Operational Topic

Effective communication is essential for a successful response to a radiological incident or accident regardless of the scale of the occurrence.

Radiation Communication: Thoughts and Considerations

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Abstract: *The importance of effective communication cannot be overstated. What you say and how you say it matters, and this is a basic truth of effective communication. A misunderstanding of radiation effects can lead people to make decisions they may not have otherwise made had they been more aware of the true nature of the potential hazard. When addressing topics that may cause anxiety in people, it is important to communicate in understandable terms while still relaying factual and useful information. It can be difficult to take a complicated topic and simplify it into terms that are easily understood, all while maintaining factual integrity. However, communication is more than simply the words we say. Most people understand the roles body language and physical appearance have on message reception. Additionally, many people overlook other considerations that may help to motivate behavior change, such as emotion, social networks, and group identity. While the communicator may not have a firm grasp on all communication complexities, one characteristic that should be embraced by all communicators is empathy. The word "radiation" can be a scary—or otherwise anxiety-inducing—word. It can cause stress and fear in many audiences, including first responder audiences. We must understand and address that people may be afraid or otherwise anxious before we tell them what to do. Whether helping an individual who has radiation-related concerns about an upcoming medical procedure or influencing the public's willingness to accept protective action recommendations during a radiation emergency, the consequences of effective communications can be far reaching and significantly affect both small-scale and large-scale responses to radiological incidents. Health Phys. 128:257–263; 2025*

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INTRODUCTION

NOBEL PRIZE-WINNING playwright George Bernard Shaw said, "The single biggest problem in communication is the illusion that it has taken place." Former President of the United States Gerald Ford said, "Nothing in life is more important than the ability to communicate effectively." British film composer John Powell said, "Communication works for those who work at it." These are just three of the many thoughts shared by successful people who understood the importance of effective communication.

When a radiation emergency occurs, one of the initial challenges is to effectively communicate the situation to varying audiences. It is necessary for someone with radiological expertise to assist the individuals/groups preparing and delivering the messages to provide clear, understandable, and accurate information. Integration of health physicists into the process of radiation communications is something that should be considered by anyone responsible for message preparation, development, and delivery.

Scenarios where the individuals/groups preparing, developing, and delivering the messages should consider assistance from a radiological subject matter expert. Areas for assistance may include supporting message development intended for the community regarding a radiological release, advising physicians or other medical care professionals about potential effects, explaining potential risks – or lack thereof – to individuals impacted by an incident, providing just-in-time training to responders, and others. The ability to successfully integrate radiation-related expertise into a response and communication scenario requires not only a recognition of the need, but access to a health physicist or qualified radiation protection professional with an ability to break down complicated concepts into an understandable manner for a broad audience. Many radiological specialists think that because they are experts

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on radiation it makes them experts on communications relating to radiation. However, this is not always the case.

DISCUSSION

Anecdotal evidence suggests that there is a misunderstanding and resulting anxiety related to what radiation can and cannot do. This anxiety was personally experienced by one of the authors (Sugarman) very early in his career. After spending months at the waste processing facility where he was surveying condenser tubes as his first radiation-related job while going to school at a local community college that offered an Associate of Science in general science with an emphasis in health physics, he was assigned to do basic job coverage in the plant. It was nothing complicated and the radiation and contamination levels were low. However, after returning home he felt a tingling sensation in his upper lip when he began trying to remember if he had inadvertently touched his face while at work in the plant. Intellectually knowing full-well that it could not be radiation-related (and having surveyed "clean" out of the facility), the tingling did not stop for a few hours until his anxiety levels lowered. This was an important lesson that continues to follow him to this day: It does not matter that people may know something, what matters at first is what they are feeling and thinking at that point in time. Once people are calm and open to the facts is the time to deliver them for maximum results.

Impacts on safety

Effective communications during a radiological incident—be it intentional or accidental—can save lives as well as the livelihoods of those living in affected communities. Varying audiences are going to need information and guidance whether it is technical input, public health guidance, medical consultation, responder risk communication, or a myriad of other potential possibilities. Health physicists and other radiation protection professionals can have a significant impact on how this information is developed; however, they must first understand what is needed and be integrated into the communications process. Integrating health physicists and other radiation professionals into the information management cycle can address people's perceptions and resulting anxiety during radiation emergencies (see Fig. 1).

The first question in Vincent Covello's 33 Item Risk and Crisis Communication Checklist (Covello 2016) based on the Center for Risk Communication's Risk Communication/High Concern Communication Template Document asks is, "Did you present information in a clear manner? Did you present information that can easily be understood by the audience and build up the complexity incrementally?" followed by "Were your sentences short (for example, 10-12 words on average)?" and then followed by "Did you avoid the use of jargon, acronyms, or technical language that would not be understood by your target audience?" When it comes to communicating crisis or emergency information about more unfamiliar hazards, such as a radiation emergency, addressing these first questions is vital to ensure effective communication occurs so people can make informed decisions.

Increasingly, the types of hazards organizations face continue to evolve. This evolution means planning for, responding to, and recovering from disasters that present new, unique, and different challenges. These challenges require organizations to recast their understanding and thinking about disasters and how to develop and implement crisis communication planning (Edmond 2011). Decades of research have been conducted in the fields of risk and crisis communication that have informed communications professionals as to how people process information during high-stress, high-concern incidents and during emotionally charged situations. Communications professionals have largely integrated this research into their communication strategies and quite often employ these strategies during more familiar crises and emergencies, such as weather events, with actionable best practices and lessons learned gleaned after implementation of these strategies. However,

FIG. 1. Information management cycle.

when confronted with more unfamiliar situations, such as a radiation emergency, professional communicators have not had as many opportunities to employ communication strategies to assess if their plans, policies, and procedures were successful or not. Additionally, some organizations fail to even include plans, policies, and procedures for communicating during a radiation emergency due to the perceived low probability of such incidents occurring. In a world of emerging threats, communicators must be equipped with the proper leadership support, skill sets, and organizational plans, policies, and procedures in a well discussed and practiced environment to successfully communicate effectively during these types of high-consequence incidents.

Communication complexities

Radiation risk communication is quite complex and made so largely by people's risk perception. A key barrier is the term "risk" itself, how it's measured, described, and ultimately perceived. People perceive risks differently, and people do not believe that all risks are of the same type, size, or importance. A review of the literature shows there is not a direct connection between risk perception and preparedness behavior (Wachinger et al. 2013; Bourque et al. 2013). Research identifies multiple factors that tend to amplify people's concern or outrage. These include the degree to which people feel they have control over the risk, i.e., smoking cigarettes versus an imposed incident; whether the risk is perceived as natural or man-made, i.e., a weather event versus a nuclear power plant accident; the degree to which it is familiar, i.e., weather events versus a chemical explosion or terrorist incident or if there is an associated lack of trust in responsible institutions that manage the risk (Hooker et al. 2017.). In any high-outrage risk issue, the chief task of communication is to address the outrage, not to state or debate assessments of the hazard itself. The best foil for outrage is to build sustainable public trust (Sandman 2014).

Many radiation experts agree that policies, procedures, licensing requirements, and other risk-mitigation mechanisms result in nuclear power and its associated waste posing less risk than perceived, and depending on the procedure, radiation doses from certain medical procedures can result in greater radiation-related risk to the patient than perceived. However, according to research by Paul Slovic, surveys of the public in the United States and elsewhere have shown people perceive radiation risks associated with medical uses as acceptable and radiation risks associated with nuclear power and nuclear waste as unacceptable. This is likely because people see the benefit of diagnostic and therapeutic uses of radiation such as CT scans, nuclear medicine, and cancer treatment while the waste from a nuclear power plant is seen as a hazardous by-product of a process for producing electricity. This research demonstrates the importance of communicating strategically when providing information about radiation and its risks. Communicators must address this perception gap by employing risk communication strategies that help people place the risks of radiation into perspective. According to Slovic, "One useful principle that has emerged is that comparisons are more meaningful than absolute numbers or probabilities, especially when these absolute values are quite small" (Slovic 2012).

However, it's also important for communicators to use appropriate comparisons. Comparisons must be relevant if it is to increase understanding and lessen confusion (Jorgensen and Moscovitch 2011). For example, radioactive iodine in milk is not equal to radioactive potassium in bananas, just as the acute dose from a chest x-ray is not directly comparable to the longer-term dose from a nuclear medicine procedure or other internal contamination event. One must be careful to consider the situation and audience for which a comparison is being used. All too often comparisons can create more questions than they answer. What works for a discussion with an individual where rapport and trust have been built may not work in a group setting where the speaker is not a well-known or trusted entity to the audience.

This strategy is amplified in FEMA's Planning Guidance for Response to a Nuclear Detonation (FEMA 2022) document in which planning and executing nuclear detonation education campaigns related to other hazards, i.e., leveraging all-hazards messaging in preparedness outreach, is an identified best practice as people are less likely to resist learning about protecting themselves and their families from this type of incident (a more unfamiliar risk) if they understand the same basic protection principles apply to other, more familiar emergencies. For example, initial protective actions for a nuclear detonation or a dirty bomb scenario are similar to the same initial protective actions for a tornado: people must "Get Inside, Stay Inside, and Stay Tuned" for more instructions (FEMA 2022). During an emergency involving radiation, the public is mainly interested in (1) The associated health effects, and (2) What to do now (Jorgensen and Moscovitch 2011). Communicators must communicate these two points prior to discussing technical issues such as dose levels or other technical information. Similarly to how air is essential for life, providing people with A.I.R. – alerting, informing, and reassuring – is essential for effective communication during a radiation emergency (see Fig. 2).

While education plays a key role in bridging this perception gap, effective risk communication should be integrated into existing

plans, policies, and procedures and practiced in meaningful ways through drills and exercises to build capacity. During a crisis event, organizations need to be prepared to provide guidance to the public on how to best protect themselves. According to Edmond (2011), "Authorities should be well-versed on (1) the appropriateness of the protective actions, (2) the when, where, who, what, why, and how protective actions will be determined and articulated, and (3) protecting the health and safety of the greatest number of residents, utilizing the best available resources." Crisis communication plans facilitate the distribution of this type of information to the public. It is imperative organizations develop an implementable plan that clearly helps the organization articulate response and recovery actions.

Perceptions and emotions

Previous incidents have shown that people will oftentimes make decisions based on their perceptions and emotions. For instance, in January of 2021 a New Jersey high school was evacuated because of a report of a potentially dangerous substance that was brought into the school that turned out to be uranium-238. A student had been gifted a radiation detector (Geiger-Mueller detector) for Christmas. He had been testing it on a uranium-glazed plate at home. He decided to break off a small part of the plate in order to have a small source that could be used in his classroom should the opportunity arise. He took it to school to show it to a teacher. An administrator subsequently saw it and noticed it was labeled as radioactive. At that time authorities were notified, and an evacuation of the school was initiated.

Although the evacuation was short-lived—approximately 30 minutes—it initiated a response by local fire and emergency teams, as well as law enforcement. It also attracted news helicopters and concerned parents. Later that afternoon it was announced there did not appear to be any danger to the public. The amount of uranium-238 was small; however, the fact it was radioactive and was in sufficient activity to be easily detected by a Geiger-Mueller detector sparked this response. While officials should not be chastised for taking actions they felt were appropriate to protect the health and safety of the students, the magnitude of the response does speak to the potential misperceptions and apprehension many people have about radiation.

Preconceptions and biases can also play a part in how preparatory messages may be received. In July of 2022, New York City Emergency Management released a public education video, available on the NYCEM YouTube channel, describing the "get inside, stay inside, and stay tuned" advice for what to do in the event of a nuclear detonation as a public education tool. The video was short, to the point, and well-presented. A quick internet search looking for thoughts about the video revealed an interestingly mixed bag of reactions. While many reactions were positive, several took a different view. Most negative comments centered around the fact that a nuclear detonation would result in mass destruction, therefore staying inside a building would not be of help. Individuals who reacted negatively to the public education video did not consider—or understand—the message was intended for people outside of the initial blast area where fallout is the primary concern and not for those in the areas devastated by the blast, or that the guidance was not intended as a way of minimizing prompt radiation doses. It also elicited significant concern about why this video was needed as evidenced by stories by multiple media outlets. This illustrates the importance of taking the time to set up and socialize the message and to carefully identify the intended audiences. It also illustrates that no matter how good a particular message is, there will be those that disagree or otherwise want to point out its perceived flaws. This is an important consideration because research shows that mental noise and preconceptions, which can impair

FIG. 2. Air: Alert, Inform, Reassure.

information processing, are hurdles that even the best messages must overcome. Therefore, proper message framing—especially around something as misunderstood and anxiety-inducing as radiation—should be an integral part of public message development, particularly in the preparedness phase.

According to risk communication researcher and scholar Peter Sandman (Sandman 2014), "Absent a stunning event, it takes powerful messaging and endless repetition in the media to break through the clutter and establish the existence of your issue in the minds of your audience." Human beings are superb rationalizers. We seek information that confirms our preconceptions and validates our existing behaviors so we can tighten our grip on what makes sense to us relative to how we believe the world works. We work hard to avoid the "cognitive dissonance" that results from learning information that disconfirms our preconceptions or invalidates our existing behaviors (Wood and Miller 2021). The term cognitive dissonance is used to describe the mental discomfort that results from holding two conflicting beliefs, values, or attitudes. An example of cognitive dissonance would be if someone holds the belief that maintaining a healthy lifestyle is important but maintains a sedentary lifestyle and eats unhealthy food. They may experience dissonance between their beliefs and their actions. Cognitive dissonance research by Wood and Miller (2021) shows that well-intended disaster management messaging not only can produce an undesirable public reaction but can also solidify public sentiment to resist or deny that very message. Cognitive dissonance can be a root cause for ignoring low-probability, high-risk events and can be labeled as "disaster blindness" (Wood and Miller 2021). According to research on cognitive dissonance in the context of disaster risk communication, risk messaging must be transparent, relatable, simple, straightforward, and clear; the source of the communication must be trusted; and public engagement is paramount. The audience must feel it can somehow influence the outcome and must feel involved in its safety decisions. When crisis messaging encourages even the slightest audience participation, dissonance is reduced, and adoption rate of the message increases (Wood and Miller 2021).

This is also supported by Covello's seven cardinal rules for the practice of risk communication (US EPA 1988), which acknowledges, "Accepting and involve (ing) the public as a legitimate partner" as the first cardinal rule. Professional communicators can employ this practice through framing risk communication into a story that also asks the audience to participate in some way. Additionally, research suggests there's a strong correlation between risk perception and self-efficacy, which is a person's judgement of how effectively they can follow a recommended course of action (Wood and Miller 2021). The audience should be included in some task or action, i.e., check in with your elderly neighbors when it's safe to leave your building, that allows them to feel like they are actively participating in the solution, and communicators can integrate actions plans into their communication strategy that address: (1) what should be done, (2) what can be done, and (3) what must be done to effectively address what people can do immediately during a radiation emergency—all of which should be informed through technical expertise and translated into understandable, meaningful messages for various audiences.

Mental noise

Radiation communication is made even more complex by mental noise. When people process information during high stress or emotionally charged situations, they commonly experience "mental noise" (Covello and Milligan 2010). Mental noise creates an inability to process information rationally. When mental noise reaches significant levels, some people are unable to hear, understand, or remember information at all. Communicating radiation risk to the public typically requires technical jargon and language that nontechnical stakeholders do not understand. However, it should be avoided when possible. Two major mistakes made by those responsible for communication: (1) assuming the public is technically savvy and knowledgeable and (2) assuming the public is completely technically illiterate. Both assumptions can lead to communication mistrust and suspicion regarding radiation emergencies. Understanding what causes stress for those with whom we are communicating is important to understand so we can address those stresses and concerns in a meaningful way through impactful messaging. This helps connect with our audience on an emotional level and validates their feelings even if science does not. Empathy certainly plays a key role in this; however, taking it even further, we need to develop messages that directly address these stresses and fears to not only better connect with our audiences but to build trust and rapport when it matters most.

Based on our understanding of mental noise and research that demonstrates people have a diminished ability to process information during high stress, high concern and during emotionally charged situations, communicators should integrate radiation technical experts into message development to ensure accuracy of the information while also integrating science-based communication principles into key messages. Risk and crisis communication research has provided communication professionals with an incredible amount of data to inform message development for better message

success. Message success refers to the effectiveness of messages based on human behavior. If people follow the guidance communicated in a message, then the message is successful. If communication professionals can communicate their messages in no more than three key messages using 27 words or less that are read or spoken in less than nine seconds, research points to the message being more successful. During radiation emergencies, achieving message success can be even more complex as very technical and sometimes more unfamiliar hazard information must be communicated in a way that is understood, clear, impactful, and actionable for the message receivers.

Effective communication considerations

The primary author (Sugarman) has extensive experience with radiological communications. Experiences during his 35+ year career have left some indelible impressions—first and foremost being that while the technical aspects of health physics and radiation protection can present some real challenges, it is the communication aspects of radiation protection that seem to be the most challenging. It can be extremely difficult to effectively and understandably communicate the potential risks associated with varying radiation exposures to people that do not already have a fundamental understanding of radiation and how it works. American journalist Sydney J. Harris said, "The two words 'information' and 'communication' are often used interchangeably, but they signify quite different things. Information is giving out; communication is getting through." Radiological facts may be provided, but that does not mean the message is received.

One needs to understand it is not uncommon for people's ideas about radiation to have been strongly influenced by popular culture, be it comic books, television shows, thriller novels, or by other means. It is incumbent upon those helping to develop messages or provide the messages themselves to recognize the hurdles that may be faced and to take actions to clear those hurdles. Recognizing people may be anxious about radiation—regardless of the reason—and having empathy for their anxiety is a good starting point. "Nobody cares how much you know until they know how much you care," is a quote that, although others are credited, is often attributed to Theodore Roosevelt. Regardless of the source of the quote, it rings true, yet is oftentimes not considered when communicating technical or otherwise complicated information to an audience that may be apprehensive about the topic.

Simply because someone may be considered a technical expert does not mean they are the right person to deliver or help develop every message. The message deliverer needs to be a skilled communicator that can not only deliver the intended message effectively but be able to answer anticipated and unanticipated questions in a manner that is understandable to the audience. In a 2020 interview with the Ohio State News, Dr. Hillary Shulman, lead author of The Effects of Jargon on Processing Fluency, Self-Perceptions, and Scientific Engagement said, "The use of difficult, specialized words are a signal that tells people that they don't belong." Along with empathy, effective radiological communication requires a skillset that must be developed, practiced, and continually improved.

The media is another entity that influences people's perceptions about radiation. "Radiation hazard," "radiation leak," and "anti-radiation pill," are commonly used phrases when a radiation event has occurred. While phrases such as these may seem somewhat innocuous, their influence on people's radiological perceptions should not be ignored. Not all radiation poses a measurable hazard. Its hazard is dependent upon dose, dose rate, tissues irradiated, etc. However, the repeated association of radiation with it being a hazard in the media, regulations, or other areas reinforces the general perception held by many that all radiation is hazardous. In some contexts, diagnostic or therapeutic medical uses of radiation may be more heavily considered as a benefit as opposed to a hazard; however, the risk associated with a particular dose delivered to the same area at the same dose rate is not influenced by whether it came from cobalt-60 in radioactive waste or from cobalt-60 from a medical procedure. We should consider other options such as "radiological concern" or "radiological considerations" whenever possible in an attempt to lessen the anxiety associated with radiation and radioactive materials and hopefully make an audience more receptive to the message that is being delivered. Radiation does not leak, but there may be a leak of radioactive materials. The heat coming from a hot cup of coffee is analogous to radiation being emitted from radioactive material in a container, yet very few—if any—would consider it a leak. Conversely, everyone recognizes that if there is a hole in the cup and coffee is coming out that material (in this case coffee) is leaking. People can quickly conceptualize leaking materials, which may help to better understand a particular situation. There is no such thing as an anti-radiation pill, but it is a term that has repeatedly been used in the media, most often in relation to potassium iodide—a blocking agent used to minimize uptake of radioiodine by the thyroid. There are plenty of other examples and efforts for how to best express radiation-related information in a way that may result in a reduction of anxiety and mental noise should be considered whenever possible. This can be achieved through integration of appropriate technical experts into message preparation, development, and delivery.

CONCLUSION

Emergency response preparations should include the integration of trained health physics personnel into communication plans. Health physics professionals obviously play a huge role in the radiation protection arena, be it performing radiation dose calculations, ALARA planning, job coverage, environmental monitoring, decommissioning, etc. This intimate knowledge of radiation and its effects make them a vital part of a radiological communications team. Assisting with the preparation, development, and delivery of radiation-related messages is an area where radiation protection professionals can have a tremendous impact on both pre- and post-event messaging success. However, health physicists should be careful not to fixate on ensuring all messages are 100% technically accurate. The overall goal is to ensure the message is being communicated in a way such that the receiver understands what is being said and can apply it in a useful way. Mental noise, cognitive dissonance, and other contributing factors should be considered. Thought should be given to whether it is better to be 100% accurate but potentially have the general message be lost in the details or be 90% accurate with the technical details yet have the message be better received and understood. This is equally important whether it is helping to develop materials to be given to patients about to undergo a medical procedure involving radiation, talking with a worker about an exposure concern, or assisting with public messaging following a large-scale incident. While changing public perceptions and understanding about radiation is a large undertaking with much work still to be done, progress can be made toward positively affecting general perceptions about radiation. Small steps such as paying attention to the words one uses, being empathetic to people's apprehensions, considering how people process complex information, and continuing to practice and hone one's communication skills can go a long way toward improving radiological communication and, ultimately, has the opportunity to save lives.

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