Environmental Risk Communication for the Clinician

Mark Miller, MD, MPH*, and Gina Solomon, MD, MPH*‡

ABSTRACT. Although they are accustomed to discussing risks in the medical arena through the process of informed consent, primary care clinicians may have difficulty communicating with their patients and communities about environmental health risks. Clinicians are generally trusted and can play important roles as educators, alert practitioners, or even advocates talking about environmental health risks with individuals and groups. Communication of risk requires an understanding of how scientists and clinicians assess risk—the process of quantitative or qualitative risk assessment. Risk is never a purely scientific issue; risk is perceived differently depending on some well-understood characteristics of the hazard, the individual perceiving the risk, and the social context. Many low-income communities of color have faced and continue to face disproportionate environmental exposures and disease burdens. The issue of environmental justice can significantly affect the context of a discussion about a specific environmental risk. The essence of risk communication has been well described and requires careful evaluation of the science and the social context, honesty, listening to and partnering with the community, and a clear, compassionate team approach. ***Pediatrics*** **2003;112:211–217;** ***environmental justice, environmental pollutants, environmental health, risk assessment, child, risk communication, risk perception.***

ABBREVIATION. NAS, National Academy of Sciences.

Pediatricians and other primary care clinicians often discuss risk with patients when questions arise about surgery, diagnostic tests, immunizations, or treatment. Indeed, the foundation of informed consent is the communication of potential risks and benefits before allowing the patient to make a voluntary decision.[1] Parental questions about pesticides, chemical exposures, electromagnetic fields, lead, and other environmental hazards abound. A 1995 survey found that exposure to environmental poison leads the list of things about which parents worry but about which pediatricians rarely give advice.[2] Several factors may help explain the disparity between parental concerns and clinicians' practice.

Communication about environmental risk differs from medical informed consent in that the hazard is likely to be unfamiliar to the clinician and the patient, it usually involves involuntary exposure, there may be no defined benefit to those exposed, and often there is much less known about the likelihood of adverse outcomes. The clinician may not know where to find information to answer questions about environmental toxicology. Even when there is scientific information about the health effects of environmental chemical exposure, it is unlikely to include specific information about exposure during particularly vulnerable periods of development of the fetus, young child, or adolescent.[3] Despite these limitations, clinicians have an important role to play in communication of risks associated with environmental health issues.

Risk communication can be defined as the exchange of information about the nature, magnitude, significance, and control of a risk. Clinicians have emerged as 1 of the most trusted and credible sources of information about occupational and environmental health risks.[4] Risk communication has blossomed as a discipline as governmental and industry experts realize that their scientific knowledge of risk is not enough to overcome considerable public mistrust.[5] Training in risk communication has become common for governmental agents who address the public about environmental issues and for spokespersons for industry. Many workshops and journals have been devoted to risk analysis and communication. Even though clinicians are on the front lines interacting with patients and the public, there has been relatively little guidance or information specifically designed for clinicians who engage in risk communication about environmental health issues.

ROLES FOR THE CLINICIANS IN RISK COMMUNICATION

A clinician might fulfill 1 or several roles when communicating environmental risk, including as educator, alert practitioner, or advocate. As a trusted advisor to an individual, a family, or a community group, the clinician may act as an educator, interpreting information, advising on where to get additional reliable information, or doing additional research. As a practitioner, an alert clinician may identify a significant unrecognized hazard or epidemic that needs investigation. This role may include alerting appropriate public health officials, working with concerned citizens, and writing case reports that will alert other clinicians to this problem.

Citizens and environmental advocacy organizations have often brought issues to the forefront and

From the *Pediatric Environmental Health Specialty Unit, University of California, San Francisco, California; and ‡Natural Resources Defense Council, San Francisco, California.

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Reprint requests to (M.M.) University of California at San Francisco, Division of Occupational and Environmental Health, Department of Medicine, Box 0843, San Francisco, CA 94143-0843. E-mail: mmiller@oehha.ca.gov

prompted governmental response to problems that affect their children and communities. These groups have been essential to the development of many of the existing laws that protect public health in the United States today, including the Clean Air Act,[6] the Food Quality Protection Act,[7] the Clean Water Act,[8] and local and state laws. These organizations often are in need of clinician advocates to assist in understanding the health implications of various situations and exposures. The clinician can act as a respected intermediary among government, citizens' groups, scientists, and the public health community.

SCIENTIFIC AND MEDICAL VIEWS OF ENVIRONMENTAL RISKS

Different groups of people usually view risks differently. Scientists and clinicians place tremendous value on an objective assessment of the magnitude of risk when it is performed in as systematic and dispassionate a manner as possible. Risk assessment is an evaluation of risk that includes an assessment of information that is known and of uncertainties. Risk assessment procedures outlined by the National Research Council[9] may be helpful for clinicians in organizing their thoughts and trying to decipher the ramifications of a possible chemical exposure. The steps of risk assessment include hazard identification, exposure assessment, dose-response assessment, risk characterization, and risk communication.

Although governmental agencies and industry scientists often engage in quantitative risk assessment in which specific numbers are calculated for each parameter to generate a number that can be used for regulatory purposes, clinicians are more likely to engage in qualitative risk assessment. A clinician's exposure assessment, for example, is less likely to involve actual measurements or mathematical modeling of exposure and is more likely to involve questions about the frequency and duration of the exposure coupled with a rough assessment of the magnitude of the exposure derived from the medical history. Some of the differences between quantitative risk assessment as commonly practiced in government and industry versus qualitative risk assessment as commonly practiced by clinicians are outlined in Table 1.

Officials may sometimes use regulatory limits (eg, reference dose, maximal concentration limit) to determine whether a chemical exposure should be dismissed as irrelevant. Although these limits are based on quantitative risk assessments and, if exceeded, should raise concern, being at or below the limit may not completely eliminate concern. The risk assessment process has many limitations. Quantitative risk assessment can be limited by failing to account for cumulative response to multiple chemical exposures, not identifying and considering highly exposed groups (particularly children), using inaccurate assumptions about species differences in extrapolating from animal studies, and not having available studies to address exposure during developmental periods or important recognized health outcomes in children (eg, neurologic, developmental, behavioral). In addition, risk assessors often do not agree on which studies to include in their calculations, and different studies often find different levels of concern.

RISK PERCEPTION

Understanding different perceptions of risk is important in communicating about risk. If the clinician who is attempting to explain a risk does not realize that the audience or individual may perceive risks

TABLE 1. Risk Assessment as Performed by Risk Assessors and Clinicians

Risk Assessment Step	Questions Asked by Risk Assessor	Questions Asked by Clinician
Hazard assessment	What are the chemicals of concern, and what kind of harm are they known or suspected to cause? Which chemicals will we focus on?	What information do we have about an environmental problem, what chemicals were involved, and what sources of information are there?
Exposure assessment	What are the sources and duration of exposures? How many people are exposed? What do our monitoring or modeling data predict about the range of doses in the population?	Is there a chance that your child may be coming in contact with (breathing, touching, ingesting, etc) this source? How often and for how long? Is the source highly contaminated or only slightly contaminated?
Dose-response assessment	What effects are seen in animals or humans at different exposure levels? What are the doses at which cancerous and noncancerous effects occur? Is there a threshold below which no effect is expected?	(Review literature, consult with experts.) How do the levels at which effects have been demonstrated compare with levels in the community? Are these levels higher than regulatory limits?
Risk characterization	Given the above, what are the human impacts of current exposures? What is the population risk? Are there sensitive subpopulations? How confident are we in this analysis?	Are regulations based on effects in the fetus or child? Is there reason to be concerned that children may be at greater risk from exposure to this chemical than adults may?
Risk communication	Is the information relevant to the audience and understandable? Does it respond to public concerns? What are the limitations in this assessment?	Have I listened to the concerns presented, responded with compassion, and helped identify information needed and credible sources for obtaining it? What additional steps are needed?

very differently, then risk communication is less likely to be productive and effective. Failure to recognize these differences in perception and deal with them appropriately can cause risk communication to fail. Factors that influence risk perception include differences in the nature of the hazard itself, differences among individuals or groups in how they react to the hazard, and factors related to the social context in which the risk communication occurs.

Risk is not an entirely objective issue but rather has scientific and social components that are subject to interpretation. The scientific basis of a risk assessment, for example, may be affected by uncertainties and inconsistencies in the scientific literature. Historical and social context, as well as ethical issues, may also lead to magnification of some risks relative to others. Therefore, a scientist's perception of risk is not necessarily "correct," and a lay person's perception is not necessarily "incorrect."[10] It is important to approach questions of risk humbly with an understanding of the limitations of the science and the importance of the social context. It is also important to understand factors that contribute to different perceptions of risk to anticipate ways in which patients or communities may react to a hazard. Although each person probably perceives risk differently, extensive research has identified some common characteristics that influence risk perception.

At least 3 major factors influence perception of risk: the nature of the hazard itself, the demographic background of the person perceiving the risk, and the social context in which the risk occurs.[11] Many non–science-related factors reported in the literature as contributing to increased or decreased perception of risk are summarized in Table 2.

Nature of the Hazard

Some characteristics of a hazard serve to magnify apparent risk irrespective of the outcome of a risk assessment. The risks from hazards that are seen as potentially catastrophic, although unlikely, are generally perceived as greater than risks from hazards that are more likely but would result in less serious or reversible outcomes.[12] For example, the risk from a nuclear power plant may be seen as greater than the risk from a coal power plant, although the likelihood of emissions that are hazardous to health is higher from a coal plant. Similarly, the risk of a dreaded outcome (eg, cancer, birth defects, brain damage) is often seen as worse than the risk of a disease that is less universally dreaded (eg, liver, lung, or kidney disease).[13] Unfamiliar hazards are generally seen as riskier than familiar hazards, and synthetic hazards may be perceived as riskier than those that occur naturally. The population affected by the hazard is also important. For example, a hazard to children is often judged worse than a similar hazard to adults.[11] Finally, hazards that are involuntary are almost always judged more serious than hazards that are faced by choice.[14] Thus, comparison of the risks associated with skiing or drinking alcohol with risks from a hazardous waste incinerator will not be seen as equivalent, because the former are voluntary and under the control of the individual, whereas the latter are imposed from outside and not controlled by the individual.

Rules of thumb known as "heuristics" affect estimates of risk in predictable ways. "Anchoring" refers to the tendency to estimate the frequency of an event on the basis of the numbers presented for other events. For example, if a person is first told that an average of 3 people a year die from botulism, then that person's estimate of annual influenza deaths is likely to be lower than if he or she was first told that there are 300 000 annual deaths from cancer. The tendency is to anchor one's estimate on the first number. Estimates of risk used for comparison and the order in which they are presented can affect how risks are perceived. "Compression" refers to the tendency to overestimate the frequency of risks that are rare and underestimate those that are common. "Availability" refers to the tendency to base the expected likelihood of an event on the ability to recall instances of a similar event. As a result, events that draw media attention tend to be perceived as more likely. The terms "unlikely" or "likely" and "rare" or "common" are verbal probabilities for which inter-

TABLE 2. Some Factors Related to Increased or Decreased Perception of Risk

Decreases Perceived Risk	Increases Perceived Risk
Hazard factors	
Familiar	Unfamiliar
Not catastrophic	Catastrophic potential
Natural	Synthetic
Adults affected	Fetuses or children affected
Nondreaded effect	Dreaded effect (cancer, birth defects)
Voluntary	Involuntary
Personal factors	
Male gender	Female gender
White race	Nonwhite race
Scientist	Nonscientist
Employed by industry or government	Employed by academic institutions
Social and ethical factors	
Trust in the risk communicator	Mistrust
Trust in the risk imposer (polluter)	Mistrust
Equal distribution of risks and benefits	Unfair or unequal distribution of risks and benefits
No perception of preexisting problem	Perception of unfair burden of cumulative risk in the community

pretation may vary depending on the context in which they are used.[1]

Demographics and Risk Perception

Different groups within the population often have different perceptions of risk. In particular, experts and scientists often view risks as less significant than do nontechnically trained individuals.[15] Furthermore, members of the public are much more concerned about very low levels of chemical exposure and low risks than are toxicologists. For example, nearly 100% of toxicologists but only 70% of public respondents in 1 study agreed that a 1 in 10 000 000 lifetime risk of cancer from exposure to a chemical is too small to worry about.[10] Among scientists and professionals, where a person works is relevant to risk perception. For example, toxicologists who work for industry rate risks from chemicals significantly lower than toxicologists who work for universities.[15] Managers of British chemical companies had far lower perceptions of risk from chemical exposure than did members of the British Toxicological Society, who in turn had lower perceptions of risk than did members of the public.[16] One's level of personal benefit from a hazard may affect his or her interpretation of associated risks.

Men often rate risks lower than do women.[17] This difference is not explained by differences in familiarity with scientific issues, because female toxicologists have been shown to perceive chemical risks as higher than have male toxicologists.[15] It is interesting that the gender difference in risk rating is seen only in white individuals. Black men, black women, and white women all rate risks similarly, whereas white men tend to rate virtually all risks as less serious.[18]

Social Context of Risk

The social context of risk communication efforts is extremely important to perceptions of risk. If the individual or organization imposing the risk is trusted by the community (eg, a local company that has provided jobs in the community for many years and is well known to the community), then the risk is often perceived as less than if the risk is imposed by an outsider. Similarly, the level of trust in governmental regulatory officials and in the risk communicator is important in the perception of risk.[19] Risks seen as unfair are often seen as larger than risks seen as fairly distributed. For example, if an individual or a community perceives significant benefits from submitting to a risk, then that risk seems smaller than if the benefits will accrue only to other communities or to a distant corporation.[20] Human rights issues, such as the rights to personal integrity, privacy, and informed consent, all play into risk perception. Finally, low-income communities, particularly those of color, have become increasingly concerned about a disproportionate and unfair burden of environmental risk in their communities. Even a relatively small risk may be seen in the context of a history of racial and socioeconomic discrimination in the distribution of environmental risks and may be perceived as adding to an already unacceptable background of risk. The area of environmental justice is important, because justice issues often figure into risk communication about hazards in low-income communities and communities of color.

Environmental Justice and Risk Communication

Although the context of any discussion about environmental health risks is important, context and history are particularly important when risk communication involves low-income communities of color. It is not possible to engage in good risk communication in such settings without some understanding of the history of the environmental justice movement. The environmental justice movement refers to a collaboration since the mid-1980s of civil rights activists and environmentalists working to ensure the rights of communities of color to clean and healthy environments.

The environmental justice movement is based on extensive empirical evidence of disproportionate environmental impacts on communities of color.[21] An early report by the United Church of Christ's Commission on Racial Justice found that three fifths of black or Hispanic people live in communities with uncontrolled toxic waste sites and that the most significant predictor for the location of hazardous waste facilities nationwide was racial composition of the local community.[22] Regulation of facilities in communities of color was also identified as deficient, with fines imposed for pollution in nonwhite communities averaging 54% lower and timelines for listing sites on the National Priorities List for cleanup 20% longer[23] (The National Priorities List is the Environmental Protection Agency's listing of sites that have undergone preliminary assessment and site inspection to determine which locations pose immediate threat to people who live or work near the release; these sites are most in need of cleanup). Air quality also tracks closely with community racial composition; 71% of Hispanic individuals and 62% of black individuals live in counties with high ozone concentrations, as contrasted with 52% of white individuals. The racial disparities are similar for other air pollutants.[24] Lead poisoning is also primarily a problem among children of color. Data from the Third National Health and Nutrition Examination Survey[25] indicate that a disproportionate number of the ~890 000 children who are 1 to 5 years of age and have elevated blood lead levels are poor or of non-Hispanic black origin or live in older housing. The prevalence of elevated blood lead levels among white children who live in housing built before 1946 was 5.6%, compared with 13% among Mexican American children and 21.9% among black children who live in similar housing. Risk of an elevated blood lead level was 16 times higher among low-income children who live in older housing than among high-income children who live in older housing.[26] Reviews of research in this area also have shown that children of color experience disproportionate burdens of disease with potential environmental aspects, including asthma, and childhood cancer.[27] A recent example of environmental injustice involves confined swine feeding operations in North Carolina.[28] Airborne emissions from these fa-

cilities include hydrogen sulfide, ammonia, dusts, endotoxins, and volatile organic compounds. Furthermore, almost half of all hog-feeding operations are located in rural areas, where >85% of households use well water—a water source likely to be contaminated by nearby waste lagoons. Health effects associated with confined hog-feeding operations include headaches, mucus membrane irritation, upper and lower respiratory symptoms, and gastrointestinal symptoms.[29] A study found that these polluting animal-feeding operations are >7 times more likely to be in the poorest areas and nearly 5 times more likely to be located in areas with the largest percentage of nonwhite residents. Communities that are both poor and nonwhite are nearly 10 times more likely to contain 1 of these facilities. A disproportionate burden of polluting industries, such as confined animal-feeding operations, can affect health in the local community in many ways. These effects range from diseases related to polluted air and contaminated well water, to occupational diseases from working in such facilities, to increased poverty attributable to declining local land values.

The First National People of Color Environmental Leadership Summit held in 1991 resulted in the formulation of 17 principles of environmental justice. Three of these principles are particularly relevant to risk communication: 1) public policy must be based on mutual respect and justice for all peoples, 2) members of the public must be given the right to participate as equal partners at every level of decision making, and 3) principles of informed consent must be strictly enforced.[30] An executive order on environmental justice signed by President Bill Clinton in 1994 mandated that every federal agency "make achieving environmental justice part of its mission."[31] To help guide implementation of the executive order on environmental justice, the National Academy of Sciences (NAS) produced a report in 1999 offering guidance to governmental agencies, scientists, and the medical community.[32] The NAS report identified a lack of knowledge among health care professionals, researchers, and communities about environmental hazards and recommended "enhanced efforts in the training of health professionals and education of the public." On the issue of risk communication, the panel found that "not only does the public receive little information about environmental health issues, but the information that is presented is often delivered in language that is too technical or full of jargon and is illustrated with examples that are obscure or culturally insensitive. Moreover, the communities most at risk of a lack of environmental justice are frequently the least likely to receive information, and the information they do receive tends to stop short of providing any guidance as to what the community can do . . . for its own protection."[32]

Because of the clear historical pattern of environmental injustice and evidence that these problems are ongoing today, any discussion of risk in a particular community must consider the nationwide and historical context. If a community feels unfairly burdened with pollution and believes that this burden is part of a national pattern, then clinicians must acknowledge this broader context to have any credibility with the community. The NAS panel recommended that education and risk communication efforts be directed toward 4 main goals: 1) increasing individual and community awareness of environmental health issues and resources; 2) involving the community in the identification of problems related to environmental exposures; 3) soliciting community involvement in research approaches; 4) and improving links among community members, health care professionals, and researchers.[32]

HOW TO COMMUNICATE ABOUT RISK

Communication about risk yields optimal results only when there is a back-and-forth dialogue. The affected people need to believe that their concerns have been heard and addressed. In the most progressive view, those involved not only develop a good understanding of the risks and potential benefits but also search together for solutions that can mitigate their concerns.[33] The extensive literature on risk communication contains recurring themes that make risk communication more effective. These themes have been expressed as the "Seven Cardinal Rules of Risk Communication."

The *Seven Cardinal Rules of Risk Communication*[34] were written for representatives of government (and others, eg, industry) to help them provide a framework for effective interaction with concerned communities about issues of technologic risk. It is helpful for clinicians to be aware of these rules because they have corollaries to the process of communication in their professional arena and because they set standards for communication that should be expected from representatives of government whenever a forum concerning an environmental hazard is held. Following are the Seven Cardinal Rules of Risk Communication (adapted from Lum and Tinker[35]), along with corollaries for clinicians to consider in their practice:

1. Accept and involve the public as a partner. The goal is to produce an informed public. The goal should not be specifically to defuse public concerns and convince them to accept the public policy without fuss. The clinician should be open to being a partner in helping patients to identify the true risks of environmental hazards and finding ways to decrease the potential risks to children whenever possible.
2. Plan carefully and evaluate your efforts. There is no one entity that is the public. Each group has its own interests, priorities, and needs that should be addressed. The clinician may find it helpful when addressing groups to pretest messages on office staff, family, or others. Define explicit objectives, such as providing information, contributing to the resolution of conflict, or motivating people or agencies to act.
3. Listen to the public's specific concerns. People are often more concerned about trust, credibility, competence, compassion, and fairness than about mortality statistics. Do not make assumptions

about what people know or want done about risks that they face. Clinicians should use their talents for listening to patients' medical problems and take the time to hear about their concerns, emotions, and experiences in tackling their children's environmental health problems.

4. Be honest, frank, and open. Trust and credibility are your most valuable assets. If you do not know an answer, then say so and volunteer to try to find out. Admit mistakes and do not minimize or exaggerate risks. The clinician may not be an expert on a specific environmental hazard but is recognized as an expert on children's health. Speak from that strength and be willing to learn and interpret the details of the environmental health issue at hand. Information should be presented with familiar and understandable language rather than technical jargon.
5. Work with credible sources. Conflicts and disagreements among organizations complicate the communication effort. The clinician is accustomed to working as a team with others who he or she believes are reliable consultants. Tackling an environmental health problem simply requires a different team (county or state environmental health department, industrial hygienists, cancer or birth defects registries, etc).
6. Meet the needs of the media. The media play an important role in setting the agenda and transmitting information on risk. They are usually more interested in politics than risk, simplicity than complexity, and danger than safety. If you choose to work with the media, then establish trust with specific editors and reporters and respect their deadlines. Try to be concise, and consolidate your message to no more than 3 points.
7. Speak clearly and with compassion. Always acknowledge the tragedy of an illness, injury, or death. Participants from all sides may have unrealistic expectations about what the outcome of a risk communication dialogue will be and may not be satisfied. Be clear about what you are able to do and help to clarify the actions that others intend. Comparing risks (eg, cigarette smoking and a nuclear power plant) may help in understanding the magnitude of a problem, but understanding the magnitude of a problem does not necessarily lead to a consensus as to what is an acceptable level of risk. Scientific information alone does not hold a solution to a risk problem. Consider the social, cultural, and community values and beliefs of the people involved.

CONCLUSIONS

Clinicians have an important role to play in risk communication and environmental health. Medical professionals are a trusted voice and may be able to act as intermediaries or advisors for individuals or communities that face a potential hazard. Unfortunately, many clinicians have limited training in the field of environmental medicine and may feel hesitant to take on the role of risk communicator. In this context, it is important to know where to find the scientific information to help answer important questions of relevance to the individual or the community. Some sources of expertise and information in environmental health risk assessment and risk communication are included in a resource list at the end of this article.

Federal and state agencies that have responsibilities in the prevention and cleanup of hazardous environmental pollutants have identified the need to work closely with the medical community to recognize and treat the health consequences of exposures. The Agency for Toxic Substances and Disease Registry, the Environmental Protection Agency, and others have begun to develop partnerships with medical organizations, such as the American Academy of Pediatrics, to promote an awareness of environmental hazards and to educate clinicians in the diagnosis and treatment of health consequences. As clinicians increasingly become involved in these matters, the ability to communicate effectively about the risks posed to individuals and the community will be important. The fundamentals of risk communication should be incorporated into undergraduate and postgraduate medical education programs that address environmental medicine.

RESOURCES FOR ENVIRONMENTAL HEALTH RISK ASSESSMENT AND RISK COMMUNICATION

Governmental

Environmental Protection Agency, Office of Children's Health Protection
202–564-2188
www.epa.gov/children/index.htm

Agency for Toxic Substances and Disease Registry (ATSDR)
1–888/422-8737
www.atsdr.cdc.gov

State health departments
(Varies by state)

Nongovernmental

Physicians for Social Responsibility, Environment and Health Program
202–898-0150
www.psr.org/enviro.htm

Pediatric Environmental Health Subspecialty Units, Association of Occupational and Environmental Clinics
202–347-4976
www.aoec.org/pesu.htm

The Children's Environmental Health Network
202–543-4033
www.cehn.org

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