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PERSPECTIVE

# Trust and consequences: Role of community science, perceptions, values, and environmental justice in risk communication

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## Abstract

Risk communication is often viewed as imparting information and perhaps as a two-way dialogue. Risk communication inadequacies on the part of both "communicator" and "community members" can lead to adverse consequences and amplify environmental justice disparities. The paper suggests a transformational approach where risk communicators must learn to trust community experts and their knowledge base (and act upon it), where risk information imparted by risk communicators addresses what communities are most concerned about (as well as risk from specific chemicals or radionuclides), and where risk information and assessments address underlying issues and disparities, as well as cultural traditions (among others). Providing risk probabilities is no longer sufficient; western science may not be enough, and community and native scientific knowledge is needed. Risk communication (or information transfer) for environmental risks that are ongoing usually applies to low-income, minority communities—people living in dense inner cities, rural communities, Native American communities—or to people living near a risky facility. Communication within this context requires mutual trust, listening and respect, as well as acceptance of indigenous and community knowledge as equally valuable. Examples are given to illustrate a community perspective.

**KEYWORDS**
community communication, community perspective, environmental justice, indigenous science, social justice

## 1 | INTRODUCTION

Everyone is exposed to risky events, whether they are catastrophic, acute events, or chronic, long-term exposures to hazardous substances. Catastrophic events typically include natural disasters such as hurricanes, tornados, and industrial accidents such as oil, chemical, or radiological spills or explosions. Chronic events normally include chemicals in drinking water, air pollution, mercury in fish, and recurrent exposure to infectious diseases (such as during winter flu season). All have the potential for important and devastation consequences. The recent COVID-19 pandemic combines many of the worst aspects of these risky events, including a catastrophic event with rapid exposure, differential susceptibility, and differential responses or treatments, overlaid with income, racial, and environmental justice disparities (Zhang & Schwartz, 2020). Risk communication with the COVID-19 pandemic is clearly contradictory at many levels, complicated by uncertainty, misinformation, and deliberate inaccurate risk communications. Over a decade ago Holmes et al. (2009) identified trust, and a partnership between health professionals and journalists important for dealing with a "potential influenza pandemic." Key to effective public health responses is timely and accurate information.

Risky environmental events are viewed differently by nearly every group that can be identified, but usually there are "risk communicators" and "others." "Others" comprise the audience(s) for the risk communicator. This dichotomy may unfortunately lead to an "us versus them," and sometimes to the unconscious or conscious feeling that risk communicators have the answers, they just need to present the information, and then they must convince others of the correct answers to

assure an appropriate, reasonable, and desired response (see Avai, 2014; Renn, 2014). While risk assessors recognize this problem, and usually try to rectify it, it is still truly impossible to understand the views of another "unless you walk in their shoes." Absent walking in their shoes, we must seek to listen, learn as much as possible, empathize, collaborate equally with the range of people who are interested and affected by the events and aftermaths of risky events, and carefully examine the consequences of the risks and benefits in terms of a communication strategy.

This paper examines communication around risky events and situations from the viewpoint of community members. As a farmer's daughter I faced teachers who assumed I was never going to college, so why waste time on me? I can relate to community members who detect condescension and feel hopelessness in the face of authorities communicating "risk knowledge." The conveying of information should be multifaceted, multidimensional, and multidirectional, and should also flow equally from the community to the risk communicator. It is the community that feels the consequences of risk communication—whose health, lives, livelihood, and culture are affected by these consequences. This makes the relationship between risk communicators and their audience unbalanced, and the balance shifts even more when dealing with low-income, minority or otherwise disadvantaged communities, as evidenced by drug overdose problems, violence in the streets, and the 2020–2021 COVID-19 pandemic. Environmental injustices become more pronounced. In this paper, environmental justice refers to fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income (www.epa.gov). Communities know what they are exposed to (although maybe not the risk probabilities), and they know and experience the complexity of exposures they face, the "cumulative risk" from economic and societal stressors, and racial and ethnic disparities, modified by community experiences, knowledge, norms, beliefs, and values (EPA, 2009; Holifield, 2001).

This paper deals mainly with communication about longer term, chronic exposures, usually of environmental justice communities. Some examples are presented that illustrate where risk communication inadequacies can lead to adverse consequences and amplify environmental justice disparities, and some communication approaches and solutions are illustrated. I suggest a transformational approach where risk communicators must learn to trust community experts and their knowledge base (and act upon it), where risk information imparted by risk communicators addresses what communities are most concerned about (as well as risk from specific chemicals or radionuclides), and where risk information and assessments address underlying issues and disparities, as well as cultural traditions (among others). Merely providing risk probabilities is no longer sufficient; western science may not be enough, and community and native scientific knowledge is needed. Risk communication (or information transfer) for environmental risks that are ongoing usually applies to low-income, minority communities—people living in dense inner cities, rural communities, Native American communities—or to people living near a risky facility (technological hazards at Department of Energy (DOE) or DOD, nuclear facilities, chemical plants, airports, municipal incinerators) (Bier, 2001; Charley et al., 2004; Corburn, 2002; Quigley et al., 2000). This paper seeks to make four key points to connect personal and community needs and health consequences to risk communication processes:

1. Recognizing that all communication has some biases because we all have unique backgrounds, knowledge, training, education, and live and work within a culture. Community members should have an equal role in the risk communication process.
2. Listening, respecting, and being part of distressed or exposed communities (whether acute or chronically exposed) are essential for risk communicators to be effective.
3. Trusting community members is as important to successful risk communication as expecting community members to trust risk communicators. Trust and empowerment are key.
4. Individuals and communities will not be satisfied with risk communication that addresses only the needs and information base of the risk communicator, and not those the community is seeking (e.g., income and health disparities, race and ethnicities, and personal susceptibilities). It should lead to reducing actual risk, not just the fear of risk.

The relationship between these key points and the communication dialogue, failure of the process, and the consequences is shown in Figure 1. Although risk assessors, communicators, and managers sometimes come from one viewpoint (e.g., "the risk isn't as high as you fear"), and community members from another ("the risk is higher than you tell me"), both groups must consider the same factors through a lens of trust if there is to be successful resolution. Failure of the communication process (confusion, leading to inaction) can result in decreased health and well-being, increased disease, injury and possibly death, increased health disparities, and decreased cultural cohesion.

The consequences for communities are potentially severe and long lasting, leading to increased cumulative effects. Nowhere has this been clearer than in the issue of race-based police violence, drug overdoses, and the COVID-19 pandemic. Risk communication has partly failed during the pandemic because of community inequities. Telling people to self-isolate, especially if they are sick, is not always possible. People in lower income neighborhoods, whatever the color of their skin, usually are forced to live in close quarters where they cannot self-isolate, cannot stay at home because they have to work, and they cannot afford not to work. And why, for example, is crack use considered and treated as a crime (used more often in poorer neighborhoods), while heroin and anti-depressant overuse (used often in white suburbia) are often considered a medical problem (CDC, 2020). The case studies presented are those that I am most familiar with, but others could equally serve to illustrate these points.

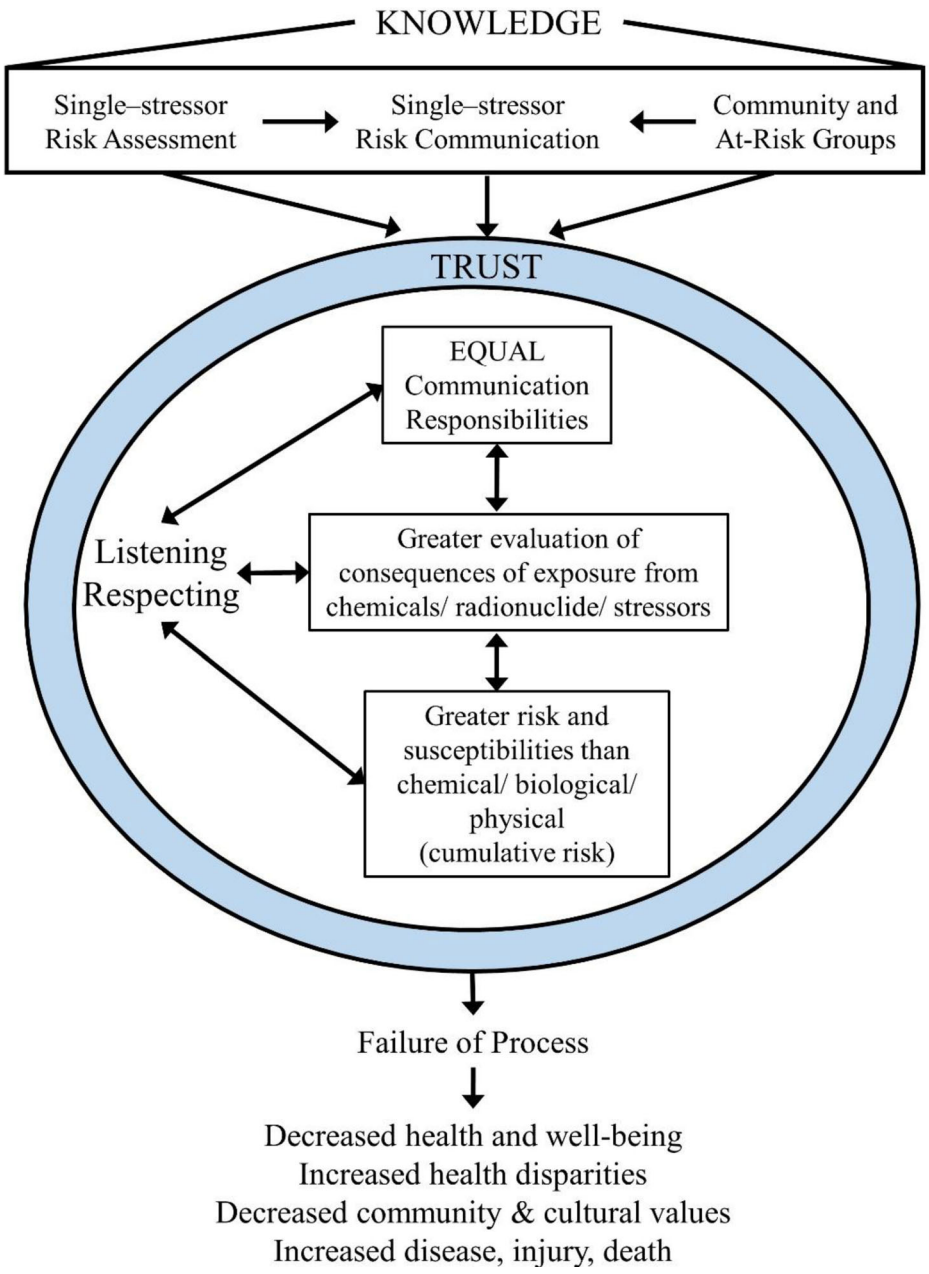


**FIGURE 1** Illustration of the relationships among different people, agencies, and communities when communicating about risky situations

## 2 | CONNECTIVITY WITH THE COMMUNITY

There have been many important papers written on risk communication, stakeholder involvement, community participation, and collaborative research. They provide both a theoretical and a practical basis for the field of risk communication. Much of risk communication (other than the transmission of non-controversial information the public needs) involves three major themes: participation of stakeholders (Burger, 2011; Goodman & Thompson, 2017; Kasperson, 1986), trust (Bier, 2001; Siegrist, 2019), and environmental justice (Bullard, 1990; Chakraborty et al., 2016; Corburn, 2002; EPA, 2009; Greenberg, 2005). All are complicated by the multiplicity of purposes, goals, messages, audiences, and stakeholders. All three involve the resolution of social conflict (Mikula & Wenzel, 2000; Taylor, 2000, 2009). The stakeholder participation movement clearly mandates involving a range of stakeholders, and their collective knowledge, beliefs, and values (Lybecker et al., 2016). There are, of course, manuals on risk communications methods and strategies (Covello et al., 1988; NRC, 1989). While clearly the perceptions of risk vary among scientists and the public (Boholm, 1998; Slovic et al., 1990, 2010; Slovic, 2016), and even among scientists (Barke & Jenkins-Smith, 1993), there is general agreement that there are environmental risks, they need to be addressed, and they need to be communicated and discussed with interested and affected parties.

While one end of the risk communication goal is to impart information quickly, efficiently, and accurately (e.g., warnings), the other end of the continuum is communication about an ongoing problem or issue (Bier, 2001; Miran et al., 2019). Decisions about whether, when, and how to resolve concerns and remove exposure or "solve the problem" may be contentious and long term. Communication becomes particularly critical for these ongoing exposures, and often community members and community activist groups become key in the communication process. Many agencies, nongovernmental organizations (NGOs), and community members become both communicators and recipients of information in an interactive, iterative manner.

## 3 | COMMUNICATION, COMMUNITY, AND CONSEQUENCES

### 3.1 | Recognizing mutual biases: Words matter

First, "risk communication" needs to embrace the multidirectional nature of exchanging health risk data or health management information on long-term, complicated, and chronic exposures. At its best, it is a risk dialogue among different disciplines, communities, and individuals. COVID-19 illustrates how information comes from multiple sources and impacts clinical care, health care workers (and their transportation and housing), essential businesses still operating (and their employees), non-essential businesses closed (and their employees), policy makers in local, state and national health departments, as well as a general public living under diverse circumstances with diverse exposures and health disparities. The same environmental justice issues identified in the pandemic need to be recognized and dealt with in other high-risk, low-probability situations, with adequate, interactive information exchanges (risk communication).

The words risk communicators use matter—among ourselves, in refereed publications, with governmental and Tribal agencies, and with the public. Effective risk communication requires using words accurately and instructively. However, a quick review of some risk communication papers reveals a difference in how some risk communicators view themselves and their message, compared to the messages, views, perceptions and knowledge of the audience. In behavioral terms, the message is what the communicator wishes to deliver, and the meaning is what the receiver hears. In some cases, it is simply mis-communication. In others, we unintentionally value our science over traditional knowledge, and follow the term "perceptions" with constructs for why these mis-perceptions occur (e.g., Lyons et al., 2020). Too often we try to explain away misperceptions, rather than appreciating, valuing, and exploring community perceptions and traditional knowledge (Table 1). Risk assessment itself is not value-free or neutral (MacGillivray, 2019, but see Hicks et al., 2020). Deciding what, when, where and how to communicate is partly value driven.

Second, sociological perspectives and emotion-laden words are used to explain how or why people respond as they do to risk communication. These terms, however, should be examined in terms of how agencies/governments/scientists use them when communicating with communities. These include, but are not limited to: backlash (Jensen et al., 2017), cultural world view (Kim & Kim, 2019), local knowledge (e.g. Corburn, 2002), mental models (Bessette et al., 2017), proximity (Lyons et al., 2020), social amplification of risk (Kandiah et al., 2017; Wirz et al., 2018), and worry (Parker et al., 2020). Risk communicators are subject to some of the same mental models and biases, and it can influence their communication methods or attitudes.

Local knowledge should provide one of the bases for risk assessments, management, and communication. Sometimes, conversations with local residents can lead to the recognition that risk assessments should be conducted to determine not only whether there is an issue but what and how to communicate with local communities. For example, the Savannah River separates Georgia and South Carolina, and part of the South Carolina side is occupied by the DOE's Savannah River Site. There are low-income, disadvantaged minority communities living on both sides of the river. At one time, South Carolina had issued fish consumption advisories based on mercury, while Georgia had not. Whether and how much the DOE site contributed to mercury can be argued, but the issue for site neighbors was whether the fish were safe to eat. The DOE was not focused on the issue because it believed that there were few people fishing along or below the Savannah River Site, and there were mercury advisories for most rivers and streams in South Carolina anyway, making it not a DOE problem. However, the locals did not agree that no one fished there. Whether this was true or not became an issue at public meetings.

While the community and DOE were disagreeing about the importance of this issue compared to other clean up issues, we decided to determine whether people were fishing by actually looking, and to determine if there was a risk by examining the level of mercury in fish that fishermen (including both men and women) were catching (Burger et al., 1999; Burger, Gaines, & Gochfeld, 2001; Burger, Gaines, & Peles, 2001; Burger, Gochfeld, et al., 2001). The study involved having local residents go up and down the river interviewing fishermen while they were fishing (and waiting for the fish to bite). Surprisingly, many people fished along the river, even stopping on the banks near "Do Not Enter" signs to rest or have lunch, or go a short way up a creek bank onto the site. Fishermen answered questions because the interviewers were local, were not from DOE, and could "visit" with them about the site, the weather, whether the fish were biting, and even about whose parents had been displaced by DOE occupancy 60 years earlier. I once stood on the sidewalk where one of the interviewer's grandmother's house had stood before she was given 3 days to move before DOE took over the land just before Christmas. Both the local interviewers and the fishermen provided knowledge about what types of fish they were eating, how they cooked them, and to whom they gave

**TABLE 1** A sampling of the use of words by risk communicators, and the underlying issues with the terms for audiences and community members. These are meant as examples to stimulate discussion about how words influence the perceptions of risk assessors, as well as others who are in dialogue with risk assessors

| Terms often used by risk communicators | Issues regarding these terms for traditional risk communicators, audiences, and stakeholders |
|---|---|
| Biases | Often used as recall bias or selection bias on the part of subjects that do not report accurate information (e.g., Crump, 2020; Liu et al., 2019; Rickard et al. 2019), or risk-related worry (Parker et al., 2020). However, all risk communicators have their own biases as well. |
| Communicator | Audience (sets up "us versus them" dialogue). |
| Data (data are assumed to be accurate, precise, and true) | Information relative to a given risk question, usually involving the risk assessment paradigm. However, data are rarely completely accurate, and are fraught with uncertainties both in the environment and in the measurements. Experts can disagree on the validity and relevance of the data, reaching different conclusions (Anjum & Rocca, 2019). |
| Data gaps | Information insufficiency, though information may exist within the community that is not necessarily quantified. |
| Hazy hedging | Making decisions about farming under conditions of uncertainty (e.g., see Findlater et al., 2019). |
| Illusion of control | People mistake control over exposure (e.g., controlling drinking water access gives control over contamination) (e.g., Hooks et al., 2019) |
| Judgment | Perceptions. Risk perception is a predictor of response, but little is known about subjective risk judgements (Rickard et al., 2019). |
| Knowledge gaps | Used to bound risk information by assessors, but not as recognized for community knowledge (e.g., Vickery & Hunter, 2016) |
| Perceived uncertainty | Perception of uncertainty by stakeholders or subjects, but the uncertainty is still real (e.g., see Findlater et al., 2019). |
| Pervasive uncertainty | Results in being unable to respond appropriately; people may satisfy their feelings rather than optimize actions (Findlater et al., 2019). |
| Risk communication | Silent recipients of information. |
| Risk facts | Risk perceptions. |
| Risk perceptions | Largely intuitive and affective, rather than deliberate assessment of probabilities (Wilson et al., 2019), but risk communicators impart their perceptions as well. |
| Science or data base | As opposed to traditional knowledge (which is also science based). |
| Social acceptance | Stakeholder opinions (but may actually be ethics, see Taebi, 2017). |
| Subjective risk judgments | Specific attributes of decisions may not yet be clear (see Rickard et al., 2019). |
| Uncertainty | Confusion, fatalism, overload, backlash (Jensen et al., 2017). |
| Value neutral or value free | It is best to recognize that all scientific inquiry, whether western or Native American, involves choices, which come from values (Hicks et al., 2020; MacGillivray, 2019). |

them. Fish collection and analysis were based on this local knowledge, in addition to a systematic sampling scheme.

A higher percentage of fishermen were black than white, and because fish was a significant part of their diet, blacks exceeded the daily mercury limit for consumption of most of the fish examined, while whites did so for only two of the fish types. Moreover, white fishermen did not "like to eat" bowfin, the fish with the highest mercury levels, and often either threw them back or gave them to black fishermen because they were trying to help (because they were poorer and needed the food). In both cases, the fishermen were fishing for food, but the combination of more minorities fishing, their willingness to eat bowfin with the highest mercury levels, and their acceptance of that species from white fishermen contributed to their higher exposure and risk. Local fishermen, like most people, did not know which fish had the highest mercury levels, a contaminant that adversely affects fetal development (ATSDR, 1999). For many of the fishermen, this was their main source of protein, and fishing was also very important culturally. Clearly, there was an environmental justice issue that was not being addressed, making an information strategy essential (Burger et al., 2001; Burger, Gaines, & Peles, 2001; Burger, Gochfeld, et al., 2001).

The end result was the recognition by DOE, the Environmental Protection Agency, and the two states that information on the risks of mercury in fish should be made available. These agencies, local interviewers and collaborators, and researchers developed a fish fact sheet that clearly conveyed the message that fish are a good source of protein, but that some fish are a less contaminated source than others. Community members and fishermen made suggestions on the brochure before it was completed. Since it was fishermen on the Savannah River who needed the risk information, the final communication brochure was distributed by local interns employed by DOE who went up and down the river during the fishing season to hand out brochures and talk to

fishermen. Although most of the agencies did not think that people would be responsive to this, all the fishermen wanted brochures, most asked questions, and many asked for more to give to friends (Burger, Gochfeld, et al., 2001; Burger & Waishwell, 2001). They specifically asked about which fish they could eat safely, what their spouses should do, and thanked us for including them in the project.

Having risk communication meetings, forums, or focus groups in the wrong place or at the wrong time is an easy mistake to make if risk managers fail to take the culture of the community into account. This applies equally to farmers in rural America, workers in industrial communities, and urban low-income communities. For example, farmers are not going to go to a meeting in spring or fall during planting or harvesting. Farm workers cannot go to a meeting if it is during the work day (unless given time off to attend; a goal worth seeking), after a long work day, or it requires long travel distances and times. Holding meetings during these times gives workers the impression that the meeting is for the convenience of the meeting-holder and not the workers, or that it does not matter if everyone (or even anyone) attends. The risk communication strategies for farming obviously vary depending upon whether the communication is with small farm families, farm workers, or large commercial farming businesses. Further, holding meetings in formal places may not result in high attendance; holding them at the farmer's cooperatives, farm implement stores, or other places small farmers gather will be more successful.

## 3.2 | Listening, respecting, and being part of communities is essential

Risk communicators have a message in mind when they speak, but the meaning audiences receive is often very different. And it is different even among different members of the community. The most important steps in risk communication are (1) listen, (2) listen, and (3) listen. And then listen some more. We may feel as risk communicators that we need to craft our communication very carefully, with appropriate caveats and confidence limits (a safe place for risk scientists), but the community hears it very differently. They know they have other risky situations that may be more important to them (e.g., air pollution, poverty, health issues, race issues) and not related to the exposures in question. Community members say, in effect—"LISTEN to our knowledge and perceptions and don't tell us only about the radionuclide or chemical risks, when biological, economic or social risks contribute more to our health concerns and disparities. You want us to deal with your reality, deal with ours."

Listening takes time and flexibility, over many months, or even years. There is a reason the "carpet-baggers" were disliked by small southern communities following the Civil War. They were outsiders that swooped in, did their deeds, and disappeared. They were not invested in the community, its health, or its ultimate well-being. Risk managers must be willing to change risk assessments or risk evaluations to address what communities want. This also may involve conducting a new risk assessment as a result of community input, or even going back and collecting more geological or biota samples. Although this appears to add time to cleanup and closure of a site (e.g., DOE legacy site or chemical plant), in the end listening to the community, and acting upon it, results in better resolutions. Mutual involvement of community members in communication is critical, especially in low-income and minority communities where other legal or professional services may not be available.

Further, listening fails to achieve risk communication goals if it is not accompanied by mutual respect, acceptance of cultural knowledge (traditional knowledge or institutional memory), and a willingness to include local knowledge in all risk assessment, management, and communication. Local community leaders and members know more about risky behaviors, underlying health conditions and disparities, exposures, and cultural practices. Two examples will illustrate this point. The first example is risk communication concerning several Native Alaskan communities (Aleuts living in the Aleutian Islands, Alaska), and the second example started with a broad potential exposure group (European countries) and involved drilling down to the risk communication needs of people and groups in different European countries and regions. In both cases, what started out as unidirectional risk communication ended up being a longer-term project that involved listening, listening, and listening on the part of all concerned, and acting upon community knowledge.

Many Native Americans communities are located in rural or remote locations, have low incomes, limited access to health care, and face consequences from a range of adverse environmental exposures and health disparities. Unique historical, political, geographic, and cultural issues and values have shaped their diets and exposures. Communities face several critical gaps in power, privilege, public policies and concepts of science, knowledge, and health constituting "historical trauma" (Taylor, 2009; Vickery & Hunter, 2016). Much of their loss of power comes from displacement from their homes or traditional hunting/fishing/gathering grounds—Amchitka Island in the Aleutians is a case in point. The U.S. government used it as a military base in the 1940s and for underground nuclear tests in the 1965s and early 1970s.

There were several problems with the DOE's communication strategy (and indeed their risk assessments). After years of extensive cleanup, DOE wanted to close Amchitka Island, and return it to U.S. Fish & Wildlife Service and the State of Alaska (DOE, 2002a,b). Because DOE had conducted underground nuclear tests on the island, the State refused, stating that it did not know whether there was leakage of radionuclides into the marine environment, and it did not want its people exposed to radionuclides (DOE retains responsibility for radionuclide legacies, regardless of land ownership). The crux of the problem was the irretrievable nuclear material buried beneath the Amchitka surface. There was the potential for radionuclides to have seeped from the underground test chambers to the marine environment, being

incorporated into biota, and moving up the food chain into Aleut subsistence foods. DOE responded to these worries by spending millions of dollars on groundwater models and human health risk assessments that indicated there was no risk (DOE, 2002a,b). However, the models predicted that radionuclide breakthroughs to the marine environment could occur anywhere from 10 to 10,000 years—not very satisfying since the tests had already occurred more than 30 years previously.

DOE held its first big public risk communication meeting in Fairbanks, Alaska in the early 2000s, which was easy to arrange logistically, and could accommodate governmental agencies (USEPA, USFWS, NOAA, State health departments). However, the Native American Aleuts lived hundreds of miles away, reachable for a public meeting by costly air travel on planes that go only a couple of days a week. The travel costs effectively excluded the potentially affected community from participating in the meeting. Aleuts rely heavily on self-caught and collected foods from around their islands. They wanted to know if radionuclide levels were in their subsistence foods. Communicating risk about such an important aspect as the safety of their foods in a place where they could not attend a meeting did not take into account how they themselves would choose to communicate. Indeed, the Aleuts were angry, the public meeting a disaster, and the State of Alaska was incensed (ADEC, 2003). This early failure in planning tainted and lengthened risk communication. The lesson learned was that future meetings should be well advertised, and should be held in Aleut communities, even at the inconveniences of government participants.

DOE risk experts were dismayed that their assessments were not accepted at face value by state agencies, and that the Aleuts were not convinced their foods were safe to eat. Most of the comments at the public meeting reflected fear that organisms living around Amchitka may be contaminated (and suffering harm), or that Aleut foods were contaminated. DOE insisted their models showed that the foods were safe to eat. Although the likelihood was small, the potential harm was great. Further, the human health models did not take into account the very high rates of fish consumption (but rather used mean consumption rates for U.S. people generally), or include subsistence foods (e.g. algae, shellfish, large predatory fish, birds, bird eggs) despite the existence of reports on Aleut diet (Egeland et al., 1998; APIA, 2002; Hamrick & Smith, 2003). Having been stranded on one Aleutian Island while discussing the issues with them, I can attest that I ate salmon for breakfast, lunch and supper, day after day.

The DOE risk communication strategy was to "rely" on models for truth, while a range of communities (Aleuts, USFWS and Alaska State resource trustees, NOAA fisheries, Alaska state health officials) did not agree on the validity of the models, assumptions, and conclusions. The potential health consequences for Aleut foods and commercial fishers from radionuclide exposure could be severe. As Greenberg (chapter 1) commented: you cannot communicate your way out of a bad risk assessment or situation. Even other government agencies were angry. The governor of the State of Alaska formally asked the Secretary of the Department of Energy for the Consortium for Risk Evaluation with Stakeholder Participation (CRESP) to develop a Science Plan that would provide the data that the various agencies, Aleuts, and other stakeholders would find acceptable to move forward with closing Amchitka (Burger et al., 2005).

Although it first appeared to be Aleuts who were most outraged by the risk communication, there were many other issues of concern to other parties, including whether radionuclides were seeping from the underground tests (State of Alaska), whether the organisms on the food chain were impacted (USFWS and Alaska natural resource trustees), and whether commercial fish were safe to eat (fisheries, NOAA). NOAA was concerned because a significant proportion of the fish eaten in the lower 48 states comes from the Bering Sea (where Amchitka Island is located), and Dutch Harbor in the Aleutian Chain sometimes has the highest tonnage of fish landings in the world (AMAP, 1991). For the Aleuts, all these questions are interconnected, and the very existence of Aleuts depends upon the safety of the marine life around their islands. Indeed, in the end, all the agencies were concerned for the whole ecosystem. The risk communications issues were thus multiple, going in all directions, with different jurisdictions, power, legal authority, and moral authority. The risk answer was relatively simple, and although expensive, it was less expensive than the DOE groundwater models and human health risk assessments. Everyone needed to know if the organisms were free of radionuclides, and complicated risk models were not going to solve this problem. It was both a risk assessment problem and a risk communication problem; the two are usually joined at the hip.

The heart of the science plan we developed was the collection of fish and subsistence foods, commercial fish, and the food chain. We visited several of the small Aleut villages, discussing the sampling plan and project first with the Village elders, then the whole community, and then with the children in each village. Most of the community came to these meetings, and all of the children did. While the adults were careful to mention only hunting, fishing, and gathering subsistence foods that they knew were legal, some of the children proudly brought small notebooks that listed how many of each bird they killed or how many of each fish they brought back to the village to help feed the elders. Additional food items were added to our sampling plan, and at their suggestion, native hunters from their villages were part of the expedition. Further, villagers expressed an interest in knowing whether their subsistence foods contained high levels of mercury and polychlorinated biphenyls (PCBs), and we committed to figuring out how to run these analyses despite DOE declining to pay for these analyses. This too led to their distrust of DOE and its communication.

The fish were collected by scientists and Aleut fishermen, and the subsistence foods were collected by Aleuts on the ship who hunted for foods they would eat if stranded there. Their knowledge of how to navigate the choppy waters of the Bering Sea, their reading of the weather, and their knowledge of where to get the necessary fish species were invaluable.

We returned to the villages following the expedition to report that the foods were free from radionuclides (Burger Gochfeld, Kosson, Powers, Friendlander, et al., 2007), and the Aleut communities were appreciative because although their foods (and culture) had been studied before, no one had come back to report results. At all the public meetings, we recorded the questions that were asked, and following the expedition we found that villagers were no longer concerned about the data or radionuclides, had trust in the findings (although trust in DOE itself did not increase), and remained concerned about mercury levels (a legitimate concern given the levels in some of their foods), (Burger & Gochfeld, 2007; Burger Gochfeld, Jeitner, Burke, & Stamm, 2007; Burger, Gochfeld, Jeitner, Burke, Stamm, Snigaroff, et al., 2007; Burger, Gochfeld, Powers, Kosson, et al., 2007; Burger, Gochfeld, Kosson, & Powers, 2007). The valued result of the Aleut collaborators telling their stories at their villages, bringing halibut from the research trip to villages, and using their photographs in the Aleut calendar was the best risk communication possible.

The first risk communication meeting that we attended was in 2001, and our final visits to the Aleut villages were over 5 years later. As a result of the multistakeholder joint communications, objectives, protocols, sampling, and policies were modified in collaboration with different federal, state and Tribal agencies and others throughout the process (Burger, Gochfeld, Kosson, & Powers, 2007). As we had committed to the Aleuts in the villages when we first visited them, both mercury and PCBs were analyzed in their subsistence foods (Burger, Gochfeld, Powers, Kosson, et al., 2007; Burger, Gochfeld, Kosson, & Powers, 2007; Hardell et al., 2010). The knowledge that there was actually no current risk from radionuclides in commercial fish or subsistence foods, coupled with a 5-year biomonitoring plan, assured the Aleuts, state, and federal agencies that DOE would continue implementing their future responsibility for any leakage of radionuclides.

A second example illustrates some of these same points, but involved many different types of communities, over a wider geographical range. A communication strategy was developed by The Consortium to Perform Human Biomonitoring on a European Scale for biomonitoring that included press releases, flyers, recruitment letters, leaflets, and other recruitment methods (Exley et al., 2015). The major lesson learned from the various communities was that social scientists were needed early and often to engage communities in each country (and in parts of countries, rural to urban), that they should be part of the research team from the start, and that a large group of medical professionals and communication experts were needed throughout. Communication was not unidirectional. The main communication issue was to foster and support human biomonitoring research and its connection to public health of diverse communities. Additional considerations, methods, and approaches were essential to communicate in different cultures, policies, languages, and priorities.

This example illustrates that communications about risks can involve very large and complex communities, with different languages, and cultures. Although it required longer time than without this risk communication strategy, it would not have been completed otherwise, and a Europe-wide human biomonitoring plan could not have been implemented (Exley et al., 2015). Further, the communication for the biomonitoring plan allowed for individual and community adaptation to best provide communities with adequate and appropriate risk information.

Both of these case studies illustrate the importance of intense, frequent, and open community involvement in the process, community-focused risk messages, and approaches to achieve a mutually agreed upon plan that ensures the public that health and safety are achieved.

## 4 | TRUST AND EMPOWERMENT: A MULTIDIMENSIONAL, MULTICOMMUNICATOR ASPECT

There are at least three different trust questions to consider when imparting risk information: Does the audience trust you? Do you trust the audience? Do members of the community trust one another? The first issue, discussed extensively by Greenberg (this issue) is the topic of many papers. It is the latter two issues that need amplification and are discussed below. Part of trust is accuracy of information and transparency (Boholm, 2019). Trust is also dependent upon cultural values and experiences (Corburn, 2002; Peters et al., 1997; Tumlison & Song, 2019), particularly prior experience with risk communicators. To some extent, power and authority parallel trust. Does the communicator have power to make decisions and deliver an accurate and transparent message? Does the audience (or community) have power to accept or reject the message (which is often associated with management recommendations), and how is power distributed among the stakeholders or audiences? Who is empowered to possess and to use knowledge to act?

### 4.1 | Risk communicator's trust of community representatives or members

Historically, risk communicators did not trust their audience for various reasons. An audience might be viewed as hostile and unreceptive or unwilling to believe the communicator's "truth." Audiences were assumed to lack technical sophistication or numeracy, unwilling or unable to deal with probabilities in the same scale as the communicator. An EPA official explained to a New Jersey town meeting that the cancer risk from the trichloroethylene in their drinking water amounted to "less than one in a million," to which the Mayor shouted, "I don't care if the risk is one in a billion, I want it OUT of my town's water." That is clearly not a predictable response. If you cannot predict how a community will respond to information, you cannot trust it. Conversely if you do not trust the audience, you cannot deliver a believable message. Failure becomes a self-fulfilling prophecy.

Much attention is devoted to the importance of risk communicators gaining the trust of their audience, and by extension of the community they address. This can be flipped, however, to ask whether the risk communicator trusts the audience or the community being addressed? This is a more difficult approach because individuals within a community are obviously, and legitimately diverse. However, a lack of trust (and respect) of community spokespeople on the part of any risk communicator is quickly perceived, impedes trust, and nullifies progress. Further, many risky situations are first brought to Tribal, federal, and state governmental agencies, NGOs, or companies by communities that identify a problem, voice concern, and strive for recognition. In many of these cases, it is not so much that the company (or government) did not know there were chemicals or radionuclides on a site, or that they did not know they presented some level of risk to communities, but rather that the community communicates their concerns about the potential risk. In these cases, usually in low-income and minority communities, the situation can become volatile quickly if agency/company risk communicators do not trust and respect the community, or fail to see the gravity of the situation.

Communities around active chemical plants or nuclear facilities may experience ongoing air releases or noise, or increased traffic. Risk communicators from the industry or government need to trust the community members' communications and observations of excessive exposures. Neighborhoods exposed to high levels of air pollution occur all over the world, but are often concentrated in poor neighborhoods (Mikati et al., 2018). Ongoing communication is key to addressing the adverse health effects, which may be able to be ameliorated, even when they cannot be immediately reduced. However, communication needs to be multidirectional and include cultural values. Communicating about complicated issues like climate change requires recognition of the unique climate vulnerabilities, environmental inequities, and historical process of Black and Brown people, Native Americans, and other cultural groups (Vickery & Hunter, 2016), as well as consideration of emerging information communication technologies, such as internet, mobile devices, and social media (Cutter et al., 2015).

## 4.2 | Trust within the community

Because it is the community that must live with the consequences of the risky situation, and thus of the risk information given to them by authorities, they must also trust one another. Not only must the risk communicator be prepared but the community should be prepared, from the perspective of individuals, of the community, and of the most vulnerable populations. Being prepared for risk communication dialogues within any community includes recognizing disparities and susceptibilities that result from being low income, minority, or in isolation (e.g., some rural communities). Trust among community members involves the following, but is not limited to this list:

1. appreciating the worth of all community members and their views;
2. understanding and knowing who in the community is trusted the most by the local community, and the company/government/others in authority that are communicating risk;
3. knowing the full range of hazards, exposures and perceptions in your community, including cumulative impacts, income disparities, and unique susceptibilities;
4. knowing and identifying who in the community can provide the most important information about perceived risks and cultural beliefs (who are your technical and cultural experts);
5. identifying who, and where geographically, individuals or community members are most at risk (proximity to a hazardous plant, polluted water supply, other hazard); and
6. knowing what community members really care about, and being able to articulate these beliefs or values, rather that accepting the "risk communicators" arguments.

It is worth noting that the language of a community communication is "knowing," "understanding," and "appreciating" rather than "What" and "How." Assembling information before, during, or after any risky event is critical to managing community risk communication (and obtaining risk information) for any current event or future event. The consequences of getting the communication wrong, and of not addressing risks, can be severe for community members, especially when combined with other pre-existing health, economic, and social conditions. Consequences could be that community members will ignore risks they could address, they will not get the correct information, or the problem may continue because risk communication among the community is unclear.

Because it is often governments, agencies, or company risk communicators that visit communities, it is important to recognize the holistic approach of any community. Risk communicators often present health risk data from the viewpoint of one chemical (or exposure), and the community may be interested in other aspects of exposure to these chemicals—often ecocultural values. Eco-cultural values among Native Americans, for example, are those values that require intact ecosystems, per se (Burger et al., 2010; Harris & Harper, 2000). For example, when the Department of Energy built nuclear bomb facilities at Hanford (Washington), Oak Ridge (Tennessee), and Savannah River (South Carolina), they needed a steady supply of water for cooling reactors, in low population density areas. They told, rather than discussed, the displacement of farmers and tribes from their lands—creating bad feelings that lingered. The farmers and Native Americans settled nearby, where the nuclear explosive hazards and chemical contamination remained an exposure threat, creating an environmental justice situation for the low-income and largely minority communities nearby. For Native Americans, it is not just a matter of the existence of radionuclide contamination on their Tribal Treaty lands (although this is stressful in itself), but that the construction of roads and structures, and

the destruction of ecosystems, damages burial and hunting grounds, destroys traditional medicinal and religious plants, and degrades viewsheds (Bohnee et al., 2011; Burger et al., 2019; Gochfeld et al., 2015; Landeen & Pinkham, 1999). They cannot visit their sacred places or collect their traditional herbs for food or ceremonial purpose. Risk assessments conducted by the Tribes calculate historic fish consumption levels (Harper & Harris, 1998), while DOE does not trust these high historic levels. Trust issues still prevail because they do not trust each other's evaluation of fish consumption rates, leading to different risk assessments (and ultimately, different cleanup levels).

### 4.3 | Trust among communities, agencies, and other entities

Other recognizable agencies and groups within a community also need to be acknowledged, although they are not the focus of this paper. That is, some external agencies and companies are part of the risk assessment, risk management, and risk communication cycle, including the U.S. and state environmental protection agencies, companies involved, NGOs and resource trustees, as well as the U.S. population generally. The latter may have only existence value interests in contamination or other stressors communities and ecosystems face (Davidson, 2013), but they also must earn, deserve, and maintain trust within and among the groups. If risk communicators expect various communities, agencies, and other entities to trust their communications, then these communicators must learn to trust others as well.

## 5 | RISK COMMUNICATORS MUST GO BEYOND THEIR INFORMATION BASE AND ADDRESS THE CONCERNS OF THE COMMUNITY AND STAKEHOLDER BASE

Risk communicators often set out to give communities information on the risks they face from a particular stressor (such as chemicals, radionuclides, drugs, diet and nutrition, and communicable diseases). Listening often leads to the recognition that the risk from a particular stressor (e.g., chemical or radionuclides exposures) being discussed may be from chronic exposure, but the audience may be worried about catastrophic events that result in massive exposures or the effect of the nuclear plant on housing values, or educational or job opportunities. For example, the worry of people living around nuclear power plants (or DOE facilities) cannot be dealt with simply by discussing the exposure rates from ongoing operations (typically negligible), but also from the risk of a catastrophic event, such as Fukushima (Denning & Mubayi, 2017; Kusumi et al., 2017) or Chernobyl. The consequences for residents near such an "accident" are long-term displacement of people and communities, loss of productive farms, and loss of community culture, among others. These consequences are great and not due solely to health exposures from the radionuclides themselves. Communication and dialogue with nearby residents, as well as those living farther away, are complex and often qualitative (Vyncke et al., 2017).

Risk communication may be directly related to reducing an exposure, but the contributing factors are amplified in low-income, minority families. For example, exposure of children to pesticides varies markedly and can be especially high in children in agricultural U.S./Mexico border areas (Shalat et al., 2003). Much of information transfer is about a given risk, when actually it should be risk/benefit communication (see Rideout & Kosatsky, 2017; Xu, 2013). It should be about the risk landscape that people are exposed to, and about the consequences of these cumulative risks (e.g., risk vs. risk). Every community has multiple environmental inputs, each of which can range from very good to very poor, including radiological and chemical exposure, level of industrialization or commercialization, air quality, tranquility or violence, noise quality, housing quality, income and other resources, ecological resources, and space. Differences in these parameters, as well as others, can lead to environmental injustices and poor physical, emotional, and cultural health. In many communities, there is a constantly changing landscape. Community responses to risk communication directed at only one stressor (e.g., mercury, cesium, or some other chemical) will likely be unsuccessful because the message does not address the community questions or needs. Some examples are provided below.

Children in suburban homes are rarely exposed to pesticides, even if they are playing outdoors. In contrast, for example, children in agricultural communities along the Rio Grande on the U.S./Mexican border (Black et al., 2005) and in North Carolina (Arcury et al., 2007) are heavily exposed to nondietary ingestion of pesticides (Black et al., 2005). Partly the risks are amplified because the children can play in the fields or are exposed to pesticides brought in on their parent's clothes. Communications between scientists, risk communicators, and the community in these instances are ongoing and must involve trust, respect, and an iterative process that results in reducing the unequal burden children face.

Many risky situations are not localized; the risk may come from one place but be carried to another. For example, low-income and minority families fish along polluted waters, and then return to their homes dispersed throughout the community. Risk communication with people at risk may be generalized, and thus not reach the susceptible audience, either because the messages are not targeted, they do not reach the community, the messages are written in agency languages, or in English rather than the language of exposed populations (Chess et al., 2005). When risk communication information is written in Spanish, by Spanish-speakers, and with the advice and collaboration of low-income, minority communities, the materials are more broadly read and the advice followed. This applies whether the information is for fish consumption (Burger et al., 2003; Chess et al., 2005) or for advice during a severe storm or hurricane (Benavides, 2013; Burger & Gochfeld, 2020). During and following Superstorm Sandy, low-income, minority community

members (largely Hispanic and Latino, Spanish-speakers, foreign-born) felt that they were not included or considered in the appropriate risk communication about preparedness and resiliency. Low-income and minority communities that reside in low-lying areas are increasingly vulnerable to the effects of climate change and sea level rise, and these effects will be amplified by already existing health disparities and difficulties in evacuating quickly, having a place to go, and having enough money to be away from home. Risk communication in these situations, often in the form of warnings, needs to take into account these realities or the outcomes will be more severe than in other communities (Burger et al., 2019).

The risk from consuming fish contaminated with mercury that could adversely affect fetal development is often "deamplified" (as opposed to social amplification) because of conflicting messages about the health benefits, without adequate communication about the risks and without community discussion about solutions (e.g., do not stop eating fish, select fish with lower levels of mercury and higher levels of omega-3s). These discussions among science/agency and community risk communicators' need to be site-specific, ethnic-preference specific, and relevant to local communities. The issue of communication of fish consumption advice is apt to become even more important with respect to community involvement and multi-issue exposures. Risk communication in the case of fish consumption is usually about contaminant warnings (e.g., avoiding mercury or PCBs because of fetal developmental issues and neurotoxicity, ATSDR, 1999). However, this is a clear case where environmental justice communities often rely on fish as a protein source and where fishing and fish consumption are part of their culture. However, with global warming, decreases in fish stocks, and food insecurity (often more common in low-income communities), eating self-caught fish as a source of protein could become more important. While risk communication warnings may remain the same, consumption may increase. At the same time, sea level rise as a result of global warming may decrease the available fish spawning habitat. Cascading effects such as flooding resulting in mold in homes, food insecurity, and difficulty obtaining medicines during severe storm events may increase overall community risks. Some people relying on fish consumption for protein live near ports and in inner cities where air pollution is an added risk. Thus, risk communication between and among risk assessors, community leaders, and community members will be complicated by multiple, cumulative, and changing risks.

## 6 | CONCLUSIONS: TOWARD A RISK COMMUNICATION DIALOGUE AMONG SCIENTISTS AND THE PUBLIC

The goal of communicating risk information is to reduce adverse effects, encourage protective behaviors, and contribute to overall human health and well-being. Ideally, communication addresses not only direct effects from exposures to one (or a combination) of radionuclides and chemicals but accounts for an environmental justice context that includes exposure to poverty, poor schools and community conditions, racial and ethnic discrimination, in communities already stressed by climate change and sea level rise, among others. Communication aimed at dispensing information needed for a short-term hazardous event (e.g., impending tornadoes or hurricanes) can be unidirectional at public meetings or by other methods. However, communication involving chronic, long-term exposure from living near contaminated sites, in a flood zone, a highly impoverished community, or other hazardous situations should involve long-term interactions between risk assessors, risk communicators, sociologists, and a wide range of community members who are interested and affected. Both risk assessors and community members have valuable science and information to impart, and understand both the risks and the consequences of actions within their community. Risk assessment scientists and sociologists from both Western and traditional cultures should be included, along with community leaders and members of the public.

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