Case Studies in *Identifying and Addressing Inaccurate and Misleading Scientific Information*

The National Academies of Sciences, Engineering, and Medicine prepared and published a Guide that explains how scientists can work collaboratively across scientific disciplines and sectors to identify and address inaccuracies that could fuel mis- and disinformation about biological threats. This supplementary "case study" document provides an example of practical application of the how-to-guide using a scenario that is based on real experiences.

The creation and spread of misinformation, disinformation, and malinformation (MDM), that builds on inaccurate, misleading, misinterpreted, and/or hyped scientific information, can result in social and individual harms. Within the public health context, the consequences of false claims can vary from limiting response efforts such as poor vaccination rates, mask-wearing, and cooperation with heath aid workers to affecting national and regional efforts to detect, assess, and control outbreaks and epidemics.

This case study provides an illustrative example of how to use the Guide to address the spread and influence of misinformation on different audiences. This case study has been generalized from real experiences of familial decision-making about the SARS-CoV-2 vaccination in Southeast Asia. Working with individuals from various audiences may allow scientists to explore key influences, influencers, and assumptions of their primary audiences. This type of approach was highlighted in the 2022 report as critical to science communication.

The Guide provides a four-step process for addressing claims, including:

1. Evaluating the claims to determine whether scientific inaccuracies should be addressed
2. Identifying the expertise needed to correct claims
3. Defining the methods for correcting the scientific inaccuracies
4. Communicating the correct information and uncertainties

Resources

National Academies of Sciences, Engineering, and Medicine. 2022. A Guide for Scientists to Identify and Address Misinformation. Washington, DC: The National Academies Press. https://nap.nationalacademies.org/resource/26466/02_A_Guide_for_Scientists_to_Identify_and_Address_Misinformation.pdf

Interactive Guide, https://nap.nationalacademies.org/resource/26466/interactive/

The Scenario

During an epidemic with a newly emerging infectious disease, scientists, governments, private industry, and foundations work internationally to characterize the microbe that causes the disease and the disease itself. Building on years of research, scientists create a new type of medicine to prevent the severity of disease, but not infection with current and future strains of the microbe. Given the concern about the epidemic, a well-educated family, which consists of elderly parents, adult children, and young grandchildren, choses to take the medication. However, an individual who assists the family on a daily basis, including caring for the grandchildren, is unsure about getting the medication based on information she receives about its effectiveness and safety through various online sources including websites and social media platforms. By not receiving the medication, the family feels that their assistant would be placing herself and the elder members of the family in harm's way, specifically by risking infections associated with newer strains of the microbe. This concern leads the family to seek information from the country's premier public health and scientific institutions, including the country's Ministry of Health,

Academy of Sciences, an internationally-recognized biomedical sciences research institution, and a local healthcare provider.

In this same scenario, a scientist who works in one of the country's premier public health and scientific institutions speaks with friends and family via various social media platforms. She hears questions and comments about the epidemic and new medications being developed. The scientist reads posts stating a variety of viewpoints, such as "the medicines are not safe to use", "they are not halal", "they have microchips embedded", or "they cause the infections and disease." The individuals who post the information cite articles and data that have not been properly reviewed and analyzed by the scientific community. In fact, some of the referenced articles have serious flaws in the science described. These posts and inaccurate information about the medicines and epidemic response elicit significant concern between the scientist and her colleagues. She decides to use an international resource, the Guide produced by a multidisciplinary, international committee of scientists, to determine whether and how to address the claims.

Addressing the Claims: Illustrative Example of Using the Guide

Step 1: Evaluating the Claim
The scientist first determines whether to address the claims by characterizing them, their sources, and their ability to be effectively corrected through scientific analysis. The scientist uses the framework below to address the following questions. This framework is from Step 1 of the Guide, and involves asking each question in-turn to determine whether the claim should be addressed and can be addressed using scientific analyses.

Question		Response
Could the claim cause significant harm or damage to public health, national security, or other social systems, either directly or indirectly through influencing individual behaviors?	What are the consequences of the claim to society?	The misinformation about the medicine led to concerns about the safety and contents of the medication, resulting in people (including the assistant in the scenario) not willing to take the medication. This refusal to use the preventative medication can extend the duration of the epidemic, resulting in illnesses and death that could have been prevented by the medication.
	Are the effects of the consequences significant?	Yes. In an active epidemic, not protecting people from illness and death from an infectious disease is significant.
Can scientific knowledge or analysis counter a particular claim?	Does the claim reference scientific information, processes, or experts?	Yes. Information about the medication contents, preparation, and effects in the body are scientific.
	Could accurate, defensible science counter specific claims or rationale underpinning the claim?	Yes. The contents of the medication, its production method, its protective ability (i.e., efficacy), and safety profile can be described.
	Does scientific consensus already exist?	Maybe. If the medication is approved for use, perhaps it has been tested and evaluated

		sufficiently to arrive at a consensus of safe and effective for use in the affected population.
Do scientific knowledge or data exist to provide accurate and defensible scientific information to counter a particular claim?	Are scientific data and/or information, either published or unpublished, available to quickly and easily correct claims?	Yes. Information about the medication type, contents, observed side effects, and protective ability are available. This information may be shared by the organization that developed, manufactured, and/or distributed the medicine. Or, the information may be available through various government agencies, such as those that regulate medication approvals and Ministries of Health.
	Are there other existing resources in the public domain that can be leveraged to address a claim?	Yes. Other sources of information may be pathogen surveillance systems, international health organizations who assist with epidemic response, and academic scientists who work with the specific microbe.
Could addressing a particular claim amplify it, resulting in greater, rather than reduced, harm?	Is the claim being shared widely and through various social media, media, and other means?	Yes.
	Do shared claims connect to prevalent themes or topics in the public debate, which suggests that the claim may be amplified?	Yes. The claims are relevant to epidemic response and if the corrective information is not communicated effectively, the misinformation could be amplified.
	Is the claim not shared widely, but might reach or otherwise influence key policymakers or audiences?	No. The claim is shared widely through various online sources.
	Could addressing the claim cause it to be shared and believed more widely or have a long-lasting lifespan?	The misinformation presumably already is widely shared via online platforms. Additional amplification of the claims may not be a risk given the widespread nature of the claim.

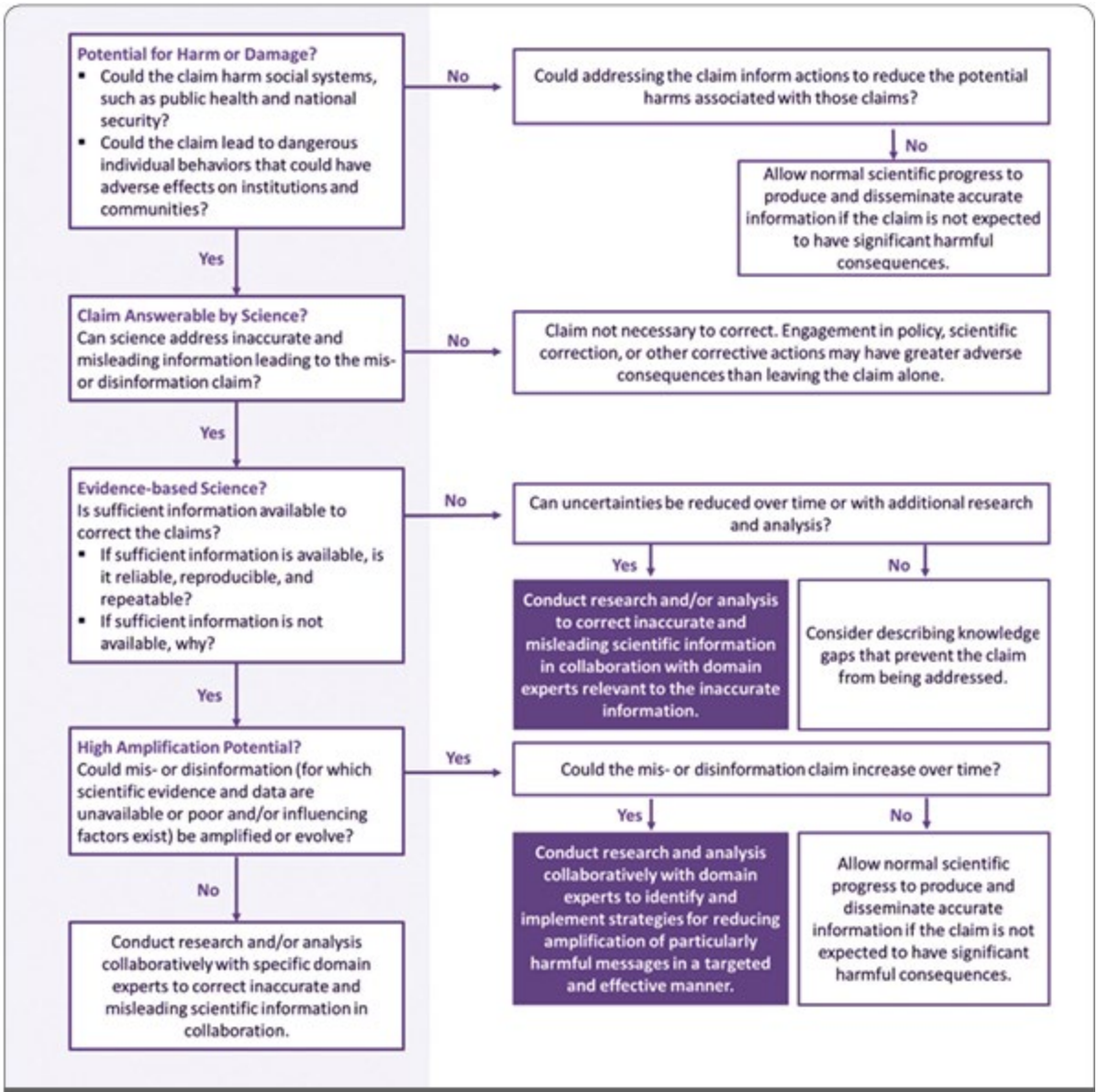

FIGURE 1 Decision-making framework for determining whether a claim should and can be addressed through scientific analysis, peer review, and/or communication. Ideally, scientists would evaluate whether to counter claims by discussing the claim with a trusted group of qualified scientists across the life, social, and computer sciences. These groups may be part of an established or newly created network, or an ad hoc set of experts. SOURCE: Adapted from Krause et al., 2022.

Step 2: Identifying the Expertise

Now that the scientist has decided that the consequences of not correcting these claims results in significant public health harms, she focuses on trying to address the claims. She starts by determining the appropriate expertise needed to address the claims.

Question		Response
What discipline-specific expertise is needed to address misinformation?	What scientific information is needed to address the false claims?	Information about the medication type, contents, observed side effects, and protective ability are available. In addition, the main influencers who are propagating the misinformation and methods for communicating the corrective audience to the intended audiences.
	What life, social, and computer science skills and expertise are needed to address scientific inaccuracies and counter associated false claims?	Life sciences, immunology, microbiology, biochemistry, clinical and health sciences, medicine, science communications, risk assessment, data science, and regulatory/policy.
Scientists with what expertise and experiences should be engaged to address misinformation?	Do the domain experts within your trusted scientific network have the appropriate skills and expertise to address the inaccurate information?	The scientist realizes that her network has some of the expertise, mostly the life and health sciences expertise. But, the scientist realizes she needs to reach out to experts in data and social sciences.
	What domain expertise exists outside of your network but is needed to address the inaccurate information?	Science communications, risk assessment, data science, and regulatory/policy.
	Do the identified experts have strong scientific credentials (e.g., publication record, scientific expertise, reputation, scientific excellence awards, and leadership positions)?	In seeking experts who are outside the scientists' network, she reviews their publications, biographies, research expertise, and other relevant information. Through this review, the scientist identifies several scientists with the needed expertise with whom to work.
	Are scientists from all relevant disciplines and sectors involved in your collaborative team for addressing the inaccurate information?	The scientist reaches out through her network and to the others who she identified to assist with correcting the inaccurate information. Once compiled, she determined that her small group had the disciplinary breadth needed to address the inaccurate information.

Step 3: Defining the Methods

The scientists next determine the most relevant and effective approaches for addressing the claims. They both characterize the claims and source and identify the most appropriate methods for identifying or producing accurate information that correct the false information.

Question		Response
What is the claim and its source?	What is the source of the inaccurate and misleading information or resulting misinformation claim?	The claims were posted and shared via online platforms including online news sources, social media, and websites.

	What is the credibility of the source of the inaccurate and misleading information or resulting misinformation claim?	The online platforms are not credible scientific sources. They were not peer reviewed journals, scientific associations, or other credible sources.
	What is the reach of that source?	Because of their online nature, all sources reached numerous members of the broader public and policy communities.
	Has the inaccurate and misleading claim been referenced in other sources?	The misleading claims were posted, tagged, and reposted many times via social media.
	Has the claim been repeated elsewhere?	Yes. The misleading claims were posted, tagged, and reposted many times via social media.
What approach should be used to address the claims?	What scientific inaccuracies and associated claims already are being addressed? What still needs to be addressed?	The scientists' group determines that much of the information to correct the claim is being shared via credible sources such as peer reviewed scientific articles, national government agencies such as Ministries of Health, and credible international health organizations. Information about efficacy and safety in a larger, diverse population and against new strains of the microbe still need to be addressed. But, these data are not always accessible in an ongoing epidemic.
	What approach will you use to correct scientific inaccuracies?	The scientists will compile all of the known data and results and evaluate the methods, statistical analyses, and results from published studies and regulatory approval information, if accessible.
	What resources are needed to correct scientific inaccuracies or build the scientific foundation to counter particular misinformation claims?	Peer reviewed articles, applications for approval of the medicines by regulatory bodies, and criteria and results of the regulatory review.

Step 4: Communicating the Correct Scientific Information

Now that the scientists have identified or produced the accurate, defensible information to correct the inaccuracies and correct the false claims, they determine how best to communicate the accurate information. During this process, they identify the audience and the most effective approach for reaching their audiences, ensuring that they do not inadvertently amplify the false claims. They use specific characteristics and best practices for communicating the accurate information, which are listed in the two boxes below. Both boxes are from Step 4 of the Guide.

Question		Response
Who is the audience and what are their needs?	Who are the primary and secondary audiences?	The primary audiences are public health officials, scientific associations, credible science journalists, community leaders, and others who are viewed as authoritative messengers of accurate information. The secondary audience are members of the broader public, some of whom believe the misinformation about the medicine.

	Have you been working with a science communication expert on your team?	Yes. The scientist identified science communication as a needed expertise and included a science communicator in her group.
	Is your approach to communication based on mental models?	The scientists decide to use a narrative approach (i.e., storytelling) communicating the corrective actions. They seek to identify the assumptions, concerns, and biases of their secondary audiences, in particular, to develop messages that can be clearly understood and accepted. They also ensure that their messages are factual and defensible, ensuring they effectively communicate to their primary audiences.
	What are your communication goals?	The scientists' goals are to dispel the false information about the medicine so people have accurate and evidence-supported information about the medicine.
	What uncertainty is associated with the correct information? How is uncertainty described for information for which little or no scientific consensus exists? How has uncertainty been captured in the corrective message?	The scientists include in their narrative clear statements about what currently is known, what remains unknown, what may change if and as new data and information are produced, and how the scientific community works to reduce risks so people can reap the benefits.

BOX 11 CHARACTERISTICS OF COMMUNICATING SCIENCE

CHARACTERISTIC 1

When developing your message, avoid jargon. Effective science communication stays away from jargon or unfamiliar words and uses terms that make sense to a broader audience. If scientific terminology must be used, explain it in more commonly understood terms.

CHARACTERISTIC 2

When creating your message, use framing messages to connect scientific information to cognitive schemas that matter to your target audience.

CHARACTERISTIC 3

When developing corrective messages, use charts, graphs, images, and other visuals to avoid jargon and make an audience comfortable with a topic.

CHARACTERISTIC 4

When developing messages for non-technical audiences, highlight the correct information rather than the misinformation.

CHARACTERISTIC 5

When developing the message, discuss the broader contextual impact of the misinformation claim and corrective message, which may help audiences understand why addressing the claim is important even if they may not understand the scientific processes behind the counter-argument.

BOX 12 BEST PRACTICES FOR SCIENCE COMMUNICATION

Actions that enhance science communication

- Employing evidence-based strategies for effective, tailored messaging in collaboration with life, social (including science communication), and computer scientists
- Referring audiences to trustworthy sources for defensible, accurate information
- Promoting collaboration between domain experts and science communicators
- Preparing information in formats accessible to the audience
- Using simple, clear, and concise language when explaining the science to lay audiences
- Being patient, empathetic, and sympathetic

Actions that reduce effectiveness of communicating science

- Overstating your expertise
- Using jargon, formulae, or complicated scientific terminology except with domain experts
- Telling people what to do without elaborating the advantages
- Overwhelming people with information
- Repeating misinformation by retweeting or sharing
- Challenging or ridiculing personal and religious beliefs that might promote motivated reasoning
- Insulting, belittling, shaming, or embarrassing people when they have shared or believed misinformation

SOURCE: Wettstadt and Shuttleworth 2020.

Scenario Resolution

The information that the scientist helped to correct allowed the premier scientific institutions in her country to share accurate information that countered the incomplete and sometimes false information accessible through online platforms. The family, whose assistant had concerns about the medication because of the misinformation spread through various online platforms, accessed the accurate information, providing it to their assistant. In the end, the assistant received the medication and reduced health risks to the family.