, 2012). By considering how messages can be interpreted and understood, adjustments can be made to address potential misinformation that could have negative health and safety outcomes (Bradley *et al.*, 2014; Centers for Disease Control and Prevention, 2014; Gesser-Edelsburg *et al.*, 2014; Weinstein and Sandman, 1993).

Environmental scanning of social media such as text messages, Facebook, Twitter, Instagram, Flickr, YouTube, and blogs is another way to evaluate how the audiences are interacting and reacting to an emergency, and how they may be receiving and understanding some of the messages (Tinker and Fouse, 2009; Veil *et al.*, 2011). This evaluation is crucial again to be aware of what is being said and understood on the topic and to modify the risk messages accordingly to address misperceptions, attitudes, and unwarranted panic or denial (Lundgren and McMakin, 2009; Rutsaert *et al.*, 2013).

Ultimately, it is assumed that by gathering information on: how the messages are constructed and presented, how the messages reach the target audiences, and how the messages are understood, it will be possible to accurately assess messages' effectiveness.

Tool development and use

The evaluation tool was created so that content, reach, and comprehension of the messages could be measured through a series of questions. Due to time constraints in a disaster, the tool was developed as a brief checklist that could be completed quickly at least once in the middle of an emergency (i.e. after messages have been delivered for a few days/weeks), and which would provide public health preparedness practitioners information about the success of their messages.

Kelson (1995) suggested that the effectiveness of risk communication can be judged by the outcome criteria perceived and researched by professionals. Lundgren and McMakin (2009) also recommended using four different types of risk communication evaluators. Following their advice, we propose to use the evaluation tool as an internal review of the messages by four evaluators. They would be familiar with the messages but not directly involved in their development, and would also have previous experience conducting evaluations (Lundgren and McMakin, 2009). We propose to invite one communication expert, one subject matter expert (e.g. a program expert in influenza), one external reviewer, and one representative member of the target audience, so that the disadvantages of one can be counterbalanced by the advantages of the other. For example, while the communication staff may have difficulty being objective, using an external reviewer may help increase this credibility and objectivity in the evaluation. We recommend using an in-house subject matter expert rather than upper management, as suggested by Lundgren and McMakin (2009), since this person understands the organization and can also provide feedback pertaining specifically to the content and technical information presented in the messages. Finally, we recommend including a community member to incorporate the perspectives of the target audience in the evaluation (Pratt, 2007).

The four evaluators would be hand selected from a list of potential evaluators by senior management requiring this evaluation. The member of the target audience,

for example, would be chosen from a pool of stakeholder groups, community members, and leaders, who previously participated in the creation and testing of disaster message templates in a pre-crisis phase (Lapka *et al.*, 2008; Lundgren and McMakin, 2009; Pratt, 2007) and who would have volunteered to be called back for future evaluations. Organizational approval to access this pool of representative members would be obtained prior to the emergency.

To conduct the evaluation, the four selected evaluators would receive the pilot evaluation tool along with samples of the risk communication products being distributed (e.g. news releases, fact sheets, tweets), and environmental scanning reports provided by in-house communication staff. These reports would include organizational reports (i.e. how key stakeholders, partners, and other organizations are communicating about the risk), daily media and social media monitoring reports conducted by the organization's communication staff, and public opinion research reports from the past few days and weeks conducted during the crisis, if the budget permits, which gives an indication of how the target audiences are discussing an issue (e.g. measles outbreak), understanding it, and reacting to the call to action present in the message (e.g. in favor, neutral, or opposed to vaccinating their children). The evaluators would receive a brief training on how to use the tool and what to look for in these supplementary materials to conduct the evaluation (Lundgren and McMakin, 2009). They would be instructed to complete the evaluation between 24 and 48 hours. The four evaluators would then meet to compare and discuss their assessments of the messages.

Immediate action would be required if all four evaluators found common problems with content, reach, and/or comprehension. This would require an urgent meeting to be organized with the communication staff to address the issues raised. If two of the four evaluators found one or more of the components to lack effectiveness, the evaluators would discuss and come to a consensus on the weaknesses identified. Following this discussion, the overall results would be presented and discussed with senior management and staff managing the disaster communication response.

Assessment of the evaluation tool

Following the development of the pilot evaluation tool, the tool was presented to a group of disaster experts at the Public Health Agency of Canada for feedback. Data collection was approved by the Director General in the Communications and Public Affairs Branch. This study was deemed exempt from Institutional Review Board review because it did not meet the criteria set forth by the Protection of Human Subject Regulations (45 CFR 46 et. seq.). No identifying information was collected from participants. All agreed to participate in the assessment of the evaluation tool.

In total, 18 experts in communication, policy, and program assessed the evaluation tool in February 2013 during an emergency risk communication workshop offered by the Public Health Agency of Canada. After attending a two-day training on the new government protocols for emergency risk communication, participants examined the tool and provided their input.

Participants were asked to: first, give written feedback on statements and sections of the pilot evaluation tool that appeared unclear or difficult to complete; second, describe how useful this tool would be in assessing the effectiveness of risk communication messages; and finally, suggest potential challenges to using this tool. These three written open-ended questions were followed by a 20-minute focus group discussion about the pilot evaluation tool.

Results

Content

Five items were developed to assess the content of the risk messages. Each item is to be ranked on a three-point scale ranging from a clear "No," "Somewhat," and "Yes." These items examine the information provided and how the content is crafted to be accessible to the target audiences, and address public perception, health literacy and numeracy, and a call to action. Due to the lack of existing tools measuring message content, development of these items was guided by existing literature (Agency for Toxic Substances and Disease Registry, 1997; Benavides, 2013; Benavides and Arlikatti, 2010; Centers for Disease Control and Prevention, 2014; Covello and Minamyer, 2007; Eysenbach and Kohler, 2002; Gesser-Edelsburg *et al.*, 2014; Glik, 2007; Lundgren and McMakin, 2009; Meredith *et al.*, 2008; Mileti and Peek, 2002; Palenchar and Heath, 2002; Reyna *et al.*, 2009; Reynolds, 2007; Sellnow and Vidoloff, 2009; Thomas *et al.*, 2008; Tierney, 2000; Weinstein, 1999). Based on the results of these five items, overall content of the risk messages would be assessed with the following single item to be ranked on a five-point scale from "Very ineffective" to "Very effective": "Based on your evaluations of these statements, to what extent are the disaster risk messages effectively presented?"

Reach

Four items were developed to assess the reach of the disaster risk messages. Similar to the evaluation of content, each item for reach is to be ranked on a three-point scale ranging from a clear "No," "Somewhat," and "Yes." These items focus on message delivery, message consistency across jurisdictions, organizations, and media outlets, as well as public awareness of the messages. These items were created based on the literature (Arlikatti *et al.*, 2014; Centers for Disease Control and Prevention, 2014; Gesser-Edelsburg *et al.*, 2014; Glik, 2007; Mileti and Peek, 2002; Rowel *et al.*, 2012; Rutsaert *et al.*, 2013; Sellnow and Vidoloff, 2009; Stephens *et al.*, 2013; Thomas *et al.*, 2008) and judged by the authors to be the most important theoretically and in practice regarding message reach. These items help ensure that the target audiences are exposed to the messages. Based on the results of these four items, the following single item would examine reach overall, using a five-point scale from "Very ineffective" to "Very effective": "Based on your reflection of these statements, to what extent are the disaster risk messages effectively reaching the target audiences?"

Comprehension

Four items were developed to assess comprehension of the disaster risk messages. Each item for comprehension is to be ranked on a three-point scale ranging from a clear "No," "Somewhat," and "Yes." These items assess the social environment including social media, public opinion research, and information seeking behavior. These items were created based on the existing comprehension literature (Bradley *et al.*, 2014; Centers for Disease Control and Prevention, 2014; Gesser-Edelsburg *et al.*, 2014; Lundgren and McMakin, 2009; Rutsaert *et al.*, 2013; Sellnow and Vidoloff, 2009; Tinker and Fouse, 2009; Veil *et al.*, 2011; Weinstein and Sandman, 1993) and assessed by the authors to be the most important in a conceptual and practical manner to assess whether a disaster message was understood. Based on the assessment of these sub-items, one general item summarizes the evaluation of comprehension. The following item is to be ranked on a five-point scale ranging from "Very ineffective" to "Very effective": "Based on your reflection of these statements, to what extent are the disaster risk messages understood by the target audiences?"

Expert assessment

Most participants appreciated the tool's practicality. One participant said that "it will be useful especially that I'm not aware we have any tool to evaluate on our own." Another participant stated that the tool is useful to "stop and think about what you are doing."

Some important challenges were identified, however, including the difficulty in accessing the information needed in the communication products and reports to accurately answer some of the items. One participant also mentioned the barrier of time needed to complete this evaluation "when there's pressure/tight timeline for deliverables."

Participants discussed how the scales (No, Somewhat, Yes) are useful when conducting the evaluation especially to see the precision of the problems (i.e. where you did well and where you did not). However, participants thought it was unclear which item among the four or five items listed in each section was the most important in the overall evaluation of the effectiveness of content, reach, and comprehension. Finally, some participants considered public opinion research to be near impossible to conduct in-house due to budget and capacity constraints in a disaster situation.

Since this expert assessment, items within the tool remain unweighted, meaning that one item may or may not be more important than another. These items reflect the key considerations for each element (content, reach, and comprehension) and help guide the overall evaluation. However, the participants' feedback was considered in the development of the tool. For example, the nuances that the evaluators may want to highlight can be written as comments at the end of each section.

The participants' input also provided a better understanding of the information needs of the evaluators (Lundgren and McMakin, 2009). All evaluators without exception would need to receive samples of the disaster communication products and the monitoring reports to conduct this internal evaluation. If no public opinion research is conducted inside the agency due to budget and time constraints, external public opinion research reports on the issue should be consulted. Having this information would allow the evaluator to save time and obtain a better picture of the situation and of the effectiveness of the risk messages.

The evaluation tool was also greatly enhanced during the manuscript review process. For example, under content, accessibility of the message for people with disabilities and language barriers was added as an important component of the tool. The final version of the pilot evaluation tool is presented in the Appendix.

Discussion

This short paper described the development and initial assessment of an evaluation tool focusing on content, reach, and comprehension of public health disaster risk messages. Creating this pilot evaluation tool is an important first step in developing a practical instrument for assessing risk communication messages during public health disasters and emergencies. Other than Weinstein and Sandman's (1993) work which mainly focused on risk message comprehension, this is the first tool available for message evaluation during such emergencies.

It is important to reiterate that this evaluation tool can be used at any point in an emergency, but that messages are expected to evolve as information becomes available (Lundgren and McMakin, 2009). The tool can be used again at that time to help evaluate the effectiveness of subsequent risk messages.

This pilot tool can be further developed. First, it can be tested in table top preparedness exercises to obtain feedback from a greater interdisciplinary team of experts. Testing the evaluation tool in these simulations may result in a more practical tool due to the inclusion and involvement of representatives of different target audiences and multiple organizations, such as local authorities, media, partners serving vulnerable populations, etc. (Bergeron and Cooren, 2012; Reyna *et al.*, 2009) as well as stronger community partnerships and coordination in their communication response ensuring consistent messaging across the board (Rowel *et al.*, 2012). The diverse members invited for these pre-crisis simulations could also provide feedback on existing messages and help identify any potential issues with the messages. At the same time, they could practice using the tool with a variety of sample materials and formats, including tweets and information brochures, confirm the tool's practicality to evaluate messages communicated through diverse media and social media channels, and improve the different agencies' evaluations and responses to disaster situations (Friedman *et al.*, 2011; Thomas *et al.*, 2008).

Cognitive interviews, a technique used to assess how target audiences understand, mentally process, and respond to materials, can be used with future evaluators to assess each item of the evaluation tool (Willis, 2005). This approach can help reduce any biases or clarity issues that may be found in the actual evaluation tool (Dickmann *et al.*, 2014).

The pilot evaluation tool has limitations. First, it represents a subjective internal review of the messages. The subjectivity of the evaluation can be addressed by obtaining information on how the messages are interpreted and understood through public opinion research and the social media analysis reports, as well as by using four experts to evaluate the risk messages, including a representative member of the target audience.

Second, the items suggested on the evaluation tool are based on the risk communication literature and existing best practices, but not on existing scales. No similar scales exist to measure the three components of disaster risk communication messages. The reliability and validity of this evaluation tool could not be assessed.

The disaster risk message development described in this study was a top-down approach to creating content for various target audiences since the messages would be created during the crisis by the sources or agencies who have authority and legitimacy on the disaster (Coleman, 1995; Swain, 2007, 2012). Although these messages would be based on messages previously tested with members of the target audiences, they may be modified depending on the disaster. A true two-way participatory process would need to involve representative members of the target audiences as well as relevant stakeholder groups in the creation and testing of these messages in an emergency (Lundgren and McMakin, 2009; Walker *et al.*, 1999). Involving a community member as one of the four evaluators of the messages helps to address this gap, although a more participatory approach to message development should be considered.

Finally, while communication remains critical in disaster situations, it does not mean that a message that is judged to be "effective" leads to the target audience's appropriate disaster response and behavior. Nevertheless, this pilot tool and future developments of the tool have the potential to help public health practitioners and disaster experts to develop and deliver more effective messages to protect the public's health.

References

Agency for Toxic Substances and Disease Registry (1997), "Evaluation primer on health risk communication programs", available at: www.atsdr.cdc.gov/risk/evalprimer/index.html (accessed February 1, 2015).

Arlikatti, S., Taibah, H.A. and Andrew, S.A. (2014), "How do you warn them if they speak only Spanish? Challenges for organizations in communicating risk to Colonias residents in Texas, USA", *Disaster Prevention and Management*, Vol. 23 No. 5, pp. 533-550.

Barnes, L.R., Gruntfest, E.C., Hayden, M.H., Schultz, D.M. and Benight, C. (2007), "False alarms and close calls: a conceptual model of warning accuracy", *Weather and Forecasting*, Vol. 22 No. 5, pp. 1140-1147.

Benavides, A.D. (2013), "Four major disaster occurrences and the Spanish language media: a lack of risk communication", *Disaster Prevention and Management*, Vol. 22 No. 1, pp. 29-37.

Benavides, A.D. and Arlikatti, S. (2010), "The role of the Spanish-language media in disaster warning dissemination: an examination of the emergency alert system", *Journal of Spanish Language Media*, Vol. 3, pp. 41-58, available at: http://spanishmedia.mcom.ttu.edu/pdf/Vol.3.pdf#page=43

Bennett, P. (1999), "Understanding responses to risk: some basic findings", in Bennett, P., Coles, D. and McDonald, A. (Eds), *Risk Communication and Public Health*, Oxford University Press, Oxford, pp. 3-19.

Bergeron, C.D. and Cooren, F. (2012), "The collective framing of crisis management: a ventriloqual analysis of emergency operations centers", *Journal of Contingencies and Crisis Management*, Vol. 20 No. 3, pp. 120-137.

Bradley, D.T., McFarland, M. and Clarke, M. (2014), "The effectiveness of disaster risk communication: a systematic review of intervention studies", *PLOS Currents Disasters*, Vol. 6, available at: http://currents.plos.org/disasters/article/the-effectiveness-of-disaster-risk-communication-a-systematic-review-of-intervention-studies/; /www-ncbi-nlm-nih-gov.pallas2.tcl.sc.edu/pmc/articles/PMC4172473/ (accessed November 7, 2014).

Breznitz, S. (2013), *Cry Wolf: The Psychology of False Alarms*, Psychology Press, Hillsdale, NJ.

Centers for Disease Control and Prevention (2014), "Crisis and emergency risk communication: 2014 edition", available at: http://emergency.cdc.gov/cerc/resources/pdf/cerc_2014edition.pdf (accessed February 1, 2015).

Coleman, C. (1995), "Science, technology and risk coverage of a community conflict", *Media, Culture and Society*, Vol. 17 No. 1, pp. 65-79.

Covello, V.T. and Allen, F.H. (1988), *Seven Cardinal Rules of Risk Communication*, US Environmental Protection Agency, Washington, DC.

Covello, V.T. and Minamyer, S. (2007), "Guide to message mapping", in Covello, V.T., Minamyer, S. and Clayton, K. (Eds), *Effective Risk and Crisis Communication During Water Security Emergencies*, US Environmental Protection Agency, Cincinnati, OH, pp. 11-21.

Covello, V.T. and Sandman, P.M. (2001), "Risk communication: evolution and revolution", in Wolbarst, A. (Ed.), *Solutions to an Environment in Peril*, John Hopkins University Press, Baltimore, MD, pp. 164-178.

Dickmann, P., Biedenkopf, N., Keeping, S., Eickmann, M. and Becker, S. (2014), "Risk communication and crisis communication in infectious disease outbreaks in Germany: what is being done, and what needs to be done", *Disaster Medicine and Public Health Preparedness*, Vol. 8 No. 3, pp. 206-211.

Edwards, A. and Elwyn, G. (1999), "How should effectiveness of risk communication to aid patients' decisions be judged? A review of the literature", *Medical Decision Making*, Vol. 19 No. 4, pp. 428-434.

Eiser, R.J., Bostrom, A., Burton, I., Johnston, D.M., McClure, J., Paton, D., van der Pligt, J. and White, M.P. (2012), "Risk interpretation and action: a conceptual framework for responses to natural hazards", *International Journal of Disaster Risk Reduction*, Vol. 1, October, pp. 5-16.

Eysenbach, G. and Kohler, C. (2002), "How do consumers search for and appraise health information on the world wide web? Qualitative study using focus groups, usability tests, and in-depth interviews", *BMJ*, Vol. 324 No. 7337, pp. 573-577.

Fischhoff, B., Brewer, N.T. and Downs, J.S. (2011), "Communicating risks and benefits: an evidence-based user's guide. Food and Drug Administration", available at: www.fda.gov/downloads/AboutFDA/ReportsManualsForms/Reports/UCM268069.pdf (accessed July 11, 2014).

Frewer, L. (2004), "The public and effective risk communication", *Toxicology Letters*, Vol. 149 No. 1, pp. 391-397.

Friedman, D.B., Rose, I.D. and Koskan, A. (2011), "Pilot assessment of an experiential disaster communication curriculum", *Disaster Prevention and Management*, Vol. 20 No. 3, pp. 238-250.

Gesser-Edelsburg, A., Mordini, E., James, J.J., Greco, D. and Green, M.S. (2014), "Risk communication recommendations and implementation during emerging infectious diseases: a case study of the 2009 H1N1 influenza pandemic", *Disaster Medicine and Public Health Preparedness*, Vol. 8 No. 2, pp. 158-169.

Glik, D.C. (2007), "Risk communication for public health emergencies", *Annual Review of Public Health*, Vol. 28, April, pp. 33-54.

Health Canada (2006), "Strategic risk communications framework for Health Canada and the Public Health Agency of Canada", available at: www.hc-sc.gc.ca/ahc-asc/alt_formats/pacrb-dgapcr/pdf/pubs/ris/ris-comm-eng.pdf (accessed July 11, 2014).

Janis, I.E. (1962), "Psychological effects of warnings", in Baker, G.W. and Chapman, D.W. (Eds), *Man and Society in Disaster*, Basic Books, New York, NY, pp. 56-92.

Kasperson, R.E. (1986), "Six propositions on public participation and their relevance for risk communication", *Risk Analysis*, Vol. 6 No. 3, pp. 275-281.

Kelson, M. (1995), *Consumer Involvement Initiatives in Clinical Audit and Outcomes – A Review of Developments and Issues in Identification of Good Practice*, Department of Health Clinical Outcomes Group, London.

Koskan, A., Foster, C., Karlis, J., Rose, I. and Tanner, A. (2012), "Characteristics and influence of H1N1 communication on college students", *Disaster Prevention and Management*, Vol. 21 No. 4, pp. 418-432.

Lang, S., Fewtrell, L. and Bartram, J. (2001), "Water quality: guidelines, standards and health", available at: www.who.int/water_sanitation_health/dwq/iwachap14.pdf (accessed February 1, 2015).

Lapka, C., Jupka, K., Wray, R.J. and Jacobsen, H. (2008), "Applying cognitive response testing in message development and pre-testing", *Health Education Research*, Vol. 23 No. 3, pp. 467-476.

Lundgren, R.E. and McMakin, A.H. (2009), *Risk Communication: A Handbook for Communicating Environmental, Safety, and Health Risks*, 4th ed., John Wiley & Sons Inc., Hoboken, NJ.

Mackie, B. (2013), "Warning fatigue – myth or misunderstanding: insights from the Australian bushfires", *Canadian Risk & Hazards Network*, Vol. 5 No. 1, pp. 51-55.

Meredith, L.S., Shugarman, L.R., Chandra, A., Taylor, S.L., Stern, S.A., Beckjord, E.B., Parker, A.M. and Tanielian, T. (2008), "Analysis of risk communication strategies and approaches with at-risk populations to enhance emergency preparedness, response, and recovery: final report", available at: http://aspe.hhs.gov/daltcp/reports/2008/ emergfr.htm (accessed February 1, 2015).

Mileti, D. and Peek, L. (2002), "Understanding individual and social characteristics in the promotion of household disaster preparedness", in Deitz, T. and Stern, P. (Eds), *New Tools For Environmental Protection: Education, Information And Voluntary Measures*, National Academy Press, Washington, DC, pp. 125-139.

Osborne, T. and Rose, N. (1999), "Do the social sciences create phenomena: the case of public opinion research", *British Journal of Sociology*, Vol. 50 No. 3, pp. 367-396.

Palenchar, M.J. and Heath, R.L. (2002), "Another part of the risk communication model: analysis of communication processes and message content", *Journal of Public Relations Research*, Vol. 14 No. 2, pp. 127-158.

Pratt, C.B. (2007), "Crafting campaign themes (and slogans) for preventing overweight and obesity", *Public Relations Quarterly*, Vol. 52 No. 2, pp. 2-8.

Price, V. (1992), *Communication Concepts: Public Opinion*, Sage Publications, Newbury Park, CA.

Reyna, V.F., Nelson, W.L., Han, P.K. and Dieckmann, N.F. (2009), "How numeracy influences risk comprehension and medical decision making", *Psychological Bulletin*, Vol. 135 No. 6, pp. 943-973.

Reynolds, B. (2007), *Crisis and Emergency Risk Communication: Pandemic Influenza*, Centers for Disease Control and Prevention, Atlanta, GA.

Rowel, R., Sheikhattari, P., Barber, T.M. and Evans-Holland, M. (2012), "Introduction of a guide to enhance risk communication among low-income and minority populations a grassroots community engagement approach", *Health Promotion Practice*, Vol. 13 No. 1, pp. 124-132.

Rutsaert, P., Regan, Á., Pieniak, Z., McConnon, Á., Moss, A., Wall, P. and Verbeke, W. (2013), "The use of social media in food risk and benefit communication", *Trends in Food Science & Technology*, Vol. 30 No. 1, pp. 84-91.

Sellnow, T. and Vidoloff, K. (2009), "Getting crisis communication right", *Food Technology*, Vol. 63 No. 9, pp. 40-45.

Sharma, U. and Patt, A. (2012), "Disaster warning response: the effects of different types of personal experience", *Natural Hazards*, Vol. 60 No. 2, pp. 409-423.

Stephens, K.K., Barrett, A.K. and Mahometa, M.J. (2013), "Organizational communication in emergencies: using multiple channels and sources to combat noise and capture attention", *Human Communication Research*, Vol. 39 No. 2, pp. 230-251.

Swain, K.A. (2007), "Sourcing patterns in news coverage of the anthrax attacks", *International Journal of Mass Emergencies and Disasters*, Vol. 25 No. 1, pp. 57-96.

Swain, K.A. (2012), "Explanation of risk and uncertainty in news coverage of an anthrax attack", *Journal of Risk Analysis and Crisis Response*, Vol. 2 No. 2, pp. 81-95.

Thomas, C.W., Vanderford, M.L. and Quinn, S.C. (2008), "Evaluating emergency risk communications: a dialogue with the experts", *Health Promotion Practice*, Vol. 9 No. S4, pp. 5S-12S.

Tierney, K.J. (2000), *Implementing a Seismic Computerized Alert System (SCAN) for Southern California: Lessons and Guidance from the Literature on Warning Response and Warning Systems*, University of Delaware Disaster Research Center, Newark, DE.

Tierney, K.J., Lindell, M.K. and Perry, R.W. (2001), *Facing the Unexpected: Disaster Preparedness and Response in the United States*, Joseph Henry Press, Washington, DC.

Tinker, T. and Fouse, D. (2009), "Expert round table on social media and risk communication during times of crisis: strategic challenges and opportunities", available at: www.boozallen.com/media/file/Risk_Communications_Times_of_Crises.pdf (accessed February 1, 2015).

Veil, S.R., Buehner, T. and Palenchar, M.J. (2011), "A work-in-process literature review: incorporating social media in risk and crisis communication", *Journal of Contingencies and Crisis Management*, Vol. 19 No. 2, pp. 110-122.

Walker, G., Simmons, P., Irwin, A. and Wynne, B. (1999), "Risk communication, public participation and the Seveso II directive", *Journal of Hazardous Materials*, Vol. 65 Nos 1-2, pp. 179-190.

Weinstein, N.D. (1999), "What does it mean to understand a risk? Evaluating risk comprehension", *Journal of the National Cancer Institute Monographs*, No. 25, pp. 15-20.

Weinstein, N.D. and Sandman, P.M. (1993), "Some criteria for evaluating risk messages", *Risk Analysis*, Vol. 13 No. 1, pp. 103-114.

Willis, G.B. (2005), *Cognitive Interviewing: A Tool for Improving Questionnaire Design*, Sage Publications, Thousand Oaks, CA.

Further reading

European Centre for Disease Prevention and Control (2013), "A literature review on effective risk communication for the prevention and control of communicable diseases in Europe: insights into health communication", available at: www.ecdc.europa.eu/en/publications/Publications/risk-communication-literary-review-jan-2013.pdf (accessed February 1, 2015).

Appendix. Pilot evaluation tool to assess the effectiveness of disaster risk messages

Thinking about message content, reach, and comprehension, rate each sub-statement using a 3-point scale ("No", "Somewhat", "Yes"). Consider these sub-statements in your overall effectiveness evaluation, ranging from 1-"Very ineffective" to 5-"Very effective".

1. CONTENT*: Consider the content of our disaster risk messages and whether these statements were addressed.

- Messages clearly state what is known and unknown and explain why information may be unavailable. ☐ No ☐ Somewhat ☐ Yes
- Messages address public perception of the issue. ☐ No ☐ Somewhat ☐ Yes
- Messages are sensitive to low literacy and numeracy levels. ☐ No ☐ Somewhat ☐ Yes
- Messages are crafted to meet the needs of our target audiences (e.g., living with disabilities; language barriers). ☐ No ☐ Somewhat ☐ Yes
- Messages encourage our target audiences to take action in response to the emergency. ☐ No ☐ Somewhat ☐ Yes

Based on your evaluations of these statements, to what extent are our disaster risk messages effectively presented?

☐ 1-Very ineffective
☐ 2-Somewhat ineffective
☐ 3-Neither effective nor ineffective
☐ 4-Somewhat effective
☐ 5-Very effective

Comments:
_____
_____
_____
_____

*Note: Messages may change as the situation progresses and more information becomes available.

2. REACH: Consider the reach of our disaster risk messages and whether these statements are addressed:

- The media used for message delivery (e.g. TV, print, web, radio, Twitter) are consistent with target audiences' common consumption patterns. ☐ No ☐ Somewhat ☐ Yes
- Risk messages are consistent across jurisdictions and organizations. ☐ No ☐ Somewhat ☐ Yes
- Risk messages are consistent across media outlets. ☐ No ☐ Somewhat ☐ Yes
- Public opinion research reveals public awareness of our messages. ☐ No ☐ Somewhat ☐ Yes

Based on your reflection of these statements, to what extent are our disaster risk messages effectively reaching our target audiences?

☐ 1-Ineffective
☐ 2-Somewhat ineffective
☐ 3-Neither effective nor ineffective
☐ 4-Somewhat effective
☐ 5-Effective

Comments:
_____
_____
_____
_____

3. COMPREHENSION: Consider the comprehension of our disaster risk messages and whether these statements are addressed:

- Social media analysis illustrates that how the issue is being discussed by our target audiences is consistent with our risk messages. ☐ No ☐ Somewhat ☐ Yes
- Primary and/or secondary public opinion research indicate clear perceptions and understanding from our target audiences. ☐ No ☐ Somewhat ☐ Yes
- Emergency public opinion research suggests that our target audiences find our risk messages clear and easy to understand. ☐ No ☐ Somewhat ☐ Yes
- There are increasing trends in information seeking behavior from our target audiences (e.g. a surge in public inquiries, web searches). ☐ No ☐ Somewhat ☐ Yes

Based on your reflection of these statements, to what extent are our disaster risk messages understood by our target audiences?

☐ 1-Ineffective
☐ 2-Somewhat ineffective
☐ 3-Neither effective nor ineffective
☐ 4-Somewhat effective
☐ 5-Effective

Comments:
_____
_____
_____
_____

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