A Practical Guide for
Natural Hazard Risk Communication

JULY 2019

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INTRODUCTION

PURPOSE OF THIS DOCUMENT

This guide presents a proactive, step-by-step approach that staff across all of NOAA's line offices can use to communicate risk and uncertainty, with a focus on how to convey risk information to stakeholders outside the agency. To help NOAA personnel communicate effectively, the guide references and draws on available NOAA risk communication tools, protocols, and models, and other sources as needed.

Communicating risk and uncertainty is integral to achieving NOAA's broad mission of science, service, and stewardship. In particular, effective risk communication helps NOAA deliver on a central tenet of its mission: *to share knowledge and information with others*. Across the nation, organizations, businesses, communities, and individuals use NOAA's research, data, and knowledge every day. These entities depend on NOAA's weather forecasts and warnings, navigational information, Earth observations, fisheries science, and other data to plan and inform their activities and to make critical decisions.

- Seven Best Practices for Risk Communication presents best practices, techniques, and brief case studies to improve risk communication conversations and products.
- Risk Communication and Behavior: Best Practices and Research Findings examines the seven best practices in the context of three weather hazards and three other environmental hazards.

Communicating risk, along with uncertainty and probabilities, helps NOAA achieve its mission by:

- **Protecting lives, human health, ecosystems, and property from extreme events and emergencies.** Example: NWS's Weather-Ready Nation initiative ensures that high-quality forecasts are communicated effectively to empower emergency managers and the public to take protective action.
- **Empowering people to make informed choices**. Example: NOS's Coastal Inundation Dashboard helps communities understand and respond to local vulnerabilities to coastal inundation.
- **Informing decision-making and policy processes.** Example: NOAA Research's Climate Resilience Toolkit helps decision-makers across the country prepare for—and adapt to—hazards that will be exacerbated by a changing climate.
- **Helping to build trust in the information NOAA provides.** Example: NWS's severe weather decision support briefings create an open and honest venue for emergency managers to receive information and ask questions, thereby building trusted relationships.

This practical guide will help you create a plan for risk communication that incorporates best practices and lessons learned from NOAA, other agencies, and other researchers and practitioners—particularly the best practices described in the documents in the box above and the list on the next page.

Worksheets will guide you through the key steps in communicating risk and uncertainty, shown in Figure 1. These steps recognize that risk communication is not a one-way, linear activity, but rather an iterative process that depends on ongoing dialogue between NOAA and its audiences and stakeholders. Ideally, your office can assemble a team with diverse experience and perspectives to work through these steps—a process that may initially take several hours, but will likely require review and revision over time as risk communication activities take place.

INTRODUCTION

BEST PRACTICES FOR RISK COMMUNICATION

- Have an informed plan.
- Know your audience; if possible, engage them in advance so you can listen and learn what matters to them.
- Speak to the audience's interests, not yours.
- Explain the risk in a manner that is clear and appropriate for the audience.
- Offer options for reducing risk that address barriers to action.
- Work with trusted sources and the public.
- Test messages or products; evaluate performance.
- Use multiple ways to communicate.

KEY TERMS

Terms related to risk may be defined in different ways, depending on the discipline and the context. For risk communication, this guide uses the definitions presented below.

Term	Example: Lightning
Hazard: a potential source of harm to people, the environment, society, or the economy.	Lightning is a hazard to human health, potentially causing death or permanent disability in people who are struck.
Risk: the likelihood that harm will occur if exposure to a hazard occurs. *Risk = Hazard × Exposure × Probability*	Each year in the United States, there are about 25 million cloud-to-ground lightning flashes and about 300 people struck by lightning. Of those struck, about 47 people are killed and others suffer severe injuries. The risk increases with certain behaviors, such as being the tallest object in an open area.
Uncertainty: the range of possible values for a particular quantity or phenomenon.[1] Uncertainty arises whenever the state of a system cannot be known unambiguously.[2] Uncertainty can be framed through three questions: What are we uncertain about? How uncertain are we? Due to what are we uncertain?[3]	Lightning warning or detection systems can provide advance warning of lightning hazards. However, no systems can detect the "first strike," detect all lightning, or predict when or where lightning will strike. Because of the unpredictability of lightning strikes, there is no safe place outside in a thunderstorm.
Risk communication: an iterative exchange of information among individuals, groups, and institutions related to the assessment, characterization, and management of risk. Inherent to the understanding of risk, and the practice of risk communication, is an awareness that risk encompasses both objective and subjective qualities.[4] The ultimate goal of risk communication is to help people make informed decisions about risks.	NWS provides resources to help people avoid lightning strikes: https://www.weather.gov/safety/lightning. *"When thunder roars, go indoors!"*

EXAMPLES OF RISKS ADDRESSED BY NOAA LINE OFFICES

The hazards and associated risks that NOAA line offices address are wide-ranging and diverse—from life-threatening weather events, to hazards to ecosystems, to long-term threats to communities and the economy. In many cases, multiple line offices, or all of them, have a role in characterizing and communicating a particular risk. For example, all line offices have a role with respect to oil spills. Additional examples include:

- Marine debris
- Coastal inundation
- Ocean acidification
- Extreme weather
- Overfishing
- Fish diseases
- Harmful algal blooms
- Lightning
- Flash flooding
- Dangerous waves and currents
- Invasive species
- Wildfires
- Aviation hazards from volcanoes
- Drought
- Arctic sea ice loss
- Navigation hazards
- Aging NOAA research vessels and aircraft

- Vision and Strategy: Supporting NOAA's Mission with Social Science describes how NOAA uses social science in and across line offices to meet its mission and advance its priorities. One goal is to "use social science methods to assess and communicate risk while reducing vulnerability to changing environmental conditions."

NOAA Line Offices

- National Environmental Satellite, Data, and Information Service (NESDIS)
- National Marine Fisheries Service (NMFS)
- National Ocean Service (NOS)
- National Weather Service (NWS)
- Office of Marine and Aviation Operations (OMAO)
- Office of Oceanic and Atmospheric Research (NOAA Research)

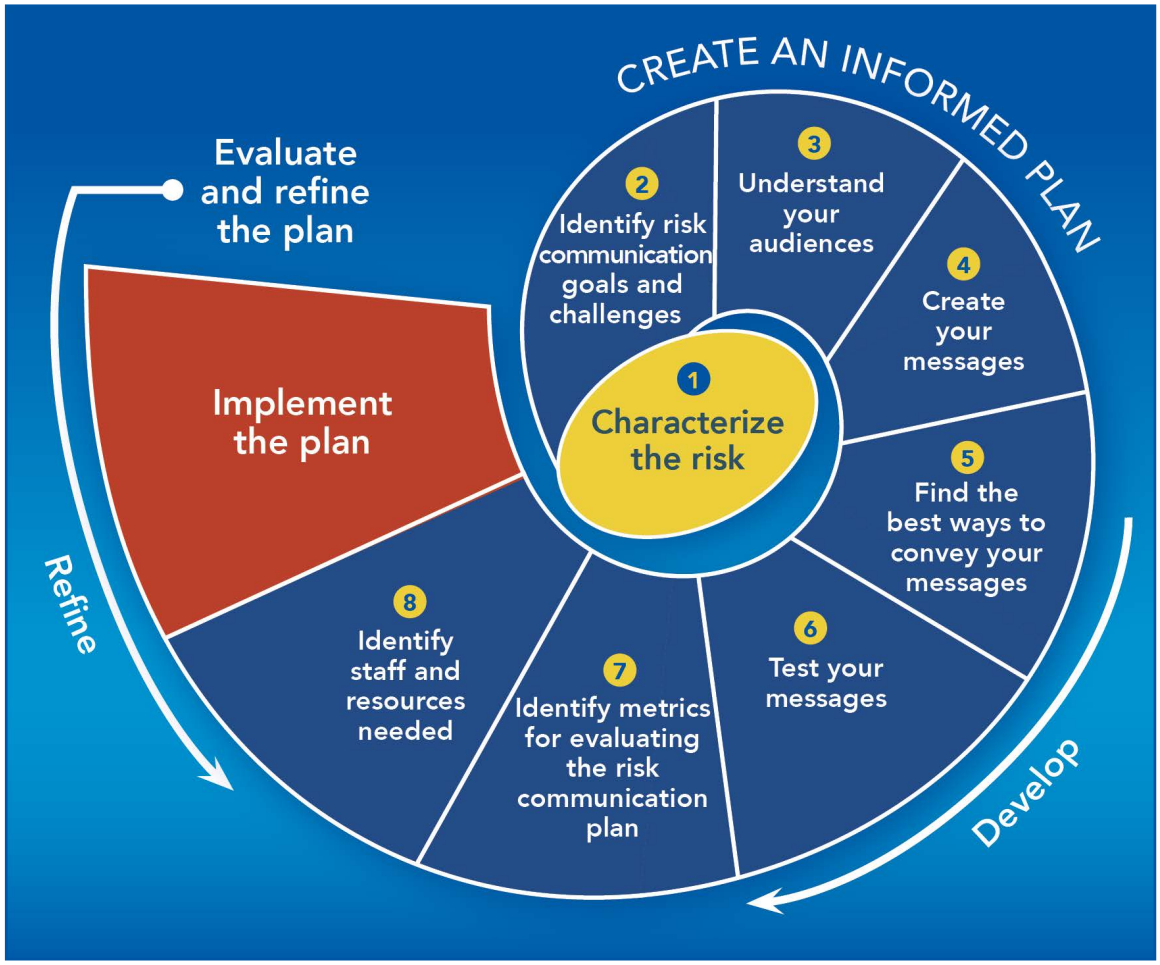


Figure 1. Steps in the risk communication process. The process is iterative and not always linear, so it may be necessary to move in both directions on the diagram.

STEP 1: *Characterize the Risk*

Effective risk communication starts with a sound assessment of the risks associated with a hazard (see definitions of "hazard," "risk," and other key terms on page 2). A hazard often presents multiple risks—for example, an oil spill can pose risks to human health, marine life, ecosystems, livelihoods, and communities. Risk assessment is a scientific process that characterizes a risk and assesses the probability of occurrences and outcomes. It seeks to answer the following questions:

- What is the hazard that creates the risk?
- Where is the hazard? Is it moving or stationary?
- Who and/or what will be harmed?
- How will they be harmed?
- How many will be harmed, and by how much?
- How long will the harm continue?

Where possible, you should include probabilities and uncertainties in this assessment, and specify the sources of uncertainty (such as availability of data, how the data were collected, data comparability). Some guidance on communicating uncertainty will be presented in Step 4, "Create Your Messages."

While this guide does not focus on risk assessment in detail, the subsequent steps assume that you have established a scientific foundation—what you know and do not know—for communicating about risks. The quality of this assessment will evolve with advances in data collection and interpretation.

Further, our definition of risk communication includes the fact that "risk encompasses both objective and subjective qualities." Your assessment of a risk, therefore, should take into account characteristics that can affect how people perceive that risk. These factors are not distortions of risk perception; they encompass real concerns that people have about the risk *in addition* to the dangers posed by the hazard. Table 1 shows some of these dimensions of risk and whether they make risk more or less concerning to those affected.

Table 1. Some Factors Affecting Perception of Risk
(adapted from various works by Slovic, Covello, and Sandman[5])

Less concerning to the public	More concerning to the public
Voluntary	Involuntary
Individually controlled	Controlled by others
Naturally occurring	Human origin
Familiar	Unfamiliar
Understood	Not understood
Low dread	High dread
Affects everyone	Affects children
Chronic/delayed effects	Catastrophic/immediate effects
Fair	Unfair
Alternatives available	No alternatives
Damage reversible	Damage irreversible
Morally relevant	Morally irrelevant
Clear benefits	Unclear benefits
Low media attention	High media attention
Trust in responsible institutions	Lack of trust in responsible institutions

Risk assessment, like risk communication, is a two-way street. Just as we hope that non-scientists take experts' assessment of risk into account, so should experts respect the cognitive, emotional, and cultural factors that shape perception of risk. Therefore, your interaction with your audiences and stakeholders should ideally start before it comes time to communicate about the risk, so you can learn what they care about and include this knowledge in your assessment.

- Stories from the Field describes numerous NOAA projects that have addressed coastal issues. Several of these examples used NOAA data and tools to characterize risks.
- For discussion of these and other dimensions of risk perception, see the Office for Coastal Management's Risk Behavior and Risk Communication: Synthesis and Expert Interviews.

WORKSHEET 1: *Characterize the Risk*

Instructions: In this step, for each specific risk that you need to communicate, review any assessments already conducted to answer the first five questions. Include uncertainty and probabilities where possible. Then consider characteristics that might affect perception of risk. If your hazard poses multiple risks, use a separate copy of this worksheet for each risk you need to characterize.

Hazard (e.g., oil spill): _____

Specific risk that you need to communicate (e.g., harm to fish stocks): _____

Key question	Assessment of risk	Probability or uncertainty (provide sources of uncertainty, ranges, probability, qualitative description as appropriate)
1. Where is the hazard creating the risk? (specify whether it is moving or stationary)		
2. Who and/or what will be harmed? (consider human health, organisms, ecosystems, communities, economies)		
3. How will they be harmed?		
4. How many will be harmed/by how much?		
5. How long will the harm continue?		
6. What characteristics potentially affect perception of these risks? *(e.g., human-caused or naturally occurring, chronic or catastrophic, etc.—see Table 1)*		

STEP 2: *Identify Risk Communication Goals and Challenges*

Once you have characterized a risk, you can begin creating an informed plan for communicating about it. First and foremost, you need to determine *why* you need to communicate. Your goals will usually involve empowering people to take action in some way. One way to think about your goals is to categorize your risk communication needs according to the following three categories:[6]

1. Communication to **promote changes in individual behavior** in situations where the risks and ways to manage it are well established. Examples:
   - Beach hazards communication to prevent drowning
   - Lightning safety messages
2. Communication to **encourage action in the face of extreme or sudden danger.** Examples:
   - Tsunami warning
   - Communication during a wildfire outbreak
3. Communication to **inform and encourage people to work together** to reach a shared decision on risk prevention or mitigation. Examples:
   - Communication around a natural resources damage assessment and restoration plan
   - Communication about sea level rise for a coastal community
   - Communication about risks of overfishing

Note that a risk can span more than one of these categories, and it can move between them over time. For example:

- Communication about harmful algal blooms (HABs) can include health risk messaging (promoting behavior change) as well as communication to support HAB mitigation strategies (helping people work together).
- Communication around risks from a major oil spill can span all three types: messaging on emergency response (action in the face of danger), seafood safety (promoting behavior change), and restoration planning (helping people work together).

Once you have broadly determined your risk communication needs, you can frame your goals in terms of the actions you hope to encourage or the behavior change you wish to bring about. (In Step 4, you will refine these goals according to the audiences you will identify.) For example:

- For beach hazards: Educate people about actions they can take to avoid being caught in a dangerous current—and to escape one if necessary.
- For sea level rise: Provide communities with information they need to plan for the effects of sea level rise.
- For tsunamis: Provide information to help coastal communities prepare for tsunamis, and warnings to get to higher ground or inland after an earthquake.

Communication around short-term risks, which may require immediate calls for action, differs significantly from that for longer-term risks, which typically focuses on education and support for decision-making. Step 4 provides additional guidance for addressing these different types of risk.

For each risk communication goal, think about what obstacles or challenges might make it harder to achieve the goal. Consider factors that influence perception of risk (Worksheet 1, Question 6). For example:

- Sea level rise: People might not trust agencies or scientists communicating the risk; it is difficult to communicate uncertainty in sea level rise projections; the risk does not seem immediate in many communities.
- Beach hazards: Swimming is a voluntary activity, so the risk seems more acceptable than some other risks; rip current messaging does not work for all dangerous currents; people may underestimate risks of dangerous waves and cold water.

In thinking about challenges, it is important to consider the characteristics of the specific audience groups with whom you are trying to communicate. Step 3 provides more detail about audience research.

Incorporating Sea Level Change Scenarios at the Local Level highlights the need to consider challenges to factoring sea level change into coastal community planning initiatives. These barriers include scientific uncertainty, varying perceptions of risk, and political implications unique to each location.

WORKSHEET 2: *Identify Risk Communication Goals and Challenges*

Instructions: For each risk you characterized in Step 1, fill out Worksheet 2. Identify the category(ies) of your risk communication needs. Within these categories, state the goal or goals you intend to achieve though risk communication. Finally, identify challenges you have faced, or anticipate facing, in achieving these goals. This step might require some speculation initially, but you might find it useful to update the list of challenges after you learn more about characteristics of your target audience(s) in Step 3.

Specific risk (from Worksheet 1): _____

Risk communication needs	Check one or more	Goal(s)	Challenges
Promote behavior change	☐		
Encourage action in the face of danger	☐		
Help people work together	☐		

STEP 3: *Understand Your Audiences*

One of the best practices for risk communication is to "speak to their interests, not yours."

This means you need to identify exactly who your audiences are—that is, who is your risk communication for? Whom do you want to empower to take action?

Your audiences include individuals and institutions directly affected (potentially harmed) by the hazard. In a sense, the term "audience" is misleading because risk communication is not a performance or a one-way activity. To be effective, you need to listen to the people you want to reach. Ideally, you will find out:

- What does your audience care about—their values and concerns?
- Who does your audience trust?
- How does your audience receive information?
- What does your audience already know about the hazard and associated risks?
- What barriers to taking action does the audience face?
- Does the audience perceive that taking action is possible and effective in mitigating risk?
- Who else is talking with your audience about the risks?

Make sure to research these questions, rather than just making assumptions about your audiences. If time and resources allow, you can gather this information through a variety of means, such as informal open houses, forums, workshops, or webinars; social media engagement; more structured interviews, focus groups, or surveys; and analyses of demographic and historical information (for example, marketing data websites and detailed U.S. Census data). While extensive research is not always possible, the key is to look for opportunities to begin a dialogue. What you learn during each conversation can help you tailor future conversations to what the audience finds important.

Credit: NOAA

- There is no single "general public" audience. For example, Risk Behavior and Risk Communication: Synthesis and Expert Interviews describes an audience segmentation analysis used to address the issue of climate change. Research on public attitudes identified six different audiences, ranging from "the Alarmed" to "the Dismissive." Reaching each segment calls for tailored communication; reaching segments at the extreme ends of the spectrum may be unachievable or unproductive.

Also, be sure to consider the unique needs and concerns of vulnerable sub-populations. Depending on the hazards and risks being addressed, populations of concern could include:

- Economically disadvantaged people
- Homeless people
- Elderly people
- Non-English speakers
- People living in institutions (e.g., nursing homes)
- People with physical disabilities (e.g., hearing or visually impaired) or mental disabilities
- Colorblind people

In addition to those directly affected by the hazard, your audiences include partners who can help shape and disseminate your communication (e.g., other federal agencies, nongovernmental organizations [NGOs], local media), people with decision-making authority (e.g., members of Congress, municipal officials), and people or groups who may oppose or derail your efforts.

Example Audiences to Consider

- State and local agencies/ officials
- Other federal agencies
- Tribes
- Emergency managers
- Congress
- Environmental advocacy groups
- Community/civic groups
- Homeowners or renters
- Parents of young children
- Health care community
- Business/trade organizations
- Recreational groups
- Insurers
- Media
- Real estate agencies
- Housing managers
- Religious leaders/ organizations
- Schools and educators

- Introduction to Stakeholder Participation provides guidance on identifying coastal management stakeholders and describes some of the most techniques for obtaining stakeholder input and participation.
- Risk Communication Basics presents a framework for understanding "Why People Do What They Do." It offers social science research to help understand how audiences may be influenced by experiences, feelings, personal values, and the ideas held by friends and family.
- Sharing Stories and Improving Discussions About Floodplain Buyouts describes how understanding the motivations and concerns of municipal officials was key to gaining their participation in a flood acquisition program following Hurricane Irene.
- Storm Surge Marketing analyzes the key audiences for risk communication materials designed to increase the public's understanding and response to storm surge. The document discusses the needs of each of these audiences: Weather Forecast Offices, the emergency management community, media, community decision-makers, community groups, and members of the public.

Credit: William B. Folsom, NOAA NMFS

WORKSHEET 3: *Understand Your Audiences*

Instructions: For each risk you characterized in Step 1, fill out Worksheet 3. Identify the audiences you will need to reach—those who may be directly harmed, vulnerable sub-populations, and partners or others you will collaborate with to communicate the risk. Answer questions 1 through 6 for each audience. Use more copies of the worksheet if needed for more audiences.

After completing Worksheet 3, go back and review Worksheet 2, "Identify Risk Communication Goals and Challenges." With a better understanding of your audiences and their needs, see if you need to revise the goals and challenges you listed on Worksheet 2.

Risk: _____

Risk communication needs	Audience 1: _____	Audience 2: _____	Audience 3: _____
1. What do they care about? Describe what you know about their values and concerns.			
2. Whom do they trust? *(institutions, news organizations, faith organizations, community officials, etc.)*			
3. How do they prefer to receive information? *(television, radio, news apps, in person, etc.)*			
4. What barriers might they face to taking action? *(denial, apathy, lack of trust, misinformation, feeling of stigma, economic challenges, etc.)*			
5. Who else is talking with them about the hazard and associated risks? *(community leaders, advocacy groups, local media, friends and family, etc.)*			
6. Describe any vulnerable sub-populations within your audiences, and potential needs to account for in communication about this risk *(e.g., language, socioeconomic status, disability)*			

A proven tool for risk communication is the "message map"—a template for developing detailed answers to anticipated questions and concerns from your target audiences. The process used to generate message maps can be as important as the end product. Message mapping is best conducted by a team (including, for example, scientists, communication specialists, and policy experts). (If these specialists are not available in your office, seek review from a collaborative partner in another office.) This process can reveal a diversity of viewpoints within an organization about an issue and can even indicate a need for changes in strategy or policy. The goal, however, is to create unified organizational messages for issues that may be controversial or of high concern.

To develop a message map (as shown in the worksheet on page 15), first **develop a list of questions** you anticipate needing to address about the hazard and its risks. Your overarching question will be "What do people need to know?" Audience questions will typically address human health, safety, trust, the environment, information, ethics, economics, responsibility, legal issues, the process, pets/livestock, religion, and fairness. (Refer back to the characteristics of the risk you identified in Worksheet 1.) Be sure to anticipate specific information people may want, as well as potentially hostile questions, such as "Why should we trust what you are telling us?," "Can you guarantee that people are safe?," and "What are you not telling us?"[7]

Then **brainstorm your answers to each question to create your key messages** and enter them on the message map (typically three messages per question). Finally, **provide three supporting facts or proofs for each key message**. You will use this three-part message map for anticipated questions in the communication products and activities you select in Step 5.

To Promote Changes in Individual Behavior

For risk communication designed to promote individual behavior change (e.g., avoiding lightning strikes), the following tips can help you develop effective messages:[8]

- Capture the audience's attention, using emotionally involving vivid scenes and lively language ("When thunder roars, go indoors!").
- Give the strongest points at the beginning of the message.
- Make sure your message clearly conveys the actions you are asking people to take.

Credit: NOAA

- Help your audience feel confident that they can take action (i.e., they feel empowered) and that taking this action will help mitigate or eliminate the risk.
- Provide good evidence for threats and benefits.
- Use an appropriate tone for the audience and topic. A serious tone is usually appropriate, but do not preach or dictate. Some audiences may respond to a humorous, light, ironic, or dramatic tone in messaging designed to influence their behavior.

To Encourage Action in the Face of Extreme or Sudden Danger

A central tenet of research on risk communication during emergencies is "mental noise theory." This theory states that when people are upset, they often have difficulty hearing, understanding, and remembering information. Mental noise can reduce a person's ability to process information by more than 80 percent. The following techniques help to overcome mental noise:[9]

- **Rule of three:** Keep the number of messages to three. In high-stress situations, people can process only three messages at a time instead of the seven they can normally process.

- **Primacy/recency:** Spokespersons should state the most important messages first and last. In high-stress situations, listeners often do not hear or remember messages in the middle of a list.
- **Average grade level minus 4 (AGL - 4):** During crises, messages should be at the average grade level of the intended audience, minus four. In the United States, message maps are typically constructed at a 6th to 8th grade reading level, instead of the typical 10th to 12th grade level.
- **Triple T model:** When time permits, present the full message map using the repetitive structure found in the "Tell me, tell me more, tell me again model," or "Triple T model": 1) Tell people what you are going to tell them in summary form (the three key messages); 2) Tell them more, (the supporting information); 3) Tell people again what you told them in summary form (repeat the three key messages).
- **Negative dominance (1N = 3P):** People tend to focus more on the negative than on the positive in emotionally charged situations. For this reason, it is important to balance negative key messages with positive, constructive, or solution-oriented key messages, offering three positive messages for every one negative. Also, avoid unnecessary, indefensible, or non-productive uses of absolutes like "no," "not," "never," "nothing," or "none."
- **Anticipate, prepare, practice (APP):** Spokespersons should anticipate questions, prepare answers, and practice ahead of time (do not "wing it").

To Inform and Encourage People to Work Together

Depending on the topic, audiences, and circumstances, messages used for this type of communication may draw on techniques for promoting behavior change or action in the face of danger, such as methods for overcoming mental noise. However, the audiences in this case are often already aware of the risks being addressed. Your emphasis should be on creating a dialogue and encouraging people to work together to decide how to manage, prevent, or mitigate a risk. You have an important role in informing this process with messages that convey the risks, uncertainties, and options. Just as important as your "answers," though, is your interest in the audience's concerns and proposed solutions. When people help identify ways to prevent or reduce risks, they feel empowered and are more likely to follow through.

Empathy in Your Messaging

Demonstrating empathy and compassion is key to establishing trust in any of the situations described above (see Figure 2). In a face-to-face situation such as a press conference or public meeting: listen, ask questions, echo

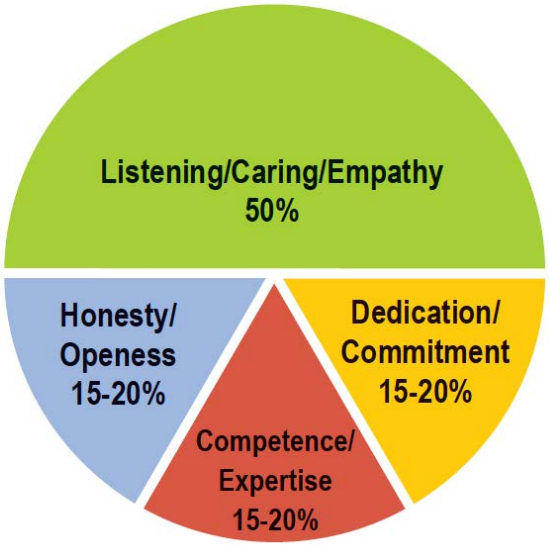


Figure 2. Some people mistakenly think they can build trust in a risk communication situation simply by projecting competence and sharing information openly. However, research shows that listeners actually form about half of their opinion of a speaker's trustworthiness based on the way the speaker listens to them and shows genuine care and concern.[10]

what you hear, find things to agree with, express reservations when you need to, do not interrupt, and do not take what you hear personally. You can express concern and empathy though statements such as:

- I hear that you are…
- That is a question we have asked ourselves.
- We recognize your concern about…
- Can you tell me more about…
- Let me see if I understand you… (rephrase)
- **NOT** I understand how you feel (because unless you are going through the same situation yourself, you *do not* understand how they feel!)

Uncertainty in Your Messaging

Most scientific information has some level of uncertainty. Rather than ignore or hide this uncertainty, effective risk communication acknowledges uncertainty and frames it in terms that the audience can understand.

Uncertainty can include data gaps, technology limitations, levels of confidence, differences in opinions, and much more. NOAA grapples with uncertainty from many sources, including:

- Inherent uncertainty in natural systems.
- Limitations or gaps in our knowledge of how natural systems work and interact.
- Limitations or gaps in the technologies (observation systems, methods, models, etc.) used to collect data and develop predictions and projections.

The amount of uncertainty information to convey in a given situation, and the best format to use, will depend on the audience, the purpose of the communication, the decision context, the type and source of the uncertainty, and the whether the uncertainty analysis is qualitative or quantitative.[11] Risk communicators routinely express uncertainty through numbers, words, graphics, or a combination of methods.

Many audiences appreciate being informed about uncertainty. For example, surveys have found that the public generally prefers weather forecasts that acknowledge uncertainty.[12] When communicating uncertainty, though, you must strike a balance. If you overemphasize uncertainty, you could understate the risk, overwhelm the audience, and leave them too confused to make a decision. Yet if you ignore or underemphasize uncertainty, you could lead people to make costly decisions that turned out to be unnecessary—which will then diminish your credibility for future communication. The key is to give your audience the right amount of information to empower them to make their own informed decisions. Being open about what you do and do not know creates transparency, which helps to build trust.

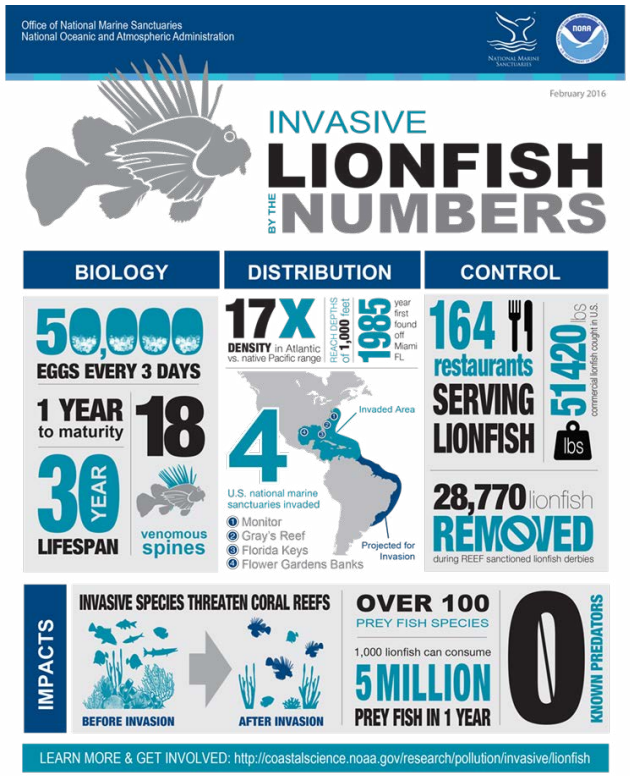


Table 2. Advantages and Disadvantages of Communicating Uncertainty Through Numbers, Words, and Graphics

Numbers	Words	Graphics
Many NOAA programs use percentages or ranges to convey probabilities or possibilities. Certain messages may take the form of *credible intervals*, such as: "I am X% certain that the true value is between Y and Z." Behavioral research has found that most people like to receive quantitative expressions of uncertainty.[13] Numbers offer precision and convey scientific credibility.[14] Numbers can be especially useful when they are presented relative to a threshold. For example, an experiment found that when uncertainty information was tied to a critical temperature threshold for treating roads to prevent ice, it led to better decision-making.[15] People sometimes misinterpret numbers, however—particularly concepts like the probability of precipitation or a "100-year flood." Also, too many numbers can overcomplicate your message for a non-technical audience.	Words such as "unlikely," "slight," "possible," "likely," "almost," and "certain" can allow for more fluid communication that capture emotions and intuitions without overwhelming non-technical audiences with numbers. However, different people may interpret the same word in very different ways. For example, "likely" might mean a 60 percent chance to one person and 80 percent to another.[16]	Visual aids that convey uncertainty include storm track projection maps with a "cone of uncertainty," mapping layers that show confidence in sea level rise projections, graphs with confidence intervals, and many other examples throughout NOAA. Engaging graphics can summarize a large amount of data and capture the audience's attention in ways that words and numbers alone cannot. For example, a study on flood perception found that graphics generate more concern about flood risk than numbers.[17] Graphics also help more advanced users; an experiment with forecasters found that a combination of an uncertainty chart with a box plot display was optimal for conveying uncertainty information.[18] However, some audiences struggle to interpret graphics correctly.

Consider a few practices recommended by seasoned risk communicators:

- Learn from your end users. What level of complexity and detail they want and need? How sensitive are their decisions to the level of certainty you convey? What methods (numbers, words, graphics) work best for them (Table 2)?
- Do not be afraid to say that scientific knowledge can change and evolve ("Based on what we know today…"; "We will continue to learn more.") and acknowledge where data are unavailable ("We do not yet know…").
- If contradictory results exist, acknowledge the discrepancy and explain it if possible.
- Describe what steps are being taken to learn more and reduce uncertainty.
- Present uncertainty in the middle of your message—not the beginning or end. You should lead with what you know, to establish common understanding, and end with the most important point you want people to remember.
- Provide context for any numbers that you use to represent probability or uncertainty.
- Avoid using scientific terms that mean something completely different to non-scientists (Table 3).

- Risk Communication Basics provides guidance on framing messages that connect risk perception with sound communication strategies. It presents "dos and don'ts" for messaging approaches, communication tips, and sample conversations.
- Coastal Inundation Toolkit presents guidance for creating effective presentation of risk messaging for communities on coastal inundation, including highlighting local knowledge, using social media, and creating data visualizations to share information about hazard threats in the community.
- Understanding Risk Behavior: The Fundamental Challenges summarizes best practices for communicating risk and changing behavior, including starting small; using social norms to your advantage; and presenting easy-to-understand, actionable information.

Table 3. Words Matter [19]

When you are communicating about uncertainty, non-scientists might perceive your words quite differently than you intended, so take care to choose words that convey your intended meaning. Examples of commonly misunderstood scientific terms—and better alternatives—include:

Scientific term	Public meaning	Better choice
Theory	Hunch, speculation	Scientific understanding
Uncertainty	Ignorance	Range
Error	Mistake, wrong, incorrect	Difference from exact true number
Bias	Distortion, political motive	Offset from an observation
Anomaly	Abnormal occurrence	Change from long-term average
Conservative	Politically conservative	Cautious, protective

Credit: Mimigu, Creative Commons

WORKSHEET 4: *Create Your Messages*

Instructions: For each question you anticipate about the hazard and its risks, develop three key messages and three supporting facts/proof for each message. At least one of your key messages should acknowledge and describe uncertainty, with supporting facts that identify what is known or not known about the issue in question. For example, if the question is "How much will sea level rise in Miami by 2050?" one key message could describe the range of likely values, one could describe how certain these values are, and one could provide some actionable information about mitigation or adaptation. Use multiple copies of this worksheet to address multiple questions.

For now, just focus on getting the basic messages on paper. Refinements to the wording can come after Step 5, when you consider how you might need to tailor your words and presentation for specific audiences, platforms, and formats.

Message Map

Audience/stakeholder: _____

Question: _____

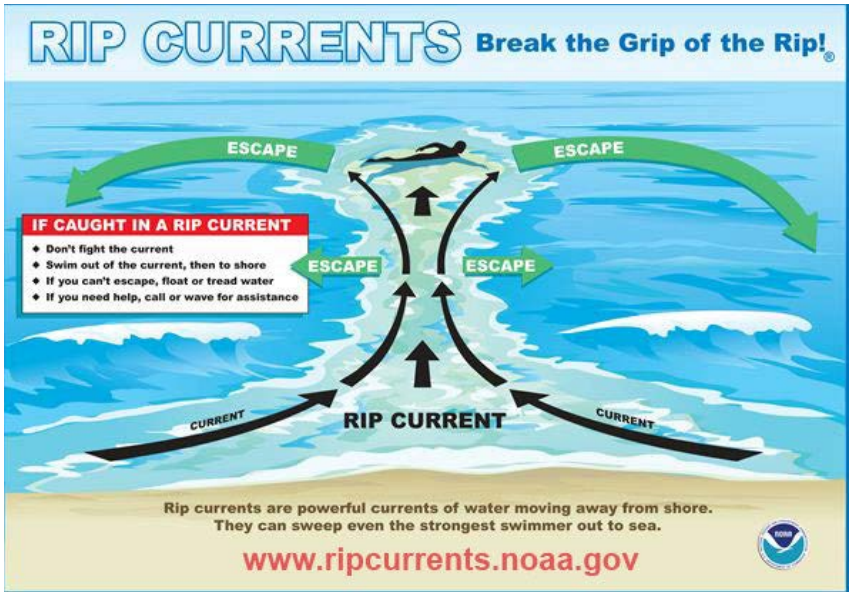
Key message 1:	
Supporting information 1:	
Supporting information 2:	
Supporting information 3:	
Key message 2:	
Supporting information 1:	
Supporting information 2:	
Supporting information 3:	
Key message 3:	
Supporting information 1:	
Supporting information 2:	
Supporting information 3:	

Review the characteristics of your audiences (Step 3) and potential barriers to their understanding and taking action. Below are some ways to reach your audiences and overcome common barriers.

Start with the bottom line (Figure 3). People want to know why they should care—the "so what" question. If you answer this question early on, your audience will be more likely to pay attention to the details. Make your key messages clear and repeat them often.

Language matters. Avoid jargon, acronyms, and words that have different meaning for scientists and members of the public (for example, "organic" "aerosol," and "positive feedback"). A helpful resource is the Plain Language Action and Information Network, www.plainlanguage.gov. Translate materials into languages other than English as needed, and work with partners ensure that the language you use is culturally appropriate for your audiences.

Use graphics and visualizations. Graphics, photos, interactive web-based tools, videos, and other visually oriented products can capture the audience's attention, make risk information easier to understand, and help people recall key information. Video is increasingly popular; watching video accounts for an estimated one-third of the total time people spend online, and more than 70 percent of all internet traffic is video.[20]



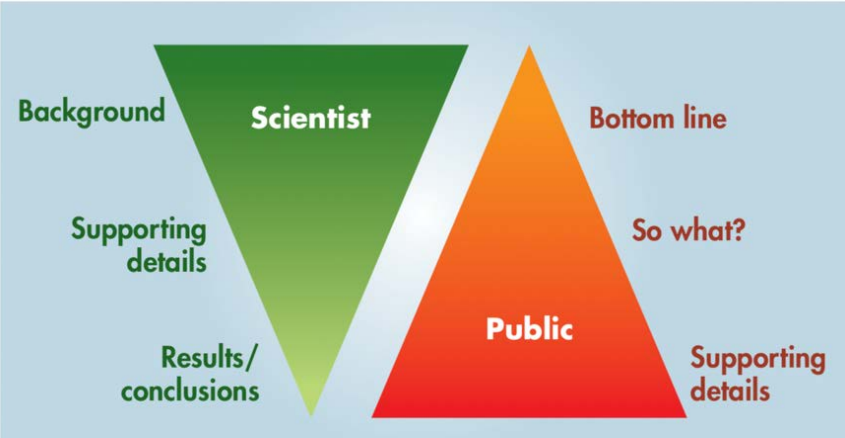


Figure 3. Scientists can communicate more effectively with the public by inverting the pyramid of their usual presentations to colleagues. Scientific publications typically begin with background and supporting information, ending with results and conclusions. In communicating with non-technical audiences, begin with the bottom line: why should people care?

Select channels that best reach your audiences. Consider how your audiences prefer to receive information (social media, traditional media, in person, etc.), and develop your products accordingly (e.g., videos or tweets for social media, presentations or handouts for in-person meetings). As noted in Step 3, you can learn more about your audiences by engaging them directly as well as by talking with others within NOAA who might have worked with them before. Use multiple channels and platforms to increase the reach of your message. Combine "one-way" channels (such as fact sheets or webpages) with channels that allow for two-way interaction (informal meetings or open houses, hotlines, Twitter). Be aware that you may have to tailor your message to the constraints of the channels you choose—for example, if your visuals need to be readable on a smartphone screen, or if your words must fit within Twitter's character limit.

Partner with trusted intermediaries. Delivering the message through a variety of trusted sources at the local, state, and/or federal levels can help audiences accept and internalize risk information and change behavior. Trusted sources might include local health or safety professionals, respected community members, clergy, nonprofit groups, and state or local government officials. For example, one study found that in emergency risk communication, local officials and emergency responders were more trusted than federal officials.[21] If you use messengers from multiple organizations, make sure all are sharing consistent messaging.

- What Is Storm Surge? and Tsunamis: Be Prepared and Stay Safe! are easy-to-understand whiteboard videos, available in multiple languages.
- Tidal Flooding is a self-guided animation explaining how tidal flooding affects coastal communities and how to prepare.
- Are You Flood Ready? is a concise infographic that describes flood risks for houses in flood zones and how to prepare.
- #SafePlaceSelfie is a social media campaign with a simple message and call to action to raise awareness about preparing for extreme weather.
- Sea Level Rise Viewer visualizes community-level impacts from coastal flooding or sea level rise.
- Coastal Flood Exposure Mapper is a tool for creating maps to visualize the people, places, and natural resources exposed to coastal flooding.
- Coastal County Snapshots is a data visualization tool that provides managers and citizens with easy-to-understand charts and graphs that describe complex coastal data.
- Coastal Inundation Dashboard is a visualization tool that provides real-time and historical inundation information at NOS stations.
- How to Avoid Getting Caught in a Rip Current is a website that provides a variety of information about rip current risks and safety.
- Flooding Resilience Meeting Template is a customizable template for local officials and those conducting public outreach in coastal communities. Presenters should add as much local context as possible so it will resonate with a local audience. This resource includes tips on risk communication, stakeholder engagement techniques, and use of interactive graphics.
- Bite-Sized Science is a series of short videos that focus on specific activities and projects from the NOAA Weather Partners in Norman, Oklahoma.

WORKSHEET 5: *Find the Best Ways to Convey Your Messages*

Instructions: For the set of key messages you developed in Step 4, identify your means for delivering those messages to reach each of the target audiences you identified in Step 3. For each audience, think about the platform, the format, and how you'll adapt the message(s) to the format (for example, creating succinct messages and a hashtag on Twitter, or creating a video with dramatic footage or testimonials). Also think of trusted intermediaries (if applicable) you could use to deliver the messages. You might consider existing products or campaigns that could serve as models. Use additional copies of this worksheet if you need to develop distinct strategies for specific key messages.

Key messages: _____

Audience	Platform (in-person meeting, press conference, social media, webpage, etc.)	Format (infographic, video, web content, maps, fact sheet, presentation, etc.)	Ideas for adapting the message(s) to this format	Intermediaries (local or state official, community member, local NGO, etc.)

Testing with representatives of your target audience is a critical step in developing your messages. Do not just show them to your family or co-workers—they are not the audience!

Begin by asking subject matter experts not directly involved in your original message mapping process to validate the accuracy of technical information contained in the message. Then test your messages with surrogates for the audiences you want to reach, through such means as focus groups, interviews, and surveys (following Office of Management and Budget information collection requirements). In doing so:

- Work with in-house experts to ensure a proper sample design that accounts for the various audience segments you are trying to reach.
- Tie the questions you ask to the goals you want to achieve in communicating the risk (Step 2). For example, does the message motivate your audiences to make a desired behavior change? Does it clearly convey a need for urgent action? Does it encourage groups to agree on a plan or policy change?
- Look for areas of confusion or lack of clarity: Are any terms hard to understand? Does the audience interpret a graphic the way you intend?
- Ask for suggestions for improvement, so you can refine the message to better meet your goals.

In addition, consider testing your messages with partner organizations. This will help overcome inconsistent messaging among different risk management organizations, which erodes trust and credibility.[22]

Testing watch, warning, and advisory messaging with attendees at an American Meteorological Society conference. Credit: ERG.

- Great Lakes Beach Hazards: Developing a Risk Communication Strategy for Dangerous Waves and Currents describes testing of messages designed to motivate behavior change, via an online survey, focus groups of practitioners, and in-person surveys of beachgoers.
- Summary of Hurricane Local Statement Social Science Projects describes collection of qualitative data using focus groups and interviews with broadcast meteorologists, emergency management personnel, and community leaders. These stakeholders reviewed prototypes of updated and reformatted local statements issued by Weather Forecast Offices when an area is under tropical cyclone threat.

WORKSHEET 6: *Test Your Messages*

Instructions: In the table below, list a key message you developed in Step 4 (use additional worksheets for multiple messages). Next, list key questions you would like to answer through testing (reflecting your goals from Step 2). For example, if your goal is to change behavior, you might ask a test audience, "How likely is this message to motivate a change in your behavior?" Then identify the audience(s) you will test the messages or products with, and how you will conduct the testing. Note that your testing may need to account for specific ways in which a message will be disseminated (e.g., will the message take the form of a tweet, an infographic, or text for a fact sheet?).

Message: _____

Questions (e.g., how clear and understandable? how likely to motivate the audience to change behavior?)	Audience(s) for testing	Testing methods (focus group, interviews, survey, etc.)

STEP 7. *Identify Metrics for Evaluating the Risk Communication Plan*

In Steps 2 through 6, you created key elements of a plan to communicating the specific risk you identified in Step 1. Your risk communication plan should also address how you will monitor and evaluate your messages, products, and activities once you begin implementing the plan.

Your office is probably already tracking **outputs or performance metrics,** such as the number of webpage views, report downloads, Twitter followers, Facebook likes, conference attendees, and brochures distributed. These "process" metrics can tell you something about the number of people exposed to your messaging and the number of times people hear a message.

Process metrics give you information about whether your plan is being implemented as intended. However, they do not tell you if you are actually achieving your goals. Therefore, you should also identify what you will measure to track **outcomes.** Outcomes are short-term or long-term results of a given activity, such as measured comprehension of risk messages or increased use of a NOAA product or service, or fewer deaths and injuries.

Measuring outcomes can require complex data collection efforts, economic studies, and longitudinal research—possibly over a long timeframe. If in-house expertise to track outcomes and impacts is not available, consider using an outside organization that specializes in evaluations. Table 4 presents some questions to answer when evaluating the three main forms of risk communication.

The following resources provide more detailed guidance on conducting evaluations:

- Planning for Meaningful Evaluation has a section on performance evaluation.
- Common Data Collection Methods for Evaluation is a short tip sheet summarizing the purpose, advantages, and challenges of common data collection methods.
- Fischhoff, B., N.T. Brewer, and J.S. Downs. (eds.) 2011. Chapter 3: Evaluation. In: Communicating Risks and Benefits: An Evidence-Based User's Guide. Silver Spring, MD: Food and Drug Administration.

The metrics you track will flow from your evaluation questions. Your metrics can be qualitative or quantitative, and can include both process and outcome measures. They can be collected through a wide range of methods, such as surveys, interviews, focus groups, observation, and media content analysis. Your evaluation will include analyzing the data you have collected; communicating the results; and adjusting your risk communication plan, products, and messages to reflect lessons learned from the evaluation.

Table 4. Some Evaluation Questions for Risk Communication [23]

Communication to promote behavior change	Communication to encourage action in the face of danger	Communication to help people work together
• Were all members of the audience, including vulnerable populations, reached and informed? • Did the audience understand the risk well enough to make decisions? • Did the audience change to less risky behavior? • How long did the behavior change last?	• Were all members of the audience, including vulnerable populations, alerted to the risk? • Did the audiences understand the risk and the recommended actions? • Did the audiences take the recommended actions? If not, why not? • Was consistent information given to audiences about the risk (across the agency and among organizations)?	• Were all segments of the audience represented in building consensus? • Did the communication engage the audience in decision-making? • Did the audience understand enough about the risk to make decisions? • Was a consensus reached about the decision? • Can the decision be implemented?

WORKSHEET 7: *Identify Metrics for Evaluating the Risk Communication Plan*

Instructions: For the risk communication plan you are implementing, identify your evaluation questions and brainstorm ideas about what you could measure, how you could collect data (e.g., surveys, website analytics), and how often you could collect the data.

Risk communication plan for: _____

Evaluation question	Metrics (outputs and outcomes)	Data collection sources and methods	Frequency of data collection

STEP 8: *Identify Staff and Resources Needed*

In this step, you will identify the staff and resources you need to implement and evaluate your risk communication plan. Table 5 lists some of the functions and skills that might be needed. You might be able to identify or cultivate the needed skills within your office, or you might need to identify resources elsewhere within or outside the agency to accomplish your risk communication goals. NOAA's Performance, Risk, and Social Science Office (PRSSO) provides risk communication support across the agency and can help you find resources if needed. Contact PRSS.SocSci@noaa.gov.

The following NOAA training resources are available to strengthen line offices' capacity to conduct effective risk communication:

- NOAA Social Science Basics: Online, self-guided training course focusing on social sciences (e.g., psychology, economics, geography, sociology) that support NOAA's mission and help the agency decide how to communicate effectively, prepare necessary support services, and determine where services are needed.
- Building Risk Communication Skills: In-classroom, instructor-led training that provides insights into how and why people respond to risk and helps participants develop new skills to better connect with a variety of audiences.
- Seven Best Practices for Risk Communication: An instructor-led, interactive webinar that introduces participants to seven best practices, numerous techniques, and examples for communicating about coastal hazards.
- Coastal Inundation Toolkit: Online, self-guided training that shows how data, tools, and other information within Digital Coast can help communities tackle coastal inundation.

Table 5. Potential functions and skills needed to implement and evaluate a risk communication plan

Team function	Skills and attributes needed
Leadership	• Decision-making authority • Management skills • Spokesperson skills
Message development and outreach	• Subject matter expertise • Social science expertise • Community outreach experience • Cultural competency • Writing • Web development • Graphic design • Social media expertise • Social marketing expertise • Translation
Communication monitoring and evaluation	• Research • Analysis • Digital expertise • Media monitoring expertise
Media relations	• Media relations • Risk communication expertise • Public speaking • Writing skills
Partner relationships and communication	• Leadership • Networking/liaisons • Community outreach • Spokesperson skills

WORKSHEET 8: *Identify Staff and Resources Needed*

Instructions: Column 1 identifies functions you may need to implement the risk communication plan that you have developed through Steps 1–7. If you think of additional functions, add them to the blank rows at the bottom. In column 2, list skills that would be helpful for each function. List potential staff members for each function in Column 3 and identify additional training needs (if any) in Column 4. If you determine that you will need resources outside your office or group, list them in Column 5.

1 Team function	2 Skills needed	3 Staff member(s)	4 Additional training needed	5 Outside resources needed
Leadership				
Message development and outreach				
Communication monitoring and evaluation				
Media relations				
Partner relationships and communication				

TAKE THE NEXT STEP

Risk communication is integral to achieving NOAA's mission. Every line office must deal with risks and how to communicate them to key stakeholders—whether those stakeholders are internal audiences, policymakers, or members of the public who depend on NOAA data to plan and inform their activities and make critical decisions.

Staff throughout the agency are encouraged to use this practical guide as a tool for planning and implementing effective risk communication strategies. Working through this guide sequentially will help you characterize risks, set goals, understand the needs and characteristics of your audience, create messages and a strategy for getting them across, test your messages, determine how you will measure results, and gather the right resources for the job. These planning steps should give you a solid foundation for communicating effectively.

Ultimately, NOAA and its stakeholders can all benefit as the agency continually improves the way it communicates about risk and uncertainty. This guide offers a starting point, but many more resources are available from PRSSO (PRSS.SocSci@noaa.gov) for anyone who wants to continue to build skill and confidence in risk communication.

NOTES

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