



HHS Public Access

Author manuscript

Biosecur Bioterror. Author manuscript; available in PMC 2015 October 10.

Published in final edited form as:

Biosecur Bioterror. 2012 June ; 10(2): 188–202. doi:10.1089/bsp.2011.0100.

Predicting Response to Reassurances and Uncertainties in Bioterrorism Communications for Urban Populations in New York and California

Elaine Vaughan, PhD [Research Professor],

Department of Psychology and Social Behavior, University of California, Irvine

Tim L. Tinker, DrPH [Program Lead],

Risk and Crisis Communication Capability, Booz Allen Hamilton, Inc., Rockville, Maryland

Benedict I. Truman, MD [Associate Director for Science],

National Center for HIV/AIDS, Viral Hepatitis, STD, and TB Prevention

Paul Edelson, MD [Medical Officer], and

Division of Global Migration and Quarantine; both at the Centers for Disease Control and Prevention, Atlanta, Georgia

Stephen S. Morse, PhD [Professor of Clinical Epidemiology]

Mailman School of Public Health, Columbia University, New York, NY, and Visiting Professor, School of Veterinary Medicine, University of California, Davis

Abstract

Recent national plans for recovery from bioterrorism acts perpetrated in densely populated urban areas acknowledge the formidable technical and social challenges of consequence management. Effective risk and crisis communication is one priority to strengthen the U.S.'s response and resilience. However, several notable risk events since September 11, 2001, have revealed vulnerabilities in risk/crisis communication strategies and infrastructure of agencies responsible for protecting civilian populations. During recovery from a significant biocontamination event, 2 goals are essential: (1) effective communication of changing risk circumstances and uncertainties related to cleanup, restoration, and reoccupancy; and (2) adequate responsiveness to emerging information needs and priorities of diverse populations in high-threat, vulnerable locations. This telephone survey study explored predictors of public reactions to uncertainty communications and reassurances from leaders related to the remediation stage of an urban-based bioterrorism incident. African American and Hispanic adults ($N = 320$) were randomly sampled from 2 ethnically and socioeconomically diverse geographic areas in New York and California assessed as high threat, high vulnerability for terrorism and other public health emergencies. Results suggest that considerable heterogeneity exists in risk perspectives and information needs *within* certain sociodemographic groups; that success of risk/crisis communication during recovery is likely to be uneven; that common assumptions about public responsiveness to particular risk communications need further consideration; and that communication effectiveness depends partly on preexisting

Address correspondence to: Elaine Vaughan, PhD, University of California, Psychology & Social Behavior, 3340 SE2 Building, School of Social Ecology, Irvine, CA 92697, evaughan@uci.edu.

values and risk perceptions and prior trust in leaders. Needed improvements in communication strategies are possible with recognition of where individuals start as a reference point for reasoning about risk information, and comprehension of how this influences subsequent interpretation of agencies' actions and communications.

Recent assessments of the bioterrorism threat anticipate that a significant incident could occur in the near future.¹⁻³ Since 2001, considerable resources have been devoted to improving preparedness, response, rapid recovery, and resilience with the goal of minimizing the societal impact and damage should a biological attack occur.^{2,4,5} Effective risk and crisis communication during an incident is a core component of strategic planning and is a priority to strengthen the U.S.'s capacity to mitigate consequences.⁶⁻⁹ Yet, since September 11, 2001, several extreme risk events in the U.S. and in other countries have demonstrated an urgent need to update and improve the risk/crisis communication infrastructure and strategies of government agencies and organizations responsible for the safety and security of civilian populations.⁹⁻¹² Terrorist attacks on the London, Mumbai, and Madrid public transportation systems; Hurricane Katrina; the December 2008 multisite terrorist attacks on "soft targets" in Mumbai, India, over a 60-hour period; the anthrax attacks of 2001; and the H1N1 influenza pandemic of 2009-10 all revealed weaknesses in crisis, risk, and public health communication planning and operations.

Despite some notable successes, gaps between communication needs of affected populations and actual practice included: less than optimal, timely adaptation to unforeseen circumstances;^{9,11-15} difficulties in interagency response coordination and cooperation;^{9,12-16} inadequate or delayed acknowledgment and correction of errors that had appeared in previous public communications about the event;^{13,17-20} inadequate uncertainty communication;^{11,13,16,18} limitations in predicting, assessing, and responding to changing or ongoing critical information needs of affected populations;^{11-13,18,19,21} and less than desired effectiveness in risk/crisis communications for certain socially vulnerable and ethnically diverse groups.^{11,17,21-24} Some gaps were historic and reflected longstanding deficiencies, such as limited communications about risk uncertainties and significant social disparities in the success of risk management strategies, with less desirable outcomes for those most vulnerable to adverse consequences of a public health emergency.^{11,25-28} Other risk/crisis communication missteps resulted from the changing characteristics of modern risks and limited intelligence about planned attacks, leading to uncertainty about the scope and methods of future extreme risk incidents.^{2,4,6,10,13,15,19,29}

Despite significant recent improvements in strategic communication approaches,^{2,18,30} ongoing critical vulnerabilities in ways of thinking about and preparing for risk/ crisis communication call for increased responsiveness to changing risk scenarios, evolving communication goals, and growing scientific evidence about the dynamics of public risk perceptions and behaviors during unfolding extreme risk occurrences.³¹ Even more critical is communication preparedness for extreme acts like biological terrorism or other weapons of mass destruction (WMD) attacks that can display high levels of uncertainty as events progress, demand ongoing timely reevaluation of response effectiveness, present a good likelihood of unexpected developments, and reflect an ongoing potential for catastrophic

outcomes.^{7,9,10,32} The resilience of communities and governments regarding bioterrorism acts requires the ability to adapt to and recover from adverse consequences within a reasonable timeframe. Communication is viewed as a crucial element of resilience because it can have a major influence on the timeliness of the public's adoption of protective actions, readiness of leaders and government agencies to act decisively, adequacy of agencies' preevent preparedness, selection of appropriate risk reduction strategies by leaders, and the willingness of affected populations to accept official declarations about the safety of environments as a result of decontamination and risk reduction efforts.^{6,15,22} "Resilience thinking" regarding terrorism or other extreme risk events³³⁻³⁵ emphasizes adapting in real time to ongoing or unexpected adverse events and having effective plans for maintaining public involvement in risk management as an incident evolves.^{6,18,36,37}

Containment of social, psychological, physical, public health, and economic damage from significant acts of bioterrorism will depend in part on full engagement of large numbers of socially, economically, and culturally diverse populations who reside or work in geographic locations most likely to be targeted for particularly surprising and sizable terrorist acts.³⁸⁻⁴⁰ Some frameworks frequently used to plan for risk/crisis communication, such as the 2002 Crisis and Emergency Risk Communication (CERC) guidelines developed by the Centers for Disease Control and Prevention (CDC),⁴¹ have made valuable contributions to preparedness and communication strategies. However, despite updates, these remain limited in fully incorporating into strategic planning the implications of dynamic and uncertain aspects of a developing event that affects diverse populations.^{10,26} Paradigms that frame risk/ crisis communication as a dynamic process affected by multiple interacting factors (eg, "systems thinking") may help identify additional priorities for risk/crisis communication planning and practice.

An especially useful but underused framework that predicts important demands of dynamic bioterrorism or other extreme public health emergencies is the notion of "situation awareness." Endsley⁴² described high situation awareness as having 3 components: correct perceptions of critical information cues in the environment, comprehension of this information's meaning, and anticipation of future situation dynamics and events. The term "situation awareness" has been used to describe a decision maker's state of knowledge, but it also can refer to Endsley's model,⁴² which depicts the factors that can interrupt, limit, or maximize situation awareness, given a decision-making scenario where relevant information is frequently changing, timeliness of actions or decisions is a major factor, and multiple sources provide feedback to risk managers about the current state of the environment (partly influenced by decision makers' previous actions).^{42,43}

This model emphasizes the temporal dynamics of an evolving event and highlights the importance of ongoing comprehension of what information is essential for decision making and actions and the timely integration of information about the effectiveness or ineffectiveness of previous or ongoing responses of decision makers. It represents the internal model of decision makers regarding the state of the environment or a dynamic event.⁴² Others recently have noted the model's relevance to decision problems, policy-making, and diagnosis of critical vulnerabilities in preparedness systems related to dynamic extreme or potentially catastrophic risk events.^{44,45} The situation awareness concept, as

applied to risk/crisis communication during an unfolding bioterrorism incident, suggests the types of messages that might be needed from risk communicators and leaders as events evolve and consequences of previous mitigation decisions and actions are realized. Optimal situation awareness aids in the identification and assessment of critical aspects of communication preparedness, including strengths and vulnerabilities of current popular approaches.

Gaps in Planning for Bioterrorism Risk Communication

Communicating Uncertainty During an Event

The situation awareness model does not require leaders and risk communicators to know everything during an ongoing event; rather, it emphasizes perception, comprehension, and prediction of *crucial* information and identification of what is missing or uncertain relative to what is needed to make effective decisions and achieve stated or implicit goals.^{42,46} During a significant act of bioterrorism, some information released to the public will subsequently be altered, and this can increase public perceptions of communication uncertainty and inconsistency.^{6,9} The updated CERC framework^{22,46} and other recent models⁴⁷ acknowledge the importance of addressing changing circumstances and uncertainty during an extreme risk event. However, characterizations of specific types of uncertainties and explanations for how these factors affect subsequent communication effectiveness and the public's response as an event progresses have not been sufficiently explored, particularly in certain socioeconomic, cultural, and ethnic populations. Certain types of uncertainties are particularly threatening to public trust and the successful implementation of risk reduction plans.^{7,17,22,30,48-50} Failure to effectively communicate these uncertainties represents vulnerability in the preparedness and response system and can threaten the resilience of affected communities.⁵¹ From a situation awareness perspective, timely management and communication of uncertainty are essential. Although reducing uncertainty may not be possible, evidence suggests that some of its negative effects can be minimized with appropriate communication approaches.^{47,52}

Adequate Responsiveness

Principles of situation awareness suggest that assessment and comprehension of persistent, emerging, or unexpected social disparities in communication effectiveness are key ongoing tasks as a crisis progresses.^{28,53} Significant acts of terrorism are most likely to occur in densely populated urban areas reflecting a range of cultural histories and backgrounds, ethnicities, primary languages, religions, access to resources, living situations, and socioeconomic circumstances.^{39,40} Each subpopulation brings different levels of trust, risk perceptions, reasoning strategies, and values to a terrorism incident or crisis situation.^{51,53,54} Differences along these dimensions have important implications for dynamic risk communication because they may influence the ongoing interpretation or reinterpretation of crucial information during an evolving emergency, shape information needs, and affect response to recommended or mandatory self-protective guidance and the timeliness of personal actions.^{28,50,55,56} Vulnerability and potential for loss during acts of WMD terrorism or other extreme incidents may be elevated as an event progresses if risk communications do not resonate or are incompatible with expectations, life circumstances,

personal/community resources, values, information needs, and personal evaluation of risk circumstances.^{18,20,21,27,28} According to recent risk analyses,⁵¹ extreme events present an unequal potential for loss, not only because of preexisting vulnerabilities in terms of social, resource, and environmental factors,^{27,28,30,40} but also because of differences in trust and the potential influence of distrust of government or leaders.^{21,28,51,55,56} Although current models acknowledge and provide some guidance for communicating across diverse populations,^{26,28,57} persistent and recent social disparities in the effectiveness of strategic communications during a crisis or emergency, as illustrated during Hurricane Katrina or the 2009-10 H1N1 pandemic, suggest the need for greater understanding of why sociocultural diversity is related to and affects the effectiveness of communication.

Consequence Management Phase

Until recently, significant resources and plans for strategic risk/crisis communication often concentrated on initial response or maintenance stages of a terrorist attack and placed less emphasis on the formidable communication needs and challenges likely to emerge during consequence management.^{7,50} As a bioterrorism event progresses, leaders and government agencies can expect numerous scientific uncertainties, technical challenges for decontamination, possible disagreements among scientific experts, persistent doubts about safety among the public, and intense scrutiny of decisions about “how clean is clean enough” during decontamination and clearance of environments.^{7,50,58,59} Furthermore, uncertainty and the public’s communication needs will be affected by whether dispersed biological agents have been weaponized, altered in other ways, or delivered through unexpected or novel means.^{7,58,59} These circumstances predict inevitable communication errors and missteps when the demand for timely information is intense and preliminary assessments of the situation are communicated by necessity.^{7,50,59} A resilient and effective risk communication strategy and infrastructure would successfully adapt to anticipated and unexpected events and to the critical evolving information needs of all affected populations during recovery and remediation stages of a biocontamination event.

This Study

This survey and interview study of bioterrorism risk perceptions and communications addressed 3 gaps in the current scientific literature and in practice regarding crisis and uncertainty communication. The research explored possible public responses to a set of messages and concepts that would need to be conveyed to diverse at-risk urban populations during an uncertain and changing episode of biological terrorism that had contaminated public spaces. We hypothesized that reported reactions to official communications about consequence management would be related to certain preexisting cognitive, cultural, and other psychosocial characteristics of individuals that have been strongly associated in previous research with risk perceptions and response to crisis communications.^{31,60-63} We expected that these factors would account for more of the variability in reactions to communications than individuals’ sociodemographic profile, and the study distinguished between sociodemographic variables and factors that describe the psychosocial context of risk decision making. A growing body of evidence about social variability in the success of communication efforts and risk decisions of the public suggests that sociodemographic

characteristics may be proxies for underlying psychosocial, experiential, and cultural processes that comprise a person's perspectives on and reasoning about risk and uncertainty.^{11,17,22,63} By focusing only on sociodemographic features to profile or segment populations, studies may not adequately inform policies about reasons for variability in information needs or how to correct the differential impact of certain crisis and risk communication strategies across diverse ethnic and socioeconomic populations.

This study examined risk perceptions and beliefs about biological terrorism among residents in 2 ethnically and culturally diverse geographic areas that had been assessed as high threat, high vulnerability for potential acts of terrorism or extreme risk events: New York City (mainly King's County, Brooklyn) and Santa Ana (in Orange County), California. The research used a situation awareness paradigm to identify critical risk messages during the consequence management phase and assessed participants' reactions to and interpretation of reassurances and messages that conveyed uncertainties in recovery activities. The communications presented during the study had been issued by government officials during a previous episode of biological terrorism or another public health emergency in the U.S. Although the data were collected several years ago, the questions and variable relationships examined by this research are relevant to existing and continuing gaps in the scientific literature, practice, and preparedness regarding bioterrorism risk management in diverse urban populations. In addition, the distributions of participants on several of the measured psychosocial variables were consistent with findings from recent studies of the risk perspectives and responses of diverse urban populations.^{17,20,21,54} Finally, the gaps in risk/crisis communication effectiveness that were explored in this study were once again evident during more recent significant public health incidents, including the 2009-10 H1N1 influenza pandemic and Hurricane Katrina.^{18,20-24} Thus, the study's emphasis remains relevant to current efforts to improve and update crisis communication preparedness for and response to bioterrorism threats in complex urban areas and provides new data on these topics.

Methods

Widmeyer Communications conducted the survey in October 2004 for collaborators at the University of California, Columbia University's Mailman School of Public Health, and the CDC. Researchers selected 2 urban locations previously identified as high-threat, high-density areas and that also were assessed as high priority in regard to social vulnerability (ie, loss potential) to natural or human-caused hazardous events, including acts of terrorism.^{64,65} New York City and Santa Ana were selected as target sampling areas. Telephone area codes and exchanges in a specific geographic area were identified, and a simple random sampling scheme that followed a random digit dialing procedure was used to construct a sample of 170 African Americans who resided in New York City and a sample of 150 Hispanics/Latinos from Orange County, California (primarily from the city of Santa Ana, where 80% of residents are of Hispanic/Latino background^{66,67}). An initial open-ended screening question asked potential participants what group best represented their race or ethnicity, and the response to this question determined whether the interviewer proceeded after receiving the respondent's verbal consent. Each interview lasted approximately 22 minutes. The

Institutional Review Boards at the University of California, Irvine, and Columbia University approved the study.

Survey Instrument and Constructed Measures

The survey and interview questionnaire included subscales and measures totaling 79 items that focused on bioterrorism risk perceptions, trust in government to respond effectively and fairly to terrorism events, beliefs and reasoning strategies regarding bioterrorism and other public health threats, and responses to uncertainties and reassurances in official bioterrorism communications. The quantitative instrument was informed by previous scientific studies and results from focus groups that Widmeyer Communications conducted during May 2004 with African American and Hispanic residents of Philadelphia on the topics of bioterrorism risks, trust, and public health emergency preparedness. Before presenting risk perception items and the primary scales in the survey instrument, the interviewer defined “bioterrorism” as the deliberate use of biological agents such as anthrax, smallpox, or other germs and viruses to harm civilians or communities. Following the interview, several items elicited sociodemographic information (Table 1).

Participants were presented with a list of public health threats and asked how concerned they were about each. Responses were recorded on a quantitative scale, ranging from “not at all concerned” to “extremely concerned.” Public health threats included bioterrorism, chemical terrorism, radiological terrorism, natural disasters, outbreaks of infectious diseases such as West Nile virus or SARS, contamination of the water supply, and release of anything toxic that would harm air quality. Three additional quantitative items assessed general perceptions of the personal threat from terrorism, and responses were averaged to produce an index. Higher numbers represented greater perceptions of personal risk. The scale demonstrated acceptable internal consistency or reliability for the African American sample (Cronbach’s alpha = .724) and the Hispanic/Latino sample (Cronbach’s alpha = .756).

Two items measured the perceived fairness of government officials when managing a bioterrorism incident: (1) “Do you think that public officials will treat *lower income* people the same as, better than, or worse than others during a terrorist event or public health emergency?” and (2) “Do you think that public officials will treat communities that are *African American or Hispanic* the same as, worse than, or better than others during a terrorist event or public health emergency?” Values on these variables were strongly associated (Chi-square (1) = 20.306, $p < .001$) and were added to produce a single composite variable. Two additional quantitative items assessed trust in government officials to release timely, honest, and accurate risk information during a terrorism event or health emergency, and 1 item asked about participants’ belief that government and public health officials are prepared to deal with a terrorist event in their neighborhood.

Two subscales were constructed to measure typical reasoning or information processing strategies about bioterrorism communications. Original items and questions from previous studies that had measured analytical and heuristic information processing styles were included.^{62,68} For the analytical processing style, 6 questions measured the extent to which consideration of terrorism information tends to be deliberative, effortful, attentive to details, and responsive to argument quality. Responses were averaged to produce an index that was

highly reliable for the African American sample (Cronbach's alpha = .815) and the Hispanic/Latino sample (Cronbach's alpha = .830). Higher values on the scale reflected *less* agreement with statements representative of an analytical information processing style. A second subscale measured a heuristic information processing strategy regarding bioterrorism communications, and 5 statements were presented that reflected the extent to which consideration of bioterrorism information usually relied on simpler decision rules and were intuitive, experiential, or based primarily on affect/ emotion. These items produced a subscale that was reliable for African American (Cronbach's alpha = .724) and Hispanic/Latino (Cronbach's alpha = .699) participants. Higher values on this scale reflected *less* agreement with statements representative of a heuristic information processing style.

We also measured participants' responses to 2 types of frequent risk/crisis communication statements: those that offered general reassurances and those that acknowledged uncertainties. The LexisNexis® Academic database of TV and radio news broadcasts was used to identify exact statements that previously had been made by leaders and risk communicators, and these were sampled for this study. Respondents were first asked to indicate how worried or reassured they felt after hearing each of 6 messages of reassurance. Values were averaged to produce an index of the degree of reassurance felt by respondents. The scale demonstrated high reliability for the African American sample (Cronbach's alpha = .841) and for the Hispanic/Latino sample (Cronbach's alpha = .802).

Five additional statements that had appeared in the broadcast media during the anthrax incidents of 2001 were presented. The statements addressed uncertainties in risk estimates and mitigation strategies to decontaminate, clear, or reopen contaminated facilities. Respondents expressed whether they felt more reassured or more fearful as a result of the message. Responses were averaged, and this scale demonstrated acceptable reliability for the African American sample (Cronbach's alpha = .819) and the Hispanic/ Latino sample (Cronbach's alpha = .734).

Data Analysis

Data from completed questionnaires were entered into an Excel file, checked for accuracy, and then converted and imported into a data file for analysis using the Statistical Package for the Social Sciences (SPSS) 14.0. Final analyses used SPSS Version 18.0. Responses with missing values on any of the variables were excluded. Statistical procedures used unweighted data to perform analyses. Cross-tabulations examined frequency distributions on the socio-demographic variables by race/ethnicity, and differences between the 2 samples were tested using Chi-square statistics. Group differences on measures of risk perceptions, information processing styles, and responses to risk communication reassurances and uncertainty messages were examined using *t*-tests. Group differences on the composite fairness variable and the 2 trust questions were tested using Chi-square statistics.

A linear multiple regression procedure examined factors that might explain why general statements of reassurance were effective for some individuals, but not others. A second regression procedure considered possible predictors of reactions to uncertainty communications. Because preliminary analyses revealed that the data did not violate the statistical assumptions of ordinary linear regression models, a linear multiple regression

procedure entered a set of predictors in a series of 3 sequential steps, and a final model, including all specified possible predictors, was tested.

Step 1 represented sociodemographic variables as predictors of individual responses to general reassurance statements or communications about risk and safety uncertainties. Sociodemographic variables entered into the regression equation were age, income, whether the respondent had children younger than 18 years of age, gender, level of education, and race/ethnicity.

Step 2 added to the prediction equation psychological variables previously associated with the interpretation of and response to risk communications while controlling for sociodemographic factors. Variables included preexisting risk perceptions about personal threat from terrorism; analytical information processing style for bioterrorism communications; heuristic information processing style; perceived fairness of government authorities when managing terrorism events; and trust in officials' openness, accuracy, and honesty about disclosing negative information during a terrorism event.

Step 3 entered interaction terms into the regression equation that represented whether effects of these psychological variables on response to reassurances or uncertainty messages depended on the population from which a respondent had been sampled. The sequential regression analysis procedure uses an F -statistic to test whether adding a set of variables to the prediction equation at a particular step adds significantly to the explanatory power of the model while controlling for factors already included in the equation. A t -statistic tested for the significance of each independent variable within a set at each step of the procedure.

Results

A total of 320 participants from New York and California completed the survey and interview questionnaire. Sociodemographic characteristics of the African American and Hispanic/Latino samples are presented in Table 1. The 2 groups did not differ significantly in gender composition, annual income, or percentage of participants having children under the age of 18. However, individuals in the Hispanic/Latino sample tended to be younger, had less formal education, were more likely to be employed part-time as opposed to full-time or to be unemployed, and were less likely to be divorced or widowed.

Risk Perceptions

The mean values on scales measuring concern about particular public health emergency situations showed that respondents tended to be "somewhat concerned" about the listed public health emergencies. Across the 2 samples, ratings of concern for the bioterrorism threat were higher than the average ratings for other public health emergencies and terrorism events ($F(1,307) = 14.98, p < .001$), but these differences were only statistically significant for relatively lower levels of concern about natural disasters and contamination of water supplies. Both samples were similar in average concern for the various public health emergencies and terrorism events, including bioterrorism ($F(1,307) = .188, ns$).

In general, participants perceived some personal risk from the terrorism threat. The 2 samples differed in their assessments: African Americans living in New York perceived a greater personal risk from terrorism than did Hispanics/Latinos in California ($t(317) = -2.69, p < .01$). Across all participants, the majority—68%—were somewhat or very confident that during a terrorism event or public health emergency, government officials would provide accurate and timely information in their community, but this percentage varied by ethnicity/race (Chi-square (3) = 29.82, $p < .001$): 83% of Hispanic/Latino participants expressed this level of confidence versus only 55% of African Americans.

In contrast, only 18% of all survey participants believed that officials would be mostly or completely forthcoming and honest about negative information during a terrorism event, and differences between the 2 samples were not statistically significant. Moreover, participants expressed considerable skepticism about how fair officials would be to individuals from lower income and/or African American and Hispanic communities during a terrorism event or public health emergency. Across all participants, 46% believed that officials would treat them worse than others, but differences between the 2 samples on this question were highly significant. Of Hispanic/Latino respondents, 32% believed that lower income individuals would be treated worse than others, versus 58% of African Americans (Chi-square (2) = 23.59, $p < .001$). When considering the treatment of African Americans and Hispanics/Latinos by officials during a terrorist attack, 41% of survey participants thought these communities would be treated worse than others. Of African American respondents, 45% believed this to be true, versus 36% of Hispanics/Latinos (Chi-square (2) = 8.11, $p < .05$). In addition, more African American participants (50%) than Hispanics/Latinos (41%) believed that public officials would not be prepared to deal with a terrorist event in their neighborhood (Chi-square (3) = 7.84, $p < .05$).

Despite these group differences, the samples did not differ in average responses to general reassurances or uncertainty messages previously issued by government officials during an extreme risk event. In addition, when encountering new communications about biological terrorism, many individuals reported using multiple information processing or reasoning styles. Both samples were similar in the likelihood of using an analytical information processing strategy to consider new information. However, Hispanics/Latinos were more likely than African Americans to also use a heuristic processing strategy to reason about bioterrorism threat information ($t(317) = -3.20, p < .005$).

Multivariate Analysis

Table 2 summarizes results of the linear regression procedure that examined predictors of responses to general reassurances issued by public officials during a past bioterrorism event or public health emergency. On Step 1, sociodemographic variables, including race or ethnicity, did not predict how reassured individuals were by official communications that offered general encouragement and optimism about managing a terrorism incident ($F(6,220) = 1.50, ns$). However, 3 of the psychological variables were significant predictors of respondents' reactions ($F(12,214) = 3.97, p < .001$). Individuals reported being more reassured and less worried in response to encouraging messages from government officials if they were more likely to use an analytic information processing style ($t(214) = -4.10, p$

< .001), had lower general risk perceptions about personal threat from terrorism ($t(214) = -3.13, p < .005$), and were more confident that public officials would provide timely and accurate information about a terrorism event in their community ($t(214) = 2.43, p < .05$). In the final model, 2 of the sociodemographic variables did reach statistical significance, although to a lesser degree than the psychological variables. When considering all possible predictors in the final step of the regression procedure, gender and education level predicted reassurance in response to leaders' encouraging messages, with men and those with more formal education more likely to report being reassured.

The second regression procedure identified several significant predictors of participants' responses to uncertainty messages from leaders that appeared in the media during the cleanup and restoration phases of the 2001 anthrax incident. These findings are summarized in Table 3. Sociodemographic variables, including ethnicity, were not significant predictors of the level of reassurance or fear that participants reported after listening to messages about uncertainties regarding cleanup, restoration, and recovery after a bioterrorism incident. Step 2 of the regression procedure revealed that 3 psychological variables were significant predictors ($F(12,235) = 3.33, p < .001$). Participants were more likely to report feeling fearful about uncertainty communications if they believed officials would be unfair in dealing with lower income and minority communities during a public health emergency or act of terrorism ($t(223) = 3.26, p < .005$) and had greater risk perceptions about personal threat from terrorism ($t(223) = -3.16, p < .005$). If participants believed that officials would be honest and forthcoming with negative information, they tended to feel less reassured (ie, more fearful) by the acknowledgment of risk uncertainties, and this variable approached the level of statistical significance ($t(223) = -1.83, p < .10$). However, in Step 3 of the regression procedure (Table 3), significant interactions between sample population and psychological predictors of response to uncertainty messages clarified these relationships.

General risk perceptions about personal threat presented by terrorism did not affect how African Americans responded to uncertainty communications ($t(169) = -.01, ns$), but for Hispanics/Latinos in the study, greater perceptions of personal risk tended to be associated with more reported fear and less reassurance in response to uncertainty messages ($t(150) = -.285, p < .01$). Furthermore, the level of trust in government officials to provide accurate and timely information in their community had a different effect on responses to risk uncertainties for the 2 samples ($t(217) = -2.26, p < .05$). For African Americans, greater confidence that officials would provide accurate and timely information was associated with a greater likelihood of feeling reassured when government officials' messages openly referred to risk uncertainties (Pearson $r(163) = .172, p < .05$). In contrast, among Hispanics/Latinos, more confidence that risk information would be accurate and timely was associated with more reported fear when risk messages acknowledged uncertainties (Pearson $r(142) = -.207, p < .01$).

Discussion

In the aftermath of the 2001 anthrax bioterrorism event, 2 crucial challenges during the remediation and recovery periods became apparent. First, the science is still evolving regarding cleanup, restoration, and clearance of environments after a biocontamination

event; therefore, some safety and consequence management decisions will be made with incomplete, evolving, or imperfect knowledge.^{7,22,58,59} Second, uncertainties and risk communication gaps can have vastly different impacts on individuals from different sociocultural backgrounds, risk perspectives, and life circumstances.^{7,9,11,17,22} Effective risk and uncertainty communications during decontamination and recovery phases of a biological attack will play a crucial role in the mitigation of damage and timely recovery.⁶⁹⁻⁷² This study explored several challenges for the risk/crisis communication process during consequence management in 2 urban populations especially vulnerable to loss in the event of an extreme act of biological terrorism. Results from this preliminary research suggest possible explanations for why particular uncertainty communications and messages of reassurance from leaders might be effective for some individuals and not others, and how communication strategies might address these challenges.

Responses to Uncertainty Communication

Findings from this study demonstrated significant variability in responses to official communications *within* 2 groups that typically are assigned to different segments of audiences for targeted communication strategies.⁷² Heterogeneity within certain ethnic or racial groups in risk perceptions, behavioral intentions, trust, and risk/crisis communication needs during a public health emergency is often minimized in preparedness strategies and plans.^{24,54} In this study, participants were somewhat divided in their reactions to communications about uncertainties in consequence management that had been previously issued by leaders during an extreme public health emergency. Whether individuals reported feeling reassured or fearful after hearing bioterrorism messages about uncertainties in decontamination efforts or reoccupancy decisions depended on preexisting trust in government officials to fairly and competently manage the consequences of a terrorist act, and on prior risk perceptions about the terrorism threat in general. These variables were more predictive of response to uncertainty messages than any sociodemographic variable.

The technical details or content of communications about uncertainties in risk management during the restoration and recovery stages of a biocontamination event will not be the sole determinants of how at-risk populations will evaluate and respond to official messages. Instead, protected values,⁷³ such as perceived fairness of officials who respond to a public health threat, and preexisting risk beliefs also are likely to play a significant role. These findings are compatible with previous research that has shown fairness beliefs and trust to be especially important to individual decision making and interpretation of events under conditions of uncertainty.^{74,75}

The significant association between values or preexisting risk beliefs and reactions to uncertainty messages in this research is noteworthy given that the 2 samples reflected different cultural and ethnic backgrounds, social histories, and geographic locations. Moreover, participants responded to actual past messages from leaders and public health officials that had been constructed based on in-place risk/crisis communication plans thought to reflect best practices at the time of the 2001 anthrax episode.⁷⁶ Of course, response to official communications may differ if these messages are conveyed in the context of an actual ongoing event.

Results also suggest that although the same values and prior beliefs can influence responses to uncertainty communications across diverse communities, the direction of these effects may differ depending on other population characteristics. For example, preexisting trust or confidence in leaders to provide accurate information was associated with different reactions to uncertainty communications for African American and Hispanic/Latino participants, and preexisting perceptions about personal risk from terrorism only influenced the response to uncertainty messages in the Hispanic/Latino sample. These interactions may reflect group differences in cultural perspectives on risk, social experiences, and other psychosocial characteristics that guide individuals' interpretation and perceived importance of events. These factors sensitize individuals to particular aspects of judgment situations while affecting the persuasiveness of certain information.^{51,53,60} In this study, Hispanic/Latino participants when compared to African American individuals tended to use a heuristic information processing style, and this could be associated with an increased reliance on preexisting perceptions of the terrorism threat to interpret the meaning of new uncertainty communications.

Moreover, consistent with previous studies,^{54,63} these samples differed significantly in perceptions of the fairness of government officials, beliefs about the likely honesty and competence of leaders during a public health emergency, and the preparedness of government officials to respond to a terrorist event in their neighborhood. Differences in each community's past experiences and history with public health or medical care systems and other government agencies also may contribute to differences in the likelihood of responding to risk communications in particular ways.^{17,28,54,63} This suggests that the "baseline" psychosocial context of decision making about and response to new uncertainty and risk messages may differ between groups from varied cultural and experiential backgrounds.²⁴

Improved communication strategies must take into account where individuals start as a reference point for reasoning about and interpreting risk information and recognize that individuals bring a preexisting readiness to interpret messages in particular ways independent of specific facts. This reference point is crucial for decision making and actions under conditions of uncertainty, because depending on this starting point, events can take on a different personal significance, meaning, and utility for decision making.⁷⁷ Furthermore, certain communication errors or missteps can have a lingering or persistent negative effect for some individuals if "baseline" perspectives lead to an emphasis on the significance and/or a moral interpretation of particular communication missteps (eg, attributions of unfairness or injustice) and influence whether these missteps are perceived to confirm preexisting hypotheses about leaders.^{11,17,18,22,55} This was demonstrated during the H1N1 pandemic in 2009-10 where, for some "low trust" communities, the level of distrust actually increased as the pandemic progressed and some communication and risk management missteps occurred, including the unanticipated delay in the availability of the H1N1 vaccine in early fall 2009.^{14,20,21} Preexisting beliefs and values create expectations for uncertainty communications and government actions, and during a prolonged incident, a violation of or failure to acknowledge these may impede communication effectiveness.^{21,23}

Although many of the “group differences” findings from this study are consistent with previous research on ethnic and cultural differences in risk perceptions, crisis communication effects, and fairness beliefs,⁵⁴ the fact that the samples were drawn from populations in different geographic locations complicates interpretations of group comparisons. For example, differences between the groups in previous engagement with or outreach efforts by government public health, social services, or homeland security agencies could contribute to differences in receptivity to the messages presented in the study, although in this investigation, on the average, reaction to the uncertainty and reassurance messages did not differ between the groups. The design of this survey study did not allow for a clear separation of the effects of place from ethnicity on responses to risk communications. Furthermore, the African American participants resided in close proximity to the World Trade Center site targeted by terrorists on September 11, 2001 (based on zip codes, the median residential distance of participants from the attack site was 5 miles), whereas the Hispanic/Latino participants were all California residents. The experience of living near the targeted sites could have influenced risk perceptions and response to uncertainty communications of African American survey participants, although the intensity and psychological characteristics of response to an extreme terrorism event is not always predicted by proximity to the physical damage from or site of terrorist attacks.⁷⁸ Other psychosocial and cultural processes may have contributed to group differences rather than just geography, and this possibility should be pursued in future research.

Effects of General Reassurances

During an extreme or a catastrophic risk event where casualties, uncertainty, and significant damage are apparent, affected populations will look to leaders (and other sources) for credible, honest, and timely information about the nature of the crisis or public health emergency, guidance about what personal actions should be taken to remain safe, predictions about what to expect in the near future, and transparency in decision making.^{79,80} Communities seek reassurance that reasonable actions are being taken to reduce risk and uncertainty and that the best interests of their families and communities have top priority.⁸⁰

In this study, when presented with messages of reassurance and comfort that had been issued by leaders during a past public health emergency, some participants reported *more* worry and *less* reassurance. The likelihood that statements of encouragement and optimism from officials prompted less reassurance and more worry was predicted by 3 factors: a decreased likelihood to adopt an analytical information processing style when considering bioterrorism communications, greater preexisting perceptions of personal risk from the terrorism threat, and less confidence that information will be accurate and timely. Leaders often assume a shared interpretation of risk messages between communicators and audiences,²² but this clearly is not always the case. As Clarke et al.²² have discussed, “... different audiences may need different messages or different kinds of messages,” and “... different groups may hear different things from the same words.” The communication process is more likely to succeed if leaders and risk communicators have figured out how to have different groups hear what is intended, but also if the process facilitates how well leaders hear and act on the information needs, concerns, and priorities of affected populations during an extreme risk

event.^{22,75,80} It may be more productive to think beyond typical sociodemographic profiles of populations most vulnerable to communication failures during a mass contamination event and consider the context or psychosocial environment of risk in terms of high or low trust individuals and in reference to likely preexisting values and risk perceptions.^{81,82}

Building an Updated Risk Communication Response Plan

The findings of this study have several implications for policymakers, practitioners, and risk communicators who are working to improve risk communication planning and implementation during response to a dynamic bioterrorism incident. The first implication relates to the importance of particular psychosocial factors in how people interpret and respond to uncertainty and reassurance messages, not only during the initial stages of an emerging event, but also during subsequent decontamination and recovery phases. The psychosocial environment can influence baseline perspectives of individuals when knowledge of an event first occurs, but also can contribute to changes in the public's reactions and growing disparities in communication effectiveness as uncertainties emerge and specific government actions are taken to contain the incident.

Therefore, in addition to assessing baseline perspectives of various audiences during the preevent period, agencies and risk communicators should consider the need and how to update those assessments on a periodic basis during the course of the crisis response and remediation stages. In particular, it may be essential to perform ongoing assessments of risk communication effectiveness and gaps in meeting the information needs of vulnerable social groups or communities whose response patterns might differ from those of the general population. Assessments should be specific and informed by the best and most up-to-date scientific evidence regarding what is likely to be most relevant to judgments and decision making for diverse affected populations. For example, a general question about current public trust in leaders and government agencies will not be as helpful to improve or modify communications as evaluations of specific components of trust such as confidence in officials' openness and honesty, competence, and expertise in providing accurate and timely information, and fairness in protecting all individuals regardless of social status or ethnic/cultural background.⁸³

As we found in this study, particular groups may focus on different aspects of trust when compared to others, and to address the information needs of a particular community, those elements of trust that are essential must be reflected in communication processes and content. Crisis communicators should consider the need for brief, iterative rounds of process and outcome evaluation of the contents and impact of warnings and messages in different segments of the population. The goals of periodic, short-term process and outcome evaluation of risk communication activities would be to modify strategies, audience segmentation, and message content to meet any emerging information needs during an evolving incident and to assess the ongoing psychosocial environment of public health and homeland security decision making. If feasible and timely, established assessment techniques such as focus group discussions, opinion polling, public meetings and internet surveys might be useful in detecting significant changes in audience perspectives and

information needs. These techniques already have been applied on occasion with some success for adapting risk management strategies in real time.⁸⁴

Preevent agreements between government agencies and academic, private, or other nongovernment entities can greatly facilitate the timely assessment of public reactions should a significant incident occur.⁸⁵ In addition, newer assessment techniques related to systematic monitoring and analysis of social media offer critical tools to identify ongoing and emerging information needs and risk perceptions of various affected populations. These techniques facilitate the accurate, timely, and up-to-date situation awareness of emergency management organizations and government agencies.⁸⁶

A second implication of this study relates to the reluctance of some segments of the U.S. population to accept or respond to government agencies' or leaders' warnings, self-protection directives, and risk and recovery messages. As others have suggested,²⁸ to address patterns of nonresponse and mistrust in disaffected segments of the population, risk communicators should build on positive relationships of mutual trust with opinion leaders and trusted sources of information in those communities during normal conditions prior to a significant incident. During the evolution of the crisis, then, essential tasks are early outreach and meaningful engagement with these trusted partners whose involvement might signal to their community that the warnings and messages are informed by their needs, perspectives, and particular sensitivities. However, even if considerable efforts have been made to strengthen government-community relations in the preevent phase, new critical communication needs and mistrust can emerge over the course of an unfolding bioterrorism event as risk circumstances dramatically change and some missteps or errors in communication or risk management inevitably surface because an event's threat details cannot be completely predicted in advance.^{7,22,26,87,88}

This situation requires procedures in place to support comprehensive ongoing monitoring of public responses, including the responses of those subpopulations in economically and culturally diverse urban areas who may be at risk and whose life circumstances may present different challenges for response and recovery. Furthermore, an agency's communication infrastructure should include "built-in" flexibility in emergency or crisis management strategies. Communicators and risk managers need to be prepared to respond to evolving and unforeseen uncertainty in situational circumstances, unexpected missteps in crisis/ risk communication, "surprising" events or a possible loss of trust in leaders that may not have been anticipated during planning. In these circumstances, it is especially crucial for risk and uncertainty communications to acknowledge previous significant errors (with explanations for how the errors are being addressed) and the prioritized or "protected" values of affected populations (eg, clear, concise, and reasonable explanations for any differential treatment of subgroups that could be interpreted as biased or unfair).

Communicators also need to explain how decision making by leaders is being informed by the information needs and perspectives of affected populations.⁸³ Even though having a diversity of messengers from government agencies and communities is likely to improve the quality of risk/crisis communication strategies, this will be insufficient for effective engagement of certain communities unless the actual content of messages is compatible with

what is valued and needed by a community for decision making. Best practices in crisis and risk communication under conditions of low trust, high emotions, uncertainty, time urgency, and potential for significant casualties may differ somewhat from practices that are effective in the absence of these factors.⁸³

Importantly, some of the actions described above might require changes in public health preparedness policies and regulations at the federal, state, and local levels. Such policies regulate the process of collecting information from the public (paperwork reduction act), human research protection, rules for the sharing of information between and among government jurisdictions, and the development, implementation, and evaluation of risk communication campaigns. Government agencies at all levels that are likely to be involved in managing the consequences of a significant bioterrorism incident may benefit from a thorough preevent evaluation of any existing regulatory and organizational barriers to flexible and dynamic risk and crisis communication approaches that could be used rapidly, if needed, during an evolving event.

Conclusion

By far the most likely scenario for an act of WMD terrorism is an attack carried out in a complex, densely populated city or urban center, placing at risk communities that reflect a range of socioeconomic or life circumstances, orientations toward risk, and ethnic or cultural backgrounds.³⁸⁻⁴⁰ As a significant act unfolds, some ongoing uncertainties would have been predicted; others will become apparent only as the event develops.^{6-9,58,59,70,87} Distrust of government actions and decisions will be high in some communities, moderate in others,^{11,17,23,28,75} and preexisting social and environmental vulnerabilities to extreme events will contribute to an unequal potential for loss.^{6,50,89}

During this dynamic phase, skilled communications about decontamination strategies, protection of public health, cleanup, restoration, and reoccupancy will be essential to support efforts to protect public health and maintain/restore public confidence within a context of disturbing events. Agencies and organizations need sufficient structure and preparedness, but also adaptive capacity, to respond to changing circumstances and an honest ongoing assessment of communication effectiveness and any gaps across diverse affected populations.

Acknowledgments

This research was supported by grants from the Newkirk Center for Science and Society at the University of California, Irvine; the Office of Research and Graduate Studies at the University of California, Irvine; and a grant titled "Survey on Diversity and Public Health Preparedness" from the Centers for Disease Control and Prevention (CDC).

During this research, Dr. Morse was supported by the CDC (CDC/ASPH Cooperative Agreement A1313-21/22, Centers for Public Health Preparedness), and the Arts & Letters Foundation. He is currently supported by the generous support of the American people through the United States Agency for International Development (USAID) Emerging Pandemic Threats PREDICT project (USAID Cooperative Agreement GHN-A-009-00010-00), and the Arts & Letters Foundation.

The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention, the Agency for Toxic Substances and Disease Registry, USAID, or the United States government.

References

1. Commission on the Prevention of WMD Proliferation and Terrorism. *World at Risk*. New York: Vintage Books; 2008.
2. Franco C, Hansen MB. Meeting Report: The state of bio-preparedness: lessons from leaders, proposals for progress. *Biosecur Bioterror*. 2010; 8(4):379–384. [PubMed: 21142766]
3. Hjalmarsson K, Isla M, Kraatz-Wadsark G, Bardesci N. Global watch: the state of biological investigations. *Bull At Sci*. 2010; 66:70–78.
4. National Research Council, Committee on Methodological Improvements to the Department of Homeland Security’s Biological Agent Risk Analysis. *Department of Homeland Security Bioterrorism Risk Assessment: A Call for Change*. Washington, DC: National Academy Press; 2008.
5. Gottron, F.; Shea, GA. *Federal Efforts to Address the Threat of Bioterrorism: Selected Issues and Options for Congress*. Washington, DC: Congressional Research Service; 2011. <http://www.fas.org/sgp/crs/terror/R41123.pdf> [April 20, 2012]
6. U.S. Department of Homeland Security. *Risk Communication During a Terrorist Attack or Other Public Health Emergency*. Washington, DC: Department of Homeland Security; 2005. www.phe.gov/emergency/communication/guides/media/Documents/11.pdf [April 20, 2012]
7. National Research Council, Committee on Standards and Policies for Decontaminating Public Facilities Affected by Exposure to Harmful Biological Agents: *How Clean is Safe?. Reopening Public Facilities After a Biological Attack: A Decision-Making Framework*. Washington, DC: National Academy Press; 2005.
8. O’Toole T, Inglesby T. Biosecurity memos to the Obama administration. *Biosecur Bioterror*. 2009; 7:25–28. [PubMed: 19317617]
9. Wray RJ, Kreuter MW, Jacobsen H, Clements B, Evans RG. Theoretical perspectives on public communication preparedness for terrorist attacks. *Fam Community Health*. 2004; 27:232–241. [PubMed: 15596970]
10. Briggs CL. Communicating biosecurity. *Med Anthropol*. 2011; 30:6–29. [PubMed: 21218354]
11. Quinn SC, Thomas T, Kumar S. The anthrax vaccine and research: reactions from postal workers and public health professionals. *Biosecur Bioterror*. 2008; 6:321–333. [PubMed: 19117431]
12. Comfort LK. Crisis management in hindsight: cognition, communication, coordination and control. *Public Admin Rev*. 2007; 67(Suppl 1):189–197.
13. London Assembly. *Report of the July 7 review committee*. London: Greater London Authority; 2006. <http://www.london.gov.uk/who-runs-london/the-london-assembly/publications/safety-policing/report-7-july-review-committee> [April 20, 2012]
14. Institute of Medicine. *The 2009 H1N1 Influenza Vaccination Campaign: Summary of a Workshop Series*. Washington, DC: National Academy Press; 2010. <http://www.nap.edu/catalog/12992.html> [April 20, 2012]
15. Rabasa, A.; Blackwill, RD.; Chalk, P.; Craigin, K.; Fair, C. *The Lessons of Mumbai*. Santa Monica, CA: 2009. Rand Corporation Occasional Report Series http://www.rand.org/pubs/occasional_papers/OP249.html [April 20, 2012]
16. Garnett JL, Kousmin A. Communicating throughout Katrina: competing and complementary conceptual lenses on crisis communication. *Public Admin Rev*. 2007; 67(Suppl 1):177–188.
17. Quinn SC, Thomas T, McAllister C. Postal workers’ perspectives on communication during the anthrax attack. *Biosecur Bioterror*. 2005; 3:207–215. [PubMed: 16181043]
18. Vanderford ML, Nastaff T, Telfer JL, Bonzo SE. Emergency communication challenges in response to Hurricane Katrina: lessons from the Centers for Disease Control and Prevention. *J Appl Commun Res*. 2007; 35:9–25.
19. Dharmakumar, R.; Vahanvaty, A. *Mumbai Attacks: Communication Was a Victim, Too*. India: IBN Live; 2008. <http://ibnlive.in.com/news/mumbai-attacks-communication-was-a-victim-too/81277-3.html> [April 20, 2012]
20. *Strengthening the Black Family, Inc.. Qualitative Assessment: H1N1 Vaccination Campaign Participation by African-Americans in Wake County*. Raleigh, NC: Strengthening the Black

- Family, Inc.; 2010. <http://www.wakegov.com/NR/rdonlyres/0C52F1F7-EB5E-4A05-9495-DFC8385115B0/0/QualitativeAssessmentReportFinalFull.pdf> [April 20, 2012]
21. Plough A, Bristol B, Fielding J, Caldwell S, Khan S. Pandemics and health equity: lessons learned from the H1N1 response in Los Angeles County. *J Public Health Manag Pract.* 2011; 17:20–27. [PubMed: 21135657]
 22. Clarke L, Chess C, Holmes R, O'Neill KM. Speaking with one voice: risk communication lessons from the US anthrax attacks. *Journal of Contingencies and Crisis Management.* 2006; 14:160–169.
 23. Eisenman DC. Disaster planning and risk communication with vulnerable populations: lessons from Hurricane Katrina. *Am J Public Health.* 2007; 97(Suppl):S109–S115. [PubMed: 17413069]
 24. Viswanath, K.; Minsky, S.; Ramamurthi, D.; Kontos, EZ. *Communication Under Uncertainty: Communication Behaviors of Diverse Audiences During the A(H1N1) Incidence of Spring and Summer 2009.* Cambridge, MA: Viswanath Laboratory, Harvard School of Public Health and Dana-Farber Cancer Institute; 2009.
 25. U.S. Centers for Disease Control and Prevention. CDC health disparities and inequalities report—United States, 2011. *MMWR Surveill Summ.* 2011; 60(Suppl):1–109.
 26. Veil S, Reynolds B, Sellnow TL, Seeger MW. CERC as a theoretical framework for research and practice. *Health Promot Pract.* 2008; 9(4 Suppl):26S–34S. [PubMed: 18936257]
 27. Cutter SL, Emrich CT, Mitchell JT, et al. The long road home: race, class and recovery from Hurricane Katrina. *Environment.* 2006; 48:10–20.
 28. Quinn S. Crisis and emergency risk communication in a pandemic: a model for building capacity and resilience in minority communities. *Health Promot Pract.* 2008; 9(4 Suppl):18S–25S. [PubMed: 18936256]
 29. Working Group on Governance Dilemmas in Bioterrorism Response. Leading during bioattacks and epidemics with the public's trust and help. *Biosecur Bioterror.* 2004; 2:25–40. [PubMed: 15068677]
 30. Vanderford ML. Communication lessons learned in the Emergency Operations Center during CDC's anthrax response: a commentary. *J Health Commun.* 2003; 8:11–12. [PubMed: 14692567]
 31. Burns, W.; Slovic, P. [April 20, 2012] The diffusion of fear: modeling community response to a terrorist strike. *Social Science Research Network.* 2006. <http://ssrn.com/abstract=912736>
 32. Speckhard, A. Prevention strategies and promoting psychological resilience to bioterrorism through communication. In: Green, MS., et al., editors. *Risk Assessment and Risk Communication Strategies in Bioterrorism Preparedness.* New York: Springer; 2007. p. 135-162.
 33. U.S. Department of Homeland Security. Quadrennial Homeland Security Review Report: A Strategic Framework for a Secure Homeland. Washington, DC: Department of Homeland Security; 2010. http://www.dhs.gov/xabout/gc_1208534155450.shtm [April 20, 2012]
 34. Edwards, C. *Resilient Nation.* London: Demos; 2009.
 35. Kahan JH, Allen AC, George JK. An operational framework for resilience. *Journal of Homeland Security and Emergency.* 2009; 6:1–50.
 36. National Research Council. *Building Community Disaster Resilience Through Private-Public Collaboration.* Washington, DC: National Research Council, Committee on Private-Public Sector Collaboration to Enhance Community Disaster Resilience; 2011. <http://www.nap.edu/catalog/13028.html> [April 20, 2012]
 37. Harrald J. Agility and discipline: critical success factors for disaster response. *Annals of the American Academy of Political & Social Science.* 2006; 604:256–272.
 38. Cutter SL, Finch C. Temporal and spatial changes in social vulnerability to natural hazards. *Proc Natl Acad Sci U S A.* 2008; 105:2301–2306. [PubMed: 18268336]
 39. Piegorsch WW, Cutter SL, Hardisty F. Benchmark analysis for quantifying vulnerability to urban terrorist incidents. *Risk Anal.* 2007; 27:1411–1424. [PubMed: 18093043]
 40. Webb J, Cutter SL. The geography of U.S. terrorist incidents, 1970-2004. *Terrorism and Political Violence.* 2009; 21:428–449.
 41. U.S. Centers for Disease Control and Prevention. [April 20, 2012] Crisis and Emergency Risk Communication. 2002. www.bt.cdc.gov/cerc/pdf/CERC-SEPT02.pdf

42. Endsley, MR. Theoretical underpinnings of situation awareness: a critical review. In: Endsley, MR.; Garland, DJ., editors. *Situation Awareness Analysis and Measurement*. Mahwah, NJ: Lawrence Erlbaum; 2000. p. 1-24.
43. Endsley, MR.; Jones, DG. Disruptions, interruptions and information attack: impact on situation awareness and decision making. Santa Clara, CA: SA Technologies, Inc; 2001. <http://citeseerx.ist.psu.edu/viewdoc/summary?doi=10.1.1.77.3095> [April 20, 2012]
44. Coombs, WT.; Holladay, SJ. Examining the effects of mutability and framing on perceptions of human-error and technical-error crises: implications for Situational Crisis Communication Theory. In: Coombs, WT.; Holladay, SJ., editors. *Handbook of Crisis Communication*. Malden, MA: Blackwell Publishing; 2010. p. 181-204.
45. Toner, ES. *Creating Situational Awareness: A Systems Approach*. Baltimore, MD: Center for Biosecurity of UPMC; 2009. <http://www.upmc-biosecurity.org/website/resources/publications/2009/2009-06-10-SituationalAwarenessSystemsApproach> [April 20, 2012]
46. Reynolds B, Seeger MW. Crisis and emergency communication as an integrative model. *Journal of Health Communication*. 2005; 10:43–55. [PubMed: 15764443]
47. Seeger MW. Best practices in crisis communication: an expert panel process. *Journal of Applied Communication Research*. 2006; 34:232–244.
48. Powell M, Dunwoody S, Griffin R, Neuwirth K. Exploring lay uncertainty about an environmental health risk. *Public Understanding of Science*. 2007; 16:323–343.
49. National Academy of Sciences, National Research Council, Committee on Human Biomonitoring for Environmental Chemicals. *Human Biomonitoring for Environmental Chemicals*. Washington, DC: National Academies Press; 2006. <http://www.nap.edu/catalog/11700.html> [April 20, 2012]
50. Raber E, Carlen TM, Folks KJ, Kirvel RD, Daniels JI, Bogen KT. How clean is clean enough? Recent developments in response to threats posed by chemical and biological warfare agents. *Int J Environ Health Res*. 2004; 14:31–41. [PubMed: 14660116]
51. Lemyre L, Gibson S, Zlepzig L, Myer-MacLeod R, Boutette P. Emergency preparedness for higher risk populations: psychosocial considerations. *Radiat Prot Dosimetry*. 2009; 134:207–214. [PubMed: 19447815]
52. Brashers DE. Communication and uncertainty management. *Journal of Communication*. 2001; 51:477–497.
53. Vaughan E, Tinker T. Effective health risk communication about pandemic influenza for vulnerable populations. *Am J Public Health*. 2009; 99(S2):S324–S332. [PubMed: 19797744]
54. Eisenman DP, Wold C, Setodji C, et al. Will public health's response to terrorism be fair? Racial/ethnic variations in perceived fairness during a bioterrorist event. *Biosecur Bioterror*. 2004; 2:146–156. [PubMed: 15588052]
55. Manuell M, Cukor J. Mother nature versus human nature: public compliance with evacuation and quarantine. *Disasters*. 2011; 35:417–442. [PubMed: 21073672]
56. Vaughan E. Contemporary perspectives on risk perceptions, health-protective behaviors, and the control of emerging infectious diseases. *Int J Behav Med*. 2011; 18:83–87. [PubMed: 21509639]
57. Sellnow, TL.; Ulmer, RR.; Seeger, MW.; Littlefield, RS. *Effective Risk Communication: A Message-Centered Approach*. New York: Springer; 2009.
58. Raber E, Hirabayashi JM, Mancieri SP, et al. Chemical and biological incident response and decision process for civilian and public sector facilities. *Risk Anal*. 2002; 22:195–202. [PubMed: 12022670]
59. Fitch JP, Raber E, Imbro DP. Technology challenges in responding to biological or chemical attacks in the civilian sector. *Science*. 2003; 302:1350–1354. [PubMed: 14631029]
60. Joffe H. Risk: from perception to social representation. *Brit J Soc Psychol*. 2003; 42:55–73. [PubMed: 12713756]
61. Slovic P, Finucane ML, Peters E, MacGregor DG. Risk as analysis and risk as feelings: some thoughts about affect, reason, risk and rationality. *Risk Anal*. 2004; 24:311–322. [PubMed: 15078302]
62. Trumbo C. Information processing and risk perception: an adaptation of the heuristic-systematic model. *Journal of Communication*. 2002; 52:367–382.

63. Satterfield TA, Mertz CK, Slovic P. Discrimination, vulnerability and justice in the face of risk. *Risk Anal.* 2004; 24:115–129. [PubMed: 15028005]
64. Cutter SL, Boruff BJ, Shirley WL. Social vulnerability to environmental hazards. *Soc Sci Q.* 2003; 84:242–261.
65. U.S. Department of Homeland Security. Urban areas security initiative grant program. Washington, DC: Department of Homeland Security, Office of Domestic Preparedness; 2004. http://www.dhs.gov/xopnbiz/grants/editorial_0565.shtm [April 20, 2012]
66. U.S. Census Bureau. Profile of general population and housing characteristics: Hispanic or Latino population. Washington, DC: U.S Census Bureau; 2002. <http://www.census.gov/population/www/cen2000/briefs/> [April 20, 2012]
67. U.S. Census Bureau. American fact finder: Profile of Hispanic or Latino population. Washington, DC: U.S Census Bureau; 2010. http://factfinder2.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=DEC_10_DP_DPDP1&prodType=table
68. Kahlor LA, Dunwoody S, Griffin RJ, Neuwirth K, Giese J. Studying heuristic-systematic processing of risk communication. *Risk Anal.* 2003; 23:355–368. [PubMed: 12731819]
69. U.S. Department of Homeland Security; Environmental Protection Agency. Draft Planning Guidance for Recovery Following Biological Incidents. Washington, DC: Biological Decontamination Standards Working Group, National Science and Technology Council; 2009. <http://www.trivalleycares.org/comments/DHSDraftGuidance.pdf> [April 20, 2012]
70. Raber E, Hibbard WJ, Greenwalt R. The national framework and consequence management guidance following a biological attack. *Biosecur Bioterror.* 2009; 9:271–279. [PubMed: 21882968]
71. Krauter P, Edwards D, Yang L, Tucker M. A systematic methodology for selecting decontamination strategies following a biocontamination event. *Biosecur Bioterror.* 2011; 9:262–270. [PubMed: 21823924]
72. Maibach E, Holtgrave DR. Advances in public health communication. *Annu Rev Public Health.* 1995; 16:219–238. [PubMed: 7639871]
73. Baron J, Spranca M. Protected values. *Organ Behav Hum Decis Process.* 1997; 70:1–16.
74. Van den Bos K, Poortvliet PM, Maas M, Miedema J, Van den Ham EJ. An enquiry concerning the principles of cultural norms and values: the impact of uncertainty and mortality salience on reactions to violations and bolstering of cultural worldviews. *J Exp Soc Psychol.* 2005; 41:91–113.
75. Taylor-Clarke K, Blendon RJ, Zalavsky A, Benson J. Confidence in crisis? Understanding trust in government and public attitudes toward mandatory state health powers. *Biosecur Bioterror.* 2005; 3:138–147. [PubMed: 16000045]
76. Robinson SJ, Newstetter WC. Uncertain science and certain deadlines: CDC responses to the media during the anthrax attacks of 2001. *J Health Commun.* 2003; 8:17–34. [PubMed: 14692570]
77. Kahneman D. A perspective on judgment and choice: mapping bounded rationality. *Am Psychol.* 2003; 58:697–720. [PubMed: 14584987]
78. Silver R, Holman A, McIntosh DN, Poulin M, Giol-Rivas V. National longitudinal study of psychological responses to September 11. *JAMA.* 2002; 288:1235–1244. [PubMed: 12215130]
79. Tinker, T.; Vaughan, E. Communicating the risks of bioterrorism. In: Ursano, RJ.; Fullerton, CS.; Norwood, AE., editors. *Bioterrorism: Psychological and Public Health Interventions.* New York: Cambridge University Press; 2004. p. 308-331.
80. Reynolds, B. *Crisis and Emergency Risk Communication by Leaders for Leaders.* Atlanta, GA: Centers for Disease Control and Prevention; 2004. www.bt.cdc.gov/cerc/pdf/leaders.pdf [April 20, 2012]
81. Lemyre L, Johnson C, Corneil C. Psychosocial considerations for mass decontamination. *Radiat Prot Dosimetry.* 2010; 142:17–23. [PubMed: 20924122]
82. Smillie L, Blissett A. A model for developing risk communication strategy. *J Risk Res.* 2010; 13:115–134.
83. Reynolds BJ. When the facts are just not enough: Credibly communicating about risk is riskier when emotions run high and time is short. *Toxicol Appl Pharmacol.* 2011; 254:206–214. [PubMed: 21034761]

84. Kwan-Gett TS, Baer A, Duchin JS. Spring 2009 H1N1 influenza outbreak in Kings County, Washington. *Disaster Med Public Health Prep.* 2009; 3(Suppl 2):S109–S116. [PubMed: 19952883]
85. Steelfisher GK, Blendon RJ, Bekheit MM, Lubell K. The public's response to the 2009 H1N1 influenza pandemic. *N Engl J Med.* 2010; 362(22):e65. [PubMed: 20484390]
86. Casman EA, Fischhoff B. Risk communication planning for the aftermath of a plague bioattack. *Risk Anal.* 2008; 28:1327–1342. [PubMed: 18564992]
87. White MP, Eiser R. Marginal trust in risk managers: building and losing trust following decisions under uncertainty. *Risk Anal.* 2006; 26:1187–1203. [PubMed: 17054525]
88. Raber E. The challenge of determining the need for remediation following a wide-area biological release. *Biosecur Bioterror.* 2011; 9:257–261. [PubMed: 21882967]
89. Borden KA, Schmidlein MC, Emrich CT, Piegorsch WW, Cutter S. Vulnerability of U.S. cities to environmental hazards. *Journal of Homeland Security and Emergency.* 2007; 4(2) article 5.

Table 1

Description of Samples

Variable	Black/African American New York, NY (N = 170) (%)	Hispanic/Latino Santa Ana, CA (N = 150) (%)
Age (years)***		
18-24	14	31
25-29	14	25
30-34	9	14
35-39	13	11
40-44	15	8
45-49	9	4
50-54	7	2
55-59	7	3
60-64	4	1
65-75	6	1
75 +	3	1
Gender (female)	49	53
Education (highest level completed)*		
Grade school	4	9
Some high school	13	14
High school graduate	27	32
Some college	31	32
Undergraduate degree	16	11
Graduate or professional degree	7	1
Employment status**		
Full time	47	37
Part time	17	33
Currently unemployed	35	29
Marital status*		
Married	33	36
Single	46	55
Widowed	7	1
Separated	5	3
Divorced	10	5
Annual household income		
Less than \$20,000	26	24
\$20,000-\$29,000	28	32
\$30,000-\$39,000	14	14
\$40,000-\$49,000	8	10
\$50,000-\$59,000	8	5
\$60,000-\$69,000	5	3
\$70,000-\$79,000	6	6

Variable	Black/African American New York, NY (N = 170) (%)	Hispanic/Latino Santa Ana, CA (N = 150) (%)
\$80,000 +	5	6
Children under 18 (yes)	35	40

Significance of group differences chi-square statistic:

*
 $p < .05$,

**
 $p < .01$,

 $p < .001$.

Author Manuscript

Author Manuscript

Author Manuscript

Author Manuscript

Table 2

Multiple Linear Regression Predicting Reassurance from Government Officials' Messages of Optimism and Encouragement about a Bioterrorism Incident ($N = 320$)

Step and Predictor	Change in R ²	Standardized β s		
		Step 1	Step 2	Step 3
Step 1: Sociodemographic Model	.04			
<i>Significant predictors:</i>				
Education		.13	.14*	.14*
Gender ¹		-.12	-.14*	-.14*
<i>Nonsignificant predictors:</i>				
Race/ethnicity ²		.13	.04	.05
Household income		-.06	-.05	-.03
Age		-.04	-.07	-.07
Children under 18		.03	-.04	-.04
Step 2: Psychosocial Model	.14****			
<i>Significant predictors:</i>				
Analytical info processing style		—	-.28****	-.28**
Terrorism risk perceptions		—	-.20***	-.20*
Trust in info accuracy/timeliness		—	.17*	.21*
<i>Nonsignificant predictors:</i>				
Perceived fairness		—	.07	.11
Heuristic info processing style		—	.06	.07
Trust in officials' honesty about negative terrorism info		—	.09	.05
Step 3: Interactions:				
Ethnic/cultural background by psychosocial predictors	.01			
<i>Nonsignificant predictors:</i>				
Ethnic \times fairness		—	—	-.07
Ethnic \times risk perception		—	—	.02
Ethnic \times analytic style		—	—	.01
Ethnic \times heuristic style		—	—	-.02
Ethnic \times trust info accuracy		—	—	.08
Ethnic \times trust officials' honesty		—	—	-.07

* $p < .05$,

** $p < .01$,

*** $p < .005$,

**** $p < .001$.

Note. Model summary at final step: $F(18, 226) = 2.69$, $p < .001$, $R^2 = .19$ (adjusted $R^2 = .12$).

¹ Male coded as "1," female coded as "2."

² Hispanic/Latino coded as "1," African American coded as "0."

Table 3

Multiple Linear Regression Predicting Level of Reassurance or Fear in Response to Bioterrorism Communications about Uncertainty ($N = 320$)

Step and Predictor	Change in R^2	Standardized β s		
		Step 1	Step 2	Step 3
Step 1: Sociodemographic Model	.05			
<i>Nonsignificant predictors:</i>				
Education		-.12	-.13	-.01
Race/ethnicity ¹		.09	.07	.06
Children under 18		.07	.02	.03
Age		-.06	-.10	-.09
Gender ²		-.06	-.10	-.09
Household Income		-.02	-.01	-.01
Step 2: Psychosocial Model	.10****			
<i>Significant predictors:</i>				
Perceived fairness		—	.23***	.24**
Terrorism risk perceptions		—	-.20***	-.20***
<i>Nonsignificant predictors:</i>				
Trust in officials' honesty about negative terrorism info		—	-.12	.02
Heuristic info processing style		—	.09	.08
Analytical info processing style		—	-.06	-.06
Trust in info accuracy/timeliness		—	-.05	.09
Step 3: Interaction:				
Ethnic/cultural background by psychosocial predictors	.06**			
<i>Significant predictors:</i>				
Ethnic \times risk perception		—	—	-.21**
Ethnic \times trust info accuracy		—	—	-.19*
<i>Nonsignificant predictors:</i>				
Ethnic \times trust officials' honesty		—	—	-.14
Ethnic \times analytic style		—	—	-.10
Ethnic \times heuristic style		—	—	.02
Ethnic \times fairness		—	—	-.00

* $p < .05$,

** $p < .01$,

*** $p < .005$,

**** $p < .001$.

Note. Model summary at final step: $F(18, 235) = 3.22, p < .001, R^2 = .21$ (adjusted $R^2 = .15$).

¹ Hispanic/Latino coded as "1," African American coded as "0."

² Male coded as "1," female coded as "2."