

Risk Communication and the Mining Industry

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Introduction

The mining industry encounters daily health, safety, and environmental communication challenges, internal and external. These challenges often evoke high concern among critical stakeholders, including workers, government regulators, the media, neighbors, environmental or citizen activist groups, and the general public. In meeting these challenges, traditional communication approaches often fall short. Integrating the principles of risk communication into the mining industry's traditional communication repertoire can add a reliable, science-based tool for meeting these communication challenges.

Risk communication has been defined by the United States National Academy of Sciences, one of the most distinguished scientific bodies in the world, as a "science based approach for communicating effectively in high concern, high stress, or emotionally charged situations." The National Academy of Sciences, together with agencies of the U.S. government, has long endorsed the use of risk communication principles in addressing health, safety, and environmental concerns. Similarly, major U.S. industries, including the chemical, petroleum, food, and pharmaceutical industries, have institutionalized risk communication principles into their overall communication strategies.

Risk Communication and the U.S. Stone and Mining Industry

The issue that has most recently stimulated interest in risk communication by the mining and stone industry in the United States is silica dust. It has long been known that health effects from silica dust occur after long exposure at high concentrations. Long-term exposure at high concentrations can cause silicosis. However, in recent years, another more serious and consequential concern has risen to the surface -- lung cancer. For example, the International Agency for Research on Cancer concluded in 1996 that silica dust is a known human carcinogen. In the year 2000, the U.S. National Institute for Environmental Health Sciences reached the same conclusion.

One of the difficulties posed by these developments is that silica dust comes from quartz. Quartz, in turn, is one of the most common minerals in the earth's crust. It is found in most rocks, sand, and soils. It is used in a variety of products, including toothpaste, building materials, and to filter drinking water to remove bacteria and fine particles.

In the United States, the mining and stone industry has responded in a variety of ways. For example, it has:

- increased funding of independent, university-based research to better understand silica health effects, to improve analytical methods and procedures, and to determine if new rulemaking is needed.
- launched an industry-wide education program, published an industry guidebook, conducted workshops with government to improve worker training, and developed technical articles for publication in the trade press.
- extended significantly its public outreach activities, with increased communication, openness, education, and dialogue.
- developed and distributed a Risk Communication Silica Dust Toolkit.

The Risk Communication Perspective

Risk communication is an interactive process of exchange of information and opinion among individuals, groups, and institutions. It involves multiple messages about the nature of risk and other messages, not strictly about risk, such as legal, ethical, and economic issues (5). Most risk communication research has focused on debates about the health, safety, environmental risks associated with waste disposal, toxic chemicals and heavy metals, air and water pollution, nuclear power, electric and magnetic fields, oil spills, food additives, radon in homes, and biotechnology (2, 11-17).

The scientific literature on risk communication addresses the problems raised in the exchange of information about the nature, magnitude, significance, control, and management of risks. (3, 7). It also addresses the strengths and weaknesses of the various channels through which risk information is communicated: press releases, public meetings, hot lines, web sites, small group discussions, information exchanges, public exhibits and availability sessions, public service announcements, and other print and electronic materials (10).

Evaluation studies have consistently demonstrated the effectiveness of risk communication practices in helping stakeholders achieve major communication objectives: providing the knowledge needed for informed decision-making about risks; building or re-building trust among stakeholders; and engaging stakeholders in dialogue aimed at resolving disputes and reaching consensus (3, 5, 18). The evaluation literature has also demonstrated the major barriers to successful risk communication (2, 6, 12), including conflict and lack of coordination among stakeholders and inadequate risk communication planning, preparation, resources, skill, and practice.

Government officials, industry representatives, and scientists often complain that non-experts and lay people irrationally respond to risk information and do not accurately perceive and evaluate risk information (2, 19). Representatives of citizen groups, worker groups, and individual citizens, in turn, often question the legitimacy of the risk assessment or risk management process. They have argued that government officials, industry representatives, and scientists are often uninterested in citizens' concerns or unwilling to take actions to solve seemingly straightforward problems. These conflicts are often exacerbated by complex, confusing, inconsistent, or incomplete risk messages (2); lack of trust in information sources (20); selective and biased reporting by the media; and psychological factors (heuristics) that affect how risk information is processed (21-23).

Effective risk communication is a professional discipline whose application requires knowledge, planning, preparation, skill, and practice (3). It is a two way, interactive process that respects different values and treats the public as a full partner (3, 9). As part of this process, non-experts acquire information about the risk in question and about the assessment and management of the risk. Experts and risk management authorities acquire, in turn, information about the interests and concerns of stakeholders (24).

Despite this interactive perspective, evaluation studies indicate that personnel from many agencies and organizations involved in risk controversies lack the knowledge, sensitivity, and skills needed for effective risk communication (6, 12). They adhere to the "decide, announce, defend" (DAD) model and proceed with limited understanding of the various stakeholders' values and concerns. They often fail to recognize and adapt to the fact that many people and groups use health, safety, and environmental risks as proxies or surrogates for other more general social, economic, political, or cultural concerns and agendas. They initiate risk communication efforts with inadequate resources, unclear objectives, and little or no information or evaluation on:

- Who is perceived to be most trustworthy
- Who is best suited to communicate risk messages
- What messages are most effective
- What messages are most respectful of different values and worldviews
- What messages raise moral or ethical issues
- What messages are most respectful of process
- Where, when, and how the risk information should be communicated

Risk Communication Models

Risk communication is based on four theoretical models that describe how risk information is processed, how risk perceptions are formed, and how risk decisions are made (5, 7). Together, these models provide a foundation for thinking about and coordinating effective communication in high-concern situations.

The Risk Perception Model

Many factors affect how risks are perceived, and these factors can alter risk perceptions in varying degrees of magnitude (4, 5, 25-27). To date, at least 15 risk perception factors have been identified that have direct relevance to risk communication (see Table 1) (3, 4, 8). These factors play a large role in determining levels of concern, worry, anger, anxiety, fear, hostility, and outrage, which, in turn, can significantly change attitudes and behavior (4,8). For example, levels of concern tend to be most intense when the risk is perceived to be involuntary, inequitable, not beneficial, not under one's personal control, associated with untrustworthy individuals or organizations, and associated with dreaded adverse, irreversible outcomes.

Because of the intense feelings that such perceptions can generate, the risk communication literature often refers to these characteristics as "outrage" factors (8). Research indicates that an individual's perception of risk is based on a combination of hazard (e.g., mortality and morbidity statistics) and outrage (8). When present, outrage factors take on strong moral and emotional overtones, predisposing an individual to react emotionally, which can, in turn, significantly amplify levels of perceived risk.

Risk perception research suggests that specific activities should ideally be undertaken as part of a risk communication effort (28-30). First, it is important to collect and evaluate empirical information obtained through surveys, focus groups, or interviews about stakeholder judgements of each of the risk perception factors (in particular trust, benefits, control, fairness, and dread). Sustained interaction and exchange of information with stakeholders about identified areas of concern is also necessary. To organize effective risk communication strategies, shared understanding of interested or affected parties regarding stakeholder perceptions and the expected levels of concern, worry, fear, hostility, stress, and outrage is necessary.

The Mental Noise Model

This model focuses on how people process information under stress and how changes in how information is processed affect their communication. When people are in a state of high concern because they perceive a significant threat, their ability to process information effectively and efficiently is severely impaired (3, 11, 28). When people feel that what they value is being threatened, they experience a wide range of emotions, ranging from anxiety to anger. The emotional arousal and/or mental agitation generated by these strong feelings create mental noise. Exposure to risks associated with negative psychological attributes (e.g., risks perceived to be involuntary, not under one's control, low in benefits, unfair, or dreaded) are also often accompanied by severe mental noise

(31-33), which, in turn, can interfere with a person's ability to engage in rational discourse.

The Negative Dominance Model

The negative dominance model describes the processing of negative and positive information in high-concern situations. In general, the relationship between negative and positive information is asymmetrical, with negative information receiving significantly greater weight. The negative dominance theory is consistent with a central theorem of modern psychology that people put greater value on losses (negative outcomes) than on gains (positive outcomes) (32). One practical implication of negative dominance theory is that a negative message should ideally be counterbalanced by a larger number of positive or solution-oriented messages (5).

Another practical implication of negative dominance theory is that communications that contain negatives – e.g., the words *no*, *not*, *never*, *nothing*, *none*, and other words with negative connotations – tend to receive closer attention, are remembered longer, and have greater impact than positive messages (5). As a result, the use of unnecessary negatives in dialogue with stakeholders in high-concern situations can be highly detrimental, having the unintended effect of drowning out positive or solution-oriented information or undermining trust by stating an absolute that is impossible to defend or maintain. More specifically, risk communications are most effective when they focus on what is being done, rather than on what is not being done.

The Trust Determination Model

A common thread in all risk communication strategies is the need to establish trust (20, 34, 35). Only when trust has been established can other goals, such as education and consensus-building, be achieved. Trust can only be built over time and is the result of ongoing actions, listening, and communication skill (35). Because of the importance of trust in resolving risk controversies, a significant part of the risk communication literature focuses on the application of a trust determination model to particular scenarios. To establish or maintain trust, third-party endorsements from trustworthy sources should ideally be undertaken, as well as the use of four trust determination factors: caring and empathy; dedication and commitment; competence and expertise; and honesty and openness (34). Evaluation studies indicate that individual or small group settings, such as information exchanges and public workshops, are the most effective venue for communicating these trust factors (5, 28).

The principle of trust transference states that a lower trusted source typically takes on the trust and credibility of the highest trusted source that takes the same position on the issue (5). Surveys indicate that certain organizations and individuals, including citizen advisory groups, health professionals, safety professionals, scientists, and educators, are perceived to have high to medium trust on health, safety, and environmental issues (21). An advantage of being from a trusted group is that it enables a person to communicate effectively, even when communication barriers exist. However, individual trust overrides organizational trust. Trust in individuals from a highly trusted organization may significantly increase or decrease depending on how they present themselves (verbally and non-verbally) and how they interact with others (3, 12).

Perceptions of trust are decreased by actions or communications that indicate: disagreements among experts; lack of coordination among risk management organizations; insensitivity by risk management authorities to the need for effective listening, dialogue, and public participation; an unwillingness to acknowledge risks; an unwillingness to disclose or share information in a timely manner; and irresponsibility or negligence in fulfilling risk management responsibilities (2, 12).

Message Maps

An important risk communication tool are "message maps." Messages maps are roadmaps for displaying detailed responses to anticipated issues, questions, or concerns. They are a visual aid that provides at a glance the organization's message strategy in response to a high concern, sensitive, or controversial issue. Examples of message maps used by the stone industry in the United States in regards to silica dust can be found in Appendix A.

Message mapping has three goals:

- (1) To organize information in an easily understandable and accessible manner.
- (2) To express the current organizational viewpoint on important issues, questions, concerns.
- (3) To promote open dialogue about sensitive or controversial issues both inside and outside the organization.

Message maps are crucial to ensuring that an organization or industry has a central repository of consistent messages. They are also critical to ensuring that an organization or industry speaks with one voice.

The process used to generate message maps can be as important as the end product. Message mapping exercises often provide early warnings of message incompleteness. They often also reveal a disconcerting diversity or inconsistency of messages within the same organization or industry for the same question, issue, or concern.

Conclusion

The mining industry faces extraordinary communication challenges. The risk communication perspective provides the following seven science-based principles and rules for addressing these challenges.

Rule 1. Accept and involve the public as a legitimate partner.

Two basic tenets of risk communication in a democracy are generally understood and accepted. First, people and communities have a right to participate in decisions that affect their lives, their property, and the things they value. Second, the goal of risk communication should not be to diffuse public concerns or avoid action. The goal should be to produce an informed public that is involved, interested, reasonable, thoughtful, solution-oriented, and collaborative.

Guidelines:

- Demonstrate respect for the public by involving the community early, before important decisions are made.
- Clarify that decisions about risks will be based not only on the magnitude of the risk but on factors of concern to the public.
- Involve all parties that have an interest or a stake in the particular risk in question.
- Adhere to highest moral and ethical standards: recognize that people hold you accountable.

Rule 2. Listen to the audience.

People are often more concerned about issues such as trust, credibility, control, benefits, competence, voluntariness, fairness, empathy, caring, courtesy, and compassion than about mortality statistics and the details of quantitative risk assessment. If people feel or perceive that they are not being heard, they cannot be expected to listen. Effective risk communication is a two-way activity.

Guidelines:

- Do not make assumptions about what people know, think or want done about risks.
- Take the time to find out what people are thinking: use techniques such as interviews, facilitated discussion groups, advisory groups, toll free numbers, and surveys.
- Let all parties that have an interest or a stake in the issue be heard.
- Identify with your audience and try to put yourself in their place.
- Recognize people's emotions.
- Let people know that what they said has been understood, addressing their concerns as well as yours.
- Recognize the "hidden agendas", symbolic meanings, and broader social, cultural, economic or political considerations that often underlie and complicate the task of risk communication.

Rule 3. Be honest, frank, and open.

Before a risk communication can be accepted, the messenger must be perceived as trustworthy and credible. Therefore, the first goal of risk communication is to establish

trust and credibility. Trust and credibility judgments are resistant to change once made. Short-term judgments of trust and credibility are based largely on verbal and non-verbal communications. Long term judgments of trust and credibility are based largely on actions and performance.

In communicating risk information, trust and credibility are a spokesperson's most precious assets. Trust and credibility are difficult to obtain. Once lost they are almost impossible to regain.

Guidelines:

- State credentials; but do not ask or expect to be trusted by the public.
- If an answer is unknown or uncertain, express willingness to get back to the questioner with answers.
- Make corrections if errors are made.
- Disclose risk information as soon as possible (emphasizing appropriate reservations about reliability).
- Do not minimize or exaggerate the level of risk.
- Speculate only with great caution.
- If in doubt, lean toward sharing more information, not less--or people may think something significant is being hidden.
- Discuss data uncertainties, strengths and weaknesses--including the ones identified by other credible sources. Identify worst-case estimates as such, and cite ranges of risk estimates when appropriate.

Rule 4. Coordinate and collaborate with other credible sources

Allies can be effective in helping communicate risk information. Few things make risk communication more difficult than conflicts or public disagreements with other credible sources.

Guidelines:

- Take time to coordinate all inter-organizational and intra-organizational communications.
- Devote effort and resources to the slow, hard work of building bridges, partnerships, and alliances with other organizations.
- Use credible and authoritative intermediaries.
- Consult with others to determine who is best able to answer questions about risk.
- Try to issue communications jointly with other trustworthy sources such as credible university scientists, physicians, citizen advisory groups, trusted local officials, and national or local opinion leaders.

Rule 5. Meet the needs of the media.

The media are a prime transmitter of information on risks. They play a critical role in setting agendas and in determining outcomes. The media are generally more interested in politics than in risk; more interested in simplicity than in complexity; and more interested in wrongdoing, blame and danger than in safety.

Guidelines:

- Be open with and accessible to reporters.
- Respect their deadlines.
- Provide information tailored to the needs of each type of media, such as sound bites, graphics and other visual aids for television.
- Agree with the reporter in advance about the specific topic of the interview; stick to the topic in the interview.
- Prepare a limited number of positive key messages in advance and repeat the messages several times during the interview.
- Provide background material on complex risk issues.
- Do not speculate.
- Say only those things that you are willing to have repeated: everything you say in an interview is on the record.
- Keep interviews short.
- Follow up on stories with praise or criticism, as warranted.
- Try to establish long-term relationships of trust with specific editors and reporters.

Rule 6. Speak clearly and with compassion.

Technical language and jargon are useful as professional shorthand. But they are barriers to successful communication with the public. In low trust, high concern situations, empathy and caring often carry more weight than numbers and technical facts.

Guidelines:

- Use clear, non-technical language.
- Be sensitive to local norms, such as speech and dress.
- Strive for brevity, but respect people's information needs and offer to provide more information.
- Use graphics and other visual or sensory material to clarify messages.
- Personalize risk data: use stories, examples, and anecdotes that make technical data come alive.
- Avoid distant, abstract, unfeeling language about deaths, injuries and illnesses.
- Acknowledge and respond (both in words and with actions) to emotions that people express, such as anxiety, fear, anger, outrage, and helplessness.
- Acknowledge and respond to the distinctions that the public views as important in evaluating risks.
- Use risk comparisons to help put risks in perspective; but avoid comparisons that ignore distinctions that people consider important.

- Always try to include a discussion of actions that are under way or can be taken.
- Promise only that which can be delivered, and follow through.
- Acknowledge, and say, that any illness, injury or death is a tragedy and to be avoided.

Rule 7. Plan carefully and evaluate performance.

Different goals, audiences, and media require different risk communication strategies. Risk communication will be successful only if carefully planned and evaluated.

Guidelines:

- Begin with clear, explicit objectives--such as providing information to the public, providing reassurance, encouraging protective action and behavior change, stimulating emergency response, or involving stakeholders in dialogue and joint problem solving.
- Evaluate technical information about risks and know its strengths and weaknesses.
- Identify important stakeholders and subgroups within the audience.
- Aim communications at specific stakeholders and subgroups in the audience.
- Recruit spokespersons with effective presentation and human interaction skills.
- Train staff -- including technical staff -- in communication skills: recognize and reward outstanding performance.
- Pretest messages.
- Carefully evaluate efforts and learn from mistakes.

Table 1: Risk Perception Factors

- 1) **Voluntariness.** Risks perceived to be involuntary or imposed are less readily accepted and perceived to be greater than risks perceived to be voluntary.
- 2) **Controllability.** Risks perceived to be under the control of others are less readily accepted and perceived to be greater than risks perceived to be under the control of the individual.
- 3) **Familiarity.** Risks perceived to be unfamiliar are less readily accepted and perceived to be greater than risks perceived to be familiar.
- 4) **Equity.** Risks perceived as unevenly and inequitably distributed are less readily accepted than risks perceived as equitably shared.
- 5) **Benefits.** Risks perceived to have unclear or questionable benefits are less readily accepted and perceived to be greater than risks perceived to have clear benefits.
- 6) **Understanding.** Risks perceived to be poorly understood are less readily accepted and perceived to be greater than risks from activities perceived to be well understood or self-explanatory.
- 7) **Uncertainty.** Risks perceived as relatively unknown or that have highly uncertain dimensions are less readily accepted than risks that are relatively known to science.
- 8) **Dread.** Risks that evoke fear, terror, or anxiety are less readily accepted and perceived to be greater than risks that do not arouse such feelings or emotions.
- 9) **Trust in institutions.** Risks associated with institutions or organizations lacking in trust and credibility are less readily accepted and perceived to be greater than risks associated with trustworthy and credible institutions and organizations.
- 10) **Reversibility.** Risks perceived to have potentially irreversible adverse effects are less readily accepted and perceived to be greater than risks perceived to have reversible adverse effects.
- 11) **Personal stake.** Risks perceived by people to place them personally and directly at risk are less readily accepted and perceived to be greater than risks that pose no direct or personal threat.
- 12) **Ethical/Moral nature.** Risks perceived to be ethically objectionable or morally wrong are less readily accepted and perceived to be greater than risks perceived not be ethically objectionable or morally wrong.
- 13) **Human vs. natural origin.** Risks perceived to be generated by human action are less readily accepted and perceived to be greater than risks perceived to be caused by nature or "Acts of God."
- 14) **Victim identity.** Risks that produce identifiable victims are less readily accepted and perceived to be greater than risks that produce statistical victims.
- 15) **Catastrophic Potential.** Risks that produce fatalities, injuries, and illness grouped spatially and temporally are less readily accepted and perceived to be greater than risks that have random, scattered effects.

References

1. U.S. General Accounting Office. *West Nile Virus Outbreak: Lessons for Public Health Preparedness*. Washington, DC: U.S. Government Printing Office; 2000.
2. Covello VT, McCallum DB, Pavlova MT. Principles and guidelines for improving risk communication. In: Covello VT, McCallum DB, Pavlova MT, eds. *Effective Risk Communication: The Role and Responsibility of Government and Nongovernment Organizations*. New York, NY: Plenum Press; 1989:3-16.
3. National Research Council. *Improving Risk Communication*. Washington, D.C.: National Academy Press; 1989.
4. Slovic P. Perception of risk. *Science*. 1987;236:280-285.
5. Covello VT. Risk perception, risk communication, and EMF exposure: Tools and techniques for communicating risk information. In: Matthes R, Bernhardt JH, Repacholi MH, eds. *Risk Perception, Risk Communication, and Its Application to EMF Exposure: Proceedings of the World Health Organization/ICNRP International Conference (ICNIRP 5/98)*. Vienna, Austria: International Commission on Non-Ionizing Radiation Protection; 1998:179-214.
6. Fischhoff B. Risk perception and communication unplugged: Twenty years of progress. *Risk Analysis* 1995;15(2):137-145.
7. Covello VT, Sandman PM. Risk communication: Evolution and revolution. In: Wolbarst A, ed. *Solutions to an Environment in Peril*. Baltimore, MD: John Hopkins University Press; 2001 (in press):164-178.
8. Sandman PM. 1989. Hazard versus outrage in the public perception of risk. In: Covello VT, McCallum DB, Pavlova MT, eds. *Effective Risk Communication: The Role and Responsibility of Government and Nongovernment Organizations*. New York, NY: Plenum Press; 1989:45-49.
9. National Research Council. *Understanding Risk: Informing Decisions in a Democratic Society*. Washington, D.C.: National Academy Press; 1996.
10. Arkin EB. Translation of risk information for the public: Message development. In: Covello VT, McCallum DB, Pavlova MT, eds. *Effective Risk Communication: The Role and Responsibility of Government and Nongovernment Organizations*. New York, NY: Plenum Press; 1989:127-135.
11. Baron J, Hershey JC, Kunreuther H. Determinants of priority for risk reduction: The role of worry. *Risk Analysis*. 2000;20(4):413-428.
12. Chess C, Salomone KL, Hance BJ, Saville A. Results of a national symposium on risk communication: Next steps for government agencies. *Risk Analysis*. 1995;15(2):115-125.
13. Burger J, Pflugh KK, Lurig L, Von Hagen LA, Von Hagen S. Fishing in urban New Jersey: Ethnicity affects information sources, perception, and compliance. *Risk Analysis*. 1999;19(2):217-229.
14. Elliot SJ, Cole DC, Krueger P, Voorberg N, Wakefield S. The power of perception: Health risk attributed to air pollution in an urban industrial neighborhood. *Risk Analysis*. 1999;19(4):621-633.

15. Grobe D, Douthitt R, Zepeda L. A model of consumers' risk perceptions toward recombinant bovine growth hormone (rbGH): The impact of risk characteristics. *Risk Analysis*. 1999;19(4):661-673.
16. McBeth MK, Oakes AS. Citizen perception of risks associated with moving radiological waste. *Risk Analysis*. 1996;16(3):421-427.
17. McDaniels TL, Gregory RS, Fields D. Democratizing risk management: Successful public involvement in local water management decisions. *Risk Analysis*. 1999;19(3):497-509.
18. Morgan G, Fischhoff B, Bostrom A, Lave L, Atman CJ. Communicating risk to the public. *Environmental Science and Technology*. 1992; 26(11): 2048-2056.
19. Jasanoff S. Bridging the two cultures of risk analysis. *Risk Analysis*. 1993;13(2):123-129.
20. Renn O, Levine D. Credibility and trust in risk communication. In: Kasperson and Stallen, eds. *Communicating Risks to the Public*. Dordrecht, the Netherlands: Kluwer Academic Publishers; 1991.
21. U.S. Environmental Protection Agency. *Public Knowledge and Perceptions of Chemical Risks in Six Communities: Analysis of a Baseline Survey*. Washington, D.C.: USGPO; 1990.
22. Sjoberg L. Factors in risk perception. *Risk Analysis*. 2000;20(1): 1-11.
23. Weinstein ND. Why it won't happen to me: Perceptions of risk factors and susceptibility. *Health Psychology*. 1984;3:431- 457.
24. Nelkin D. Communicating technological risk: The social construction of risk perception. *Annual Review of Public Health*. 1989;10: 95-113.
25. Rogers GO. The dynamics of risk perception: How does perceived risk respond to risk events? *Risk Analysis*. 1997;17(6):745-757.
26. Wildavsky A, Dake K. Theories of risk perception: Who fears what and why. *Daedalus*. 1990;112:41-60.
27. Renn O, Bums WJ, Kasperson JX, Kasperson RE, Slovic P. The social amplification of risk: Theoretical foundations and empirical applications. *Journal of Social Science Issues*. 1992;48,137-6.
28. Fischhoff B. Helping the public make health risk decisions. In: Covello VT, McCallum DB, Pavlova MT, eds. *Effective Risk Communication: The Role and Responsibility of Government and Nongovernment Organizations*. New York, NY: Plenum Press; 1989:111-116.
29. Johnson BB. 'The mental model' meets 'the planning process': wrestling with risk communication research and practice. *Risk Analysis*. 1993;13(1):5-8.
30. Wilson R, Crouch E. Risk assessment and comparisons: An introduction. *Science*. 1987; Vol. 236 (17 April 1987):267-270.
31. Neuwirth K, Dunwoody S, Griffin RJ. Protection motivation and risk communication. *Risk Analysis*. 2000;20(5):721-733.
32. Maslow AH. *Motivation and Personality*. New York, NY: Harper and Row; 1970.
33. Gould L, Walker C, eds. *Too Hot to Handle*. New Haven, CT: Yale University Press; 1982.

34. Slovic P. Trust, emotion, sex, politics, and science: Surveying the risk-assessment battlefield. *Risk Analysis*. 1999;19(4):689-701.
35. Peters RG, Covello VT, McCallum DB. The determinants of trust and credibility in environmental risk communication: An empirical study. *Risk Analysis*. 1997;17(1):43-54.
36. New York City Department of Health. *Comprehensive Arthropod-borne Disease Surveillance and Control Plan 2000*. New York, NY; 2000.
37. National Research Council. *Chemical and Biological Terrorism: Research and Development to Improve Civilian Medical Response*. Washington, D.C.: National Academy Press; 1999.
38. Lederberg J. *Biological Weapons: Limiting the Threat*. Cambridge, MA: MIT Press; 1999.
39. Santos S, Covello VT, McCallum DB. Industry response to SARA Title III: Pollution prevention, risk reduction, and risk communication. *Risk Analysis*. 1996;16(1):57-65.
40. Lynn FM, Busenberg GJ. Citizen advisory committees and environmental policy: What we know, what's left to discover. *Risk Analysis*. 1995;15(2):147-161.