Guidelines for Communicating Epidemiology and Public Health

Genomic Epidemiology Program

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Introduction

Effective communication is one of the ten essential public health services, and communicating complex topics and data to the public is challenging (CDC, 2024). The previous era of public health communications conformed to the "information deficit model" that assumed that raising the public's general knowledge of public health information improved abilities to understand, interpret, and apply specific guidance. The deficit model, however, is unsupported by scientific evidence (Akin and Scheufele, 2017). While public audiences do use their general understanding of science to interpret information, this is a small component of information processing (Allum et al., 2008). Instead, lay audiences rely on their values and ideals (Nisbet and Scheufele, 2009). The deficit model also propagates the view of an unintelligent public, risking further harm to the public-science relationship (Nisbet and Scheufele, 2009). Moving beyond the deficit model requires understanding and implementing evidence-based practices for communicating public health information in a way that reflects public health's values of meeting communities' needs and its systems of self-correction (Jamieson, 2017).

This handbook seeks to share evidence-based strategies for communicating public health information and data. These strategies are organized into thirteen guidelines across five sections. The first section, Essentials for Clear and Concise Writing, draws on the information presented in Gopen and Swan's 1990 article "The Science of Scientific Writing" and the Duke University Graduate School Writing Center.[1] It includes guidelines one through three: Use Proper Grammar, Ensure Cohesion and

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Coherence, and Be Concise. The second section, Communicating Concepts in Public Health and Epidemiology, includes guidelines four through six: Appeal to Credibility and Shared Values, Set a Realistic Scope, and Employ Rhetorical Devices. The third section, Communicating Data, includes guidelines seven through nine: Present Simple Numbers, Display Accessible Visualizations, and Prioritize and Explain Data. The fourth section, Communicating Uncertainty, includes guidelines ten and eleven: Be Reasonably Transparent and Create an Expectation of Change. The fifth section, Misinformation Prevention and Response includes guidelines twelve and thirteen: Emphasize Consensus and Distribute Warnings and Corrections. Additionally, this handbook provides a rubric to evaluate existing public health communications based on the evidence-based guidelines. Finally, the Additional Resources section shares sources for further information.

Essentials for Clear and Concise Writing

All forms of effective communication include clear and concise writing. Writing is clear when the audience can sufficiently understand and interpret the communication content. When writing is concise, the audience can quickly and easily interact with the content. In communications with non-expert audiences, including the public, clarity and concision are even more important. Guidelines 1–3 provide some essential principles for writing with clarity and concision.

Guideline 1: Use Proper Grammar

The most essential principle in clear writing is the use of proper grammar. When grammatical norms are broken, even simple messages become hard to understand. While an in-depth review of grammatical rules is outside the scope of this handbook, the Additional Resources section provides links to helpful sources.

Guideline 2: Ensure Cohesion and Coherence

Cohesion and coherence improve writing clarity by guiding a reader's "train of thought" along a single topic or "track". In literature, cohesion is how well sentences connect to each other—like train cars. Coherence is how well those connected sentences stay on the same track. This paragraph demonstrates good cohesion but poor coherence:

> *My favorite animal is the domestic cat. Cats were domesticated almost*
>
> *10,000 years ago in ancient Mesopotamia. Mesopotamia is a name that*

literally means "the land between two rivers," taken from Greek. The

Greek Language is one of the oldest written languages, and its alphabet

forms the basis of many other writing systems, including Latin. Latin…

In this paragraph, the author demonstrates cohesion by starting each sentence with the idea presented in the preceding sentence. In general, this is a good strategy as readers will understand writing better when sentences lead with familiar information and conclude with unfamiliar information. Similarly, readers expect context to come first in a sentence, followed by the message at the end of the sentence. Because the end of a sentence is the "stress position," readers will be more likely to retain the information found there. Consider the following paragraph:

Farmers try to provide optimal growing conditions for crops by using soil

additives to adjust soil pH. Garden lime, or agricultural limestone, is made

from pulverized chalk, and can be used to raise the pH of the soil. Clay

soil, which is naturally acidic, often requires addition of agricultural lime.

Because the second and third sentences put new information *first*, the reader will need to backtrack. By moving some of the information around, the paragraph will gain more cohesion and be more understandable to the reader:

Farmers try to provide optimal growing conditions for crops by using soil

additives to adjust soil pH. One way to raise the pH of the soil is an

additive made from pulverized chalk called garden lime or agricultural

limestone. Agricultural limestone is often added to naturally acidic soils,

such as clay.

However, as shown in the first example, a lack of coherence across sentences disorients the reader. To ensure coherence, make the first and last sentences of a paragraph match—like the engine and caboose on a train. Readers expect thoughts to be expressed in paragraph units with a single paragraph corresponding to a single topic. Organizing topics into paragraphs with matching introductory and conclusion sentences also cues readers to what information is about to be presented. The first sentence should introduce the topic and the last sentence should emphasize the takeaway while setting up the start of the next paragraph. All the sentences in between the engine and caboose should fill in the topic and lead toward the takeaway.

Guideline 3: Be Concise

Writing concisely about complex topics can be difficult. The communicator must illustrate the complete picture without providing more detail than needed. At the beginning of the writing process, you must decide how much detail your audience needs to arrive at the desired conclusion.

Readers do not passively read; they interpret information as it is presented to them. The role of the communicator is to make it easy for the reader to interpret that information. The best way to do this is to match reader expectations for basic sentence components: subjects and actions.

The first piece of information a reader looks for in a sentence is the subject – who is the sentence about? To make this information easy to find, structure your sentences with the "main character" as the grammatical subject. Consider this sentence:

The movement in the liquid medium of the bacteria was accomplished by

microflagella.

The grammatical subject in this sentence is "movement in the liquid medium," but that

likely is not the best "main character." Consider this revised sentence:

The bacteria move themselves in the liquid medium with microflagella.

Here, there is a clear and concise grammatical subject, the bacteria, and the sentence

is shorter and easier to understand. Similarly, keep the subjects of your sentences

simple. It may be tempting to define a complex, abstract subject and describe what it

does in a single sentence, but this often results in long, complicated sentences. For

example, the sentence below can be split into two sentences for better clarity and

concision:

Before: *The sequences that had passed our filtering, trimming, and*

alignment with ClustalX were scanned for conserved elements across

mammals.

After: *The sequences were trimmed, filtered, and aligned with ClustalX.*

The resulting alignments were scanned for conserved elements across

mammals.

The second piece of information a reader looks for in a sentence is the action –

what does the subject do? To make this information easy to find, structure your

sentences with an action as the sentence's verb. Non-verbs that reflect action, called

nominalizations, inhibit a reader from understanding what the subject is doing. Consider

the following sentences:

Poor: *The ABC database has been subject to different improvements, modifications, and extensions in structure and content over the years.*

Better: *The ABC database has been improved, modified, and extended in both structure and content over the years.*

Best: *The curators have improved the structure and content of the ABC database.*

The best version of the sentence has both an active subject and an action-filled verb.

Once a sentence has a clear subject and action, make it easy for a reader to connect those two pieces of information by keeping subjects near their verbs. Complex subjects or non-essential clauses often add too many words between a subject and the action, making it harder to understand who the sentence is about and what they are doing. The sentences below demonstrate the value of having simple subjects (highlighted in blue) and verbs (highlighted in yellow) that are near each other.[2]

Before: *==Farmers== that understand the difference between the soil requirements of plants when they are seedlings and their requirements when they are mature ==are== high in demand.*

After: *==Farmers== ==are== high in demand if they can understand the difference between the soil requirements of plants when they are seedlings and their requirements when they are mature.*

In addition to the above structural components, concision is achieved by using simple words and omitting needless words. Often, simple words convey the same meaning as longer, more complex words while being easier to read and understand.

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[2] Note that this example demonstrates two important concepts. Clarity is achieved by (1) restructuring the sentence so that the subject and verb are close to each other and (2) simplifying the subject.

Table 1 provides some examples of complex words and phrases and their simpler counterparts. Public health practitioners and epidemiologists also use many words unfamiliar to the public. These terms may also convey different ideas and feelings to different audiences (e.g., surveillance). Public health communicators may need to "translate" these terms into more familiar words. The Centers for Disease Control and Prevention's (CDC) Everyday Words for Public Health Communication Tool and the University of Michigan's Plain Language Medical Dictionary may be helpful for translating industry-specific words (see Additional Resources).

Needless words include common or cliché phrases and unnecessary adverbs or adjectives. These words and phrases typically add excess length or grammatical structure without contributing meaningful content. Table 2 provides some examples of needless words and phrases.

Many of the concepts highlighted in the first 3 guidelines are part of "plain language," a framework for maximizing readability and audience understanding. For a more complete summary of plain language guidance, see the CDC's Laboratory Communications Toolkit in the Additional Resources section.

Table 1; Simplifying complex or lengthy words and phrases.

Instead of…	consider….	Instead of…	consider….
Modification	Change	A decreased amount of	Less
Impediment	Hurdle	Are of the same opinion	Agree
Erroneous	Wrong	As a result of	Because
Ineffective	Poor	At the conclusion of	After
Magnitude	Scale	In the event that	If
Alleviate	Relieve	For the reason that	Since
Accentuate	Stress	Take into consideration	Consider
Elucidate	Explain	On those occasions in which	When
Utilize	Use	To the fullest extent possible	Fully
Methodology	Method	Present status	Status
Etiology	Cause	New initiative	Initiative

Table 2; Low Information Content Words and Phrases

Low Information Content Words and Phrases to Avoid		
It appears that…	There is little doubt…	Interestingly…
It may be said that…	A large majority of…	At this point in time…
Needless to say…	It is important to realize…	This is a subject that…
It is believed that…	Broadly	In order to…
The majority of…	Very/Really/Extremely	Phenomena
First of all…	It is important to note that…	It should be noted that…

Communicating Concepts in Public Health and Epidemiology

Before communicating public health data and its interpretation, audiences must be sufficiently oriented to the foundational concepts supporting the data and interpretations. Communicating topics that are complex, even for subject matter experts, is challenging because of the public's variable baseline scientific literacy. For example, 49% of Americans surveyed by the National Science Foundation incorrectly thought antibiotics are effective against both bacteria and viruses, but 76% correctly defined a pathogen's incubation period (National Science Board, 2018; Kennedy and Hefferon, 2019). Guidelines 4–6 provide some strategies to convey complex information to lay audiences.

Guideline 4: Appeal to Credibility and Shared Values

Audiences are inundated with information from a variety of sources. In this free market of information, communicators need to be perceived as impartial and honest while representing shared values (Jamieson, 2017). In most communication formats, however, it is difficult to establish impartiality and honesty directly as these traits develop over time. Instead, communicators can leverage existing institutional or scientific credibility. Most U.S. citizens trust science as an institution, scientists themselves, and government public health organizations (3M, 2022). Some formats (e.g., websites and news releases) intrinsically leverage institutional credibility by appearing in association with the institution. Even these formats, however, can further appeal to the credibility of science as an institution (i.e., a collection of scientists and their academies or traditions), a body of knowledge, or a process. Communicators

leverage scientific credibility when they refer to professionals as "scientists" and information or the process of producing information as "science". By explicitly referring to science, communicators also convey concepts of self-correction and objectivity that heighten credibility (Jamieson, 2017). Some audiences, however, may interpret a reference to "science" as a concrete fact rather than a reliable method for collecting and interpreting evidence. To avoid this undesired interpretation, practice reasonable transparency as explained in the Communicating Uncertainty section of this guide. The scientific concepts of self-correction and objectivity also reduce politicization (see Misinformation Prevention and Response section) (Jamieson, 2017). Other, community specific shared values such as community safety, privacy, or ethics similarly increase trust. Leveraging institutional and scientific credibility along with shared values increases the likelihood that audiences will trust the information presented.

Appealing to shared values, however, may be complicated by the presence of alternate perspectives and attitudes toward language and the concepts it conveys. For example, the term "herd immunity" conveys a sense of success for public health experts, but the same term may appear to the public as a comparison to cattle (Jamieson, 2017). Similarly, the term "surveillance" may elicit images of government overreach and spying to the public rather than a positive, public health activity (National Cancer Institute, 2011).[3] The public may also consider scientific information in a much broader context than anticipated. Food safety concerns, for example, may be connected to debates on modern food manufacture, environmental health, and market monopolization (Ferrari, 2017). Communicators must then consider which aspects of a

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[3] Rather than "herd immunity," consider "community immunity." The CDC's Everyday Words for Public Health Communication Tool recommends "collecting or gathering information" rather than "surveillance."

topic they are the most credible in and which shared values to highlight. Considering alternate meanings and perceptions of language may prevent miscommunication and strengthen appeals to shared values, increasing message efficacy.

Appeals to scientific or institutional credibility and shared values do not have to be extensive. Consider the City of Amarillo, Texas webpage on wastewater epidemiology. While seemingly straightforward, the use of the word "scientists" and the list of academic partners is an appeal to scientific credibility (City of Amarillo Department of Public Health, 2024). Similarly innocuous, the New York State Department of Health's wastewater dashboard emphasizes a commitment to privacy, likely a shared value in their community (New York State Department of Health, 2024).
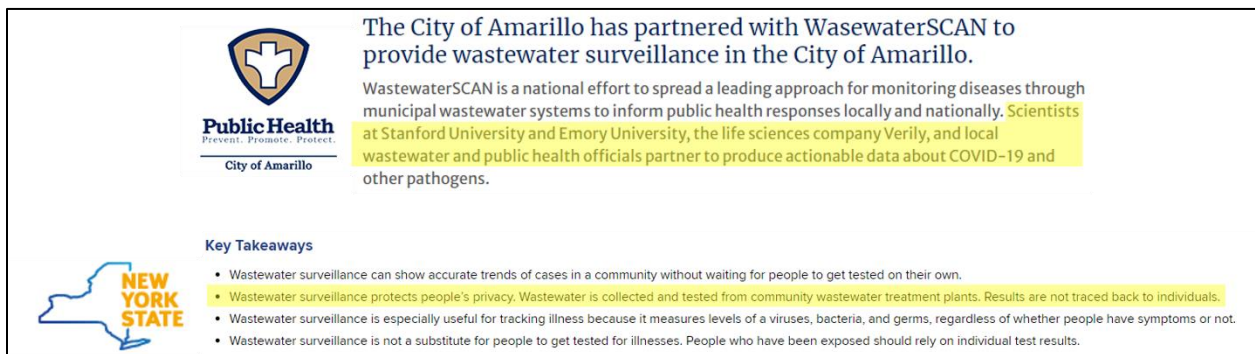

Figure 1; Examples of leveraging credibility and shared values

Guideline 5: Set a Realistic Scope

When communicating complex topics, it is critical to decide what the audience needs to understand and how much information they need to reach an appropriate conclusion. Communication is best achieved when five to nine pieces of information are used to support a single, bottom-line message (Druckman and Lupia, 2017; National Cancer Institute, 2011). In their 2011 workbook, the National Cancer Institute (NCI)

recommends each chunk of information "should be able to stand alone by communicating a single idea, but, collectively, [they] should provide rationale for the larger theme." This larger theme is most effective when it communicates timely information with an actionable recommendation (Janssen et al., 2006). The Wisconsin Department of Health Services and Santa Clara County Public Health dashboards demonstrate a reasonable scope by highlighting the level of concern for SARS-CoV-2 concentrations in wastewater.
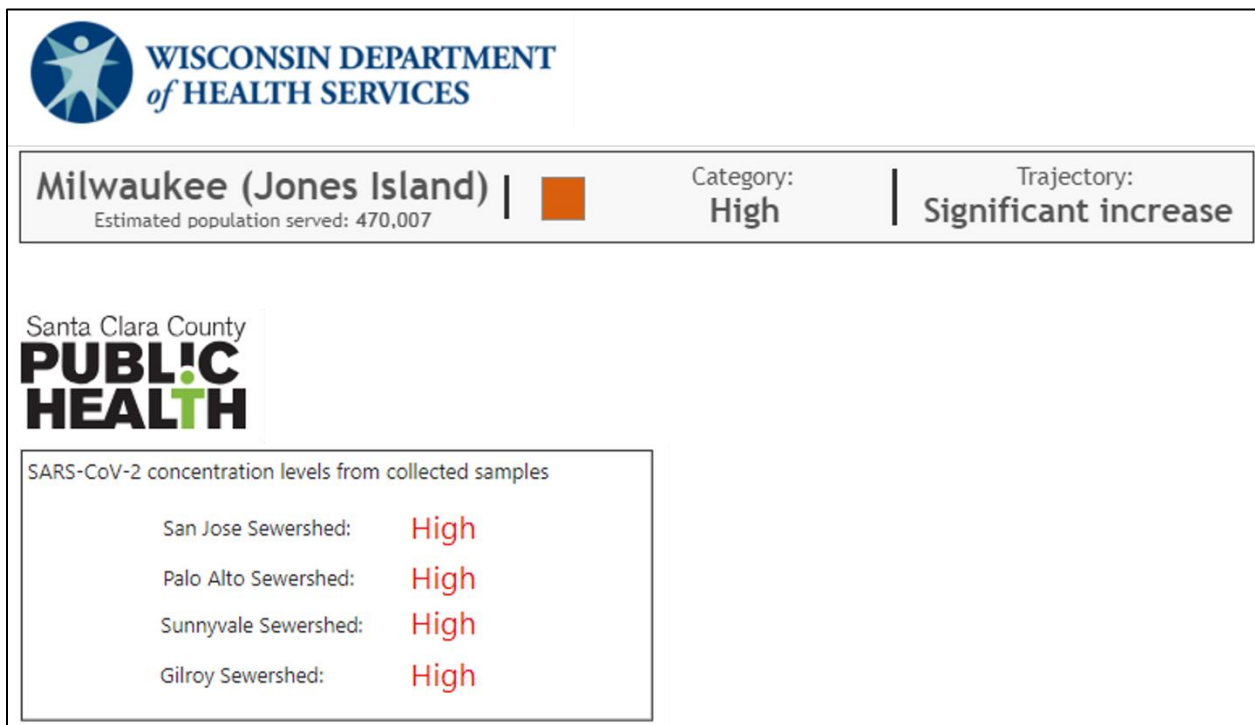

Figure 2; Examples of appropriate scope.

These dashboards could better align with the guideline by linking different categories of risk with specific recommendations. However, both dashboards communicate complex topics by emphasizing a main takeaway and presenting the most important information.

<u>Guideline 6: Employ Rhetorical Devices</u>

When interpreting new, complex information, audiences may use mental shortcuts called heuristics. Heuristics allow readers to quickly assess information based on how that information conforms to known frameworks and how that information makes the reader feel (Peters, 2017). While heuristics left unguided can lead to bias, communicators can use complementary strategies to aid reader comprehension (Peters, 2017). These complementary strategies involve the use of rhetorical devices such as framing, metaphor, analogy, and narratives.

The simplest rhetorical device is framing, the intentional presentation of a message to highlight a desired viewpoint. As public health topics are complex and multifaceted, lay audiences can be overwhelmed by the width and breadth of available information. Frames allow a communicator to guide the audience to an appropriate lens through which to view information (Druckman and Lupia, 2017). Different frames influence, and potentially even change, how an audience perceives a topic (Scheufele, 2006). For example, a public health vaccination strategy could be framed as emergency preparedness, a community support mechanism, a community health improvement, government overreach, mass experimentation, government handouts, corporate bailouts, etc. Indeed, even the concept of framing can be framed as either a form of manipulation or meeting audience needs and expectations. All communications are framed despite the communicator's intention (National Academy of Sciences, 2017). Intentional frames, however, allow a communicator to better convey complex topics to specific audiences and prevent bias (Druckman and Lupia, 2017).

Emphasis framing is a particularly useful frame for communicating public health topics. Similar to presenting a narrow scope of information, emphasis framing focuses audience attention to a single aspect of a complex topic (National Academy of Sciences, 2017). Emphasis frames can either be episodic or thematic. Episodic framing focuses on a specific instance or story (e.g., a family's experience with cancer) while thematic framing focuses on broader trends (e.g., statistics) (National Academy of Sciences, 2017). The City of Amarillo, Texas wastewater surveillance webpage provides an excellent example of framing. Here, wastewater surveillance is framed as an efficiency and a means through which health officials can actively protect community health (City of Amarillo Department of Public Health, 2024).
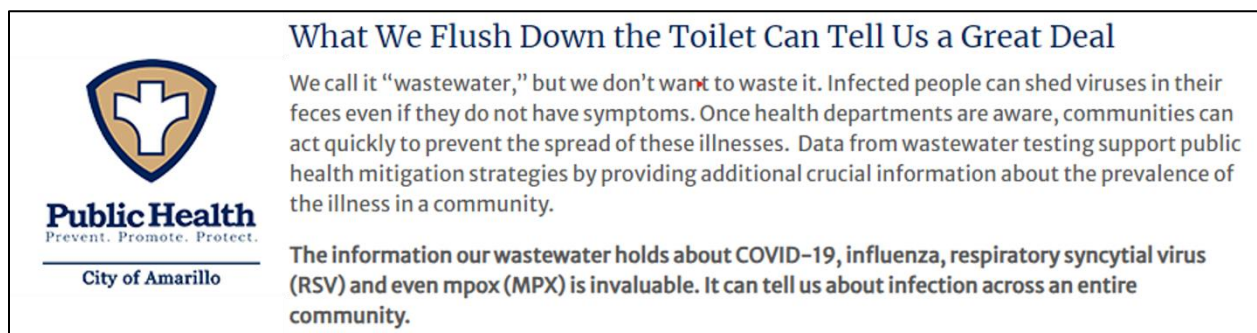

Figure 3; Example of framing

Similarly, metaphors and analogies are quick and easy rhetorical devices that increase audience comprehension of complex topics. Non-expert audiences commonly use metaphor and analogy to better understand complex topics (NAS, 2017). By providing accurate metaphors and analogies, communicators can balance audience understanding with scientific accuracy. The Erie County Wastewater Surveillance dashboard demonstrates an excellent use of metaphor. The use of the familiar concept

of stool and urine collection at a doctor's office provides a framework to understand wastewater surveillance (Erie County Department of Health, 2024).

Figure 4; Metaphor example.

Narratives are more extensive than framing, metaphors, or analogies. Most lay audiences already receive information in narrative formats (e.g., documentaries, news articles, or other media) (Dahlstrom, 2014). Communicating through short (e.g., case study) or long (e.g., short story) narratives helps attract and engage audiences in a competitive information market (NCI, 2011; Dahlstrom, 2014). As discussed above, using examples to explain a concept reduces an audience's cognitive burden. The illustration provided by a narrative is more effective than communicating data and generalizations such as statistics (Kaplan and Dahlstrom, 2017; Peters, 2017). Narratives have also been shown to increase audience comprehension while decreasing reading time (Dahlstrom, 2014). Regardless of length, narratives simply depict a character engaged in an action. Incorporating emotion or exploring a cause-effect relationship further adds to the effectiveness of narratives (Martinez-Conde and

Macknik, 2017). Embedding shortcuts such as narratives, metaphors, analogies, and

frames in communications facilitates audience understanding and retention.

Communicating Data

Just as there is a range of public literacy, there is a range for which individuals can understand and interpret numbers, termed numeracy. Numeracy varies extensively as some individuals, even those highly educated, have difficulty comprehending numbers when making decisions (Peters, 2012). Numeracy can be divided into three levels: primary, applied, and interpretive (Schapira et al., 2008). Primary numeracy is the ability to understand foundational math concepts and graphs, applied numeracy is the ability to understand how numbers relate to everyday tasks, and interpretive numeracy is the ability to use numbers in complex decision making (Schapira et al., 2008). Discomfort exists at every level (Schapira et al., 2008). As such, communicators must present data in a way that individuals with low numeracy can engage in and retain the communication content. Guidelines 7–9 provide suggestions for accessibly communicating data in public health contexts.

Guideline 7: Present Simple Numbers

To accommodate all levels of numeracy when communicating data, communicators should format numbers simply. Numbers should always appear as symbols (e.g., 2) rather than as words (e.g., two) (NCI, 2011; Bierer and Kassis, 2023). Formatting numbers as whole integers rather than decimals also improves audience comprehension (Bierer and Kassis, 2023). In comparisons between numbers, ensure units and denominators are consistent (Bierer and Kassis, 2023). Audiences also better understand risk when presented as absolute risk formatted as a frequency (e.g., 1 out of

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100) as opposed to relative risk expressed as probabilities or percents (e.g., 50% reduction of disease incidence in the treatment group) (Bierer and Kassis, 2023; Siegrist and Hartmann, 2017; Peters, 2017). Formatting numbers as simply as possible reduces the audience's cognitive burden and improves comprehension.

In addition to formatting, presenting data along with other information and cues helps audiences interpret data. Because numbers are inherently abstract, audiences need context to apply and interpret data (Peters, 2012). This context can be added using qualifiers (NCI, 2011; Peters, 2012; Bierer and Kassis, 2023). For example, label probabilities as very likely, likely, possible, unlikely (rare), or very unlikely (very rare) and accompany concentrations with labels for high, normal, or low (Bierer and Kassis, 2023). Not only do qualifiers add context to numbers, but they also present the same information in words, increasing accessibility for less numerate individuals. The Utah Department of Health and Human Services' wastewater surveillance dashboard demonstrates using qualifiers to communicate data (Utah Department of Health and Human Services, 2024).
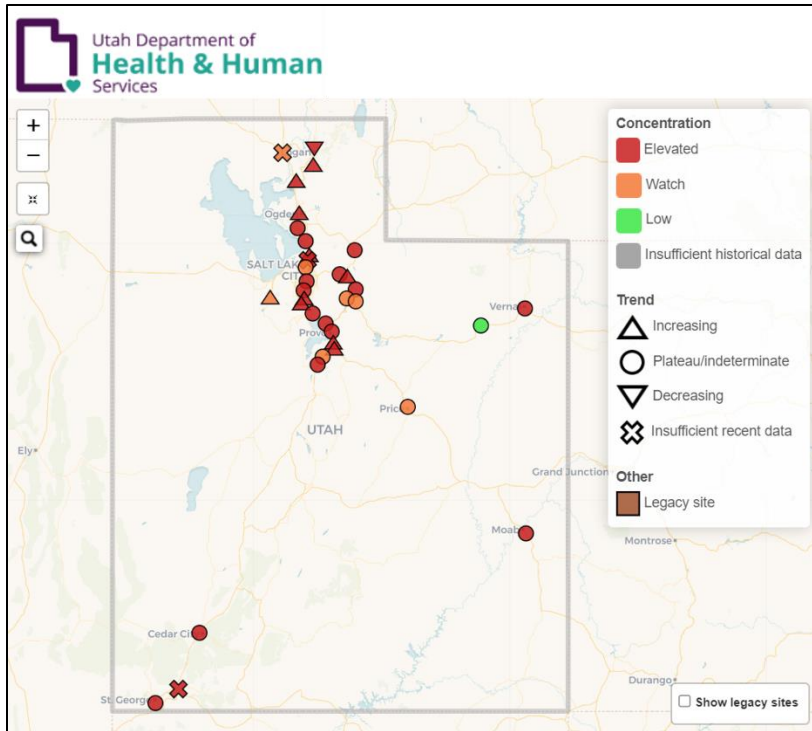
Figure 5; Example of using qualifiers with data.

Guideline 8: Display Accessible Visualizations

To further accommodate varying degrees of numeracy, present numbers alongside text or visualizations (Bierer and Kassis, 2023). Visualizations more familiar to audiences (e.g., bar charts, line graphs, and pie charts) require less effort and time to understand (NCI, 2011). Regardless of the visualization format, adding text labels and qualifiers near graphical components and avoiding red-green color scales facilitate audience comprehension (NCI, 2011; Bierer and Kassis, 2023). When using colors, ensure a 3:1 contrast between elements and the background (Harvard Digital Accessibility Services, 2024).[4] Similarly, avoiding abstract shapes with poor contrast ensures useability (Bierer and Kassis, 2023). The NCI's *Making Data Talk* Workbook provides further recommendations for accessible visualizations provided in table 3. For

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[4] Black text on a white background has a color contrast ratio of 21:1.

more guidance on designing accessible webpages see the Additional Resources

section.

Table 3; Recommendation for Data Visualizations (from NCI's Making Data Talk).

Visualization Format	Do	Don't
Pie Charts	• Make sure the largest slice is pointed at 12 o'clock • Display slices clockwise in descending order • Use short labels and position them horizontally and outside the pie	• Show more than 6 slices
Bar Charts	• Use six or fewer bars per chart • Use color/shading with strong contrast • Use a bar or line to show a baseline value • Use short and easy-to-understand titles, labels, and key messages • Select beginning and end values and interval widths for axes that represent patterns in the data without distortion	• Use segmented or stacked bar charts • Overlay line representation on top of the bars to indicate variance estimates or confidence intervals
Visualization Format	Do	Don't
Line Graphs	• Use arrows or text to highlight key events or data • Place labels close to their lines • Include baseline data for comparison purposes • Use short and easy-to-understand titles, labels, and key messages • Select beginning and end values and interval widths for axes that represent patterns in the data without distortion	• Add unnecessary labels or symbols • Use more than 4 trendlines
Icon Arrays	• Use body-shaped figures to represent humans when it seems fitting • Place icons representing numerator values contiguously • Use common denominators between 2 arrays • Highlight numerator icons	• Randomly place icons representing numerator values unless the goal of the array is to demonstrate randomness • Distort data; make sure to carefully increase the height and width of icons when showing change in magnitude

Visual Scales	• Provide anchoring information (lines or arrows) to give contextual cues and orient the audience to baseline data • Include short titles and key messages • Follow conventional approaches for data presentation (e.g., red to indicate higher levels of threat in the United States)	• Underestimate the role of emotion and perceived inequity if scales are used in involuntary exposure situations • Include too much information
Data Maps	• Use line to demarcate discrete entities (geographic borders) • Write clear titles and make labels short and to-the-point but complete • Use callouts to highlight some regions when necessary • Use color to enhance attractiveness and illustrate variation in data • Use a sequential progression of colors from light to dark	• Place red and green side-by-side • Use more than 3 to 4 colors or assume that color schemes displayed on computer monitors will look the same in print

The City of Chicago's wastewater monitoring dashboard demonstrates good use of simple visualizations with qualifiers (Chicago Department of Public Health, 2024). The trendline description at the top of the scatterplot emphasizes the main takeaway from the data.
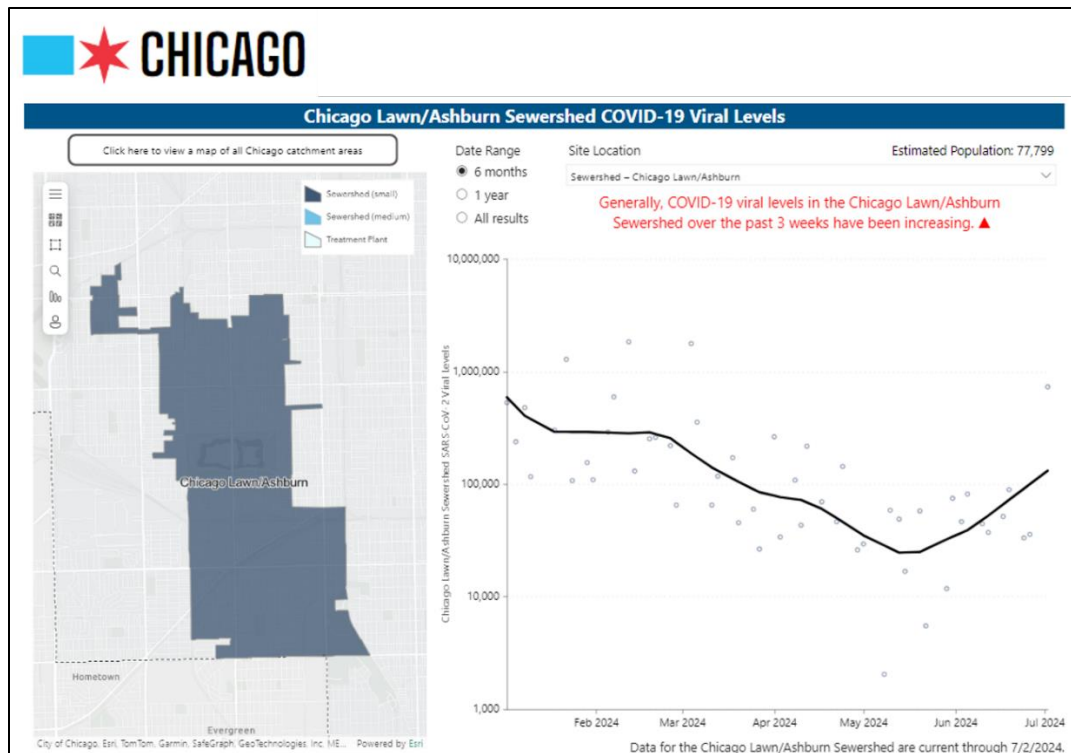
Figure 6; Example of accessible data visualization.

Guideline 9: Prioritize and Explain Data

Like communicating public health concepts, data communications are most effective when they present a few key pieces of information accompanied with detailed explanations. As such, communicators should prioritize two to three numbers or figures when presenting public health data (NCI, 2011; Peters, 2012). To ensure audience comprehension, accompany data with analogies and meaningful examples (NCI, 2011; Bierer and Kassis, 2023). For instance, compare the number of people affected by a disease to the capacity of a local football stadium. It is also helpful for audiences to describe both the positive and negative outcomes (Bierer and Kassis, 2023). For example, "3 out of 10 restaurant patrons fell ill while 7 out of 10 did not." These strategies will ensure both audience comprehension and retention.

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Communicating Uncertainty

Public health and the science on which it is based are continuously evolving and always involve some level of uncertainty. This uncertainty is good as it creates room for advances in understanding and self-correction. As such, public health communications should reflect these norms of uncertainty and self-correction (Jamieson, 2017). Communicating uncertainty not only presents a more accurate frame for public health information, but also primes audiences to accept updated information. Guidelines 10 and 11 provide methods of effectively communicating uncertainty.

Guideline 10: Be Reasonably Transparent

When communicating to the public, balancing transparency about uncertainty while projecting confidence is difficult. Explicit transparency regarding uncertainty increases credibility, but ill-placed transparency conveys incompetency and insignificance (NAS, 2017; Schapira et al., 2008; Ferrari, 2017). Transparency focused on the processes of obtaining knowledge, reaching conclusions, and reducing uncertainty rather than the information or recommendations themselves represents an appropriate balance (NAS, 2017; NCI, 2011). This so-called "reasoned transparency" is most effective when the needs and culture of an audience inform communications (Hodson et al., 2023). When information or recommendations change, avoid simply replacing old information with new information. Instead, explain past reasoning based on the old data, why new data and recommendations are needed, and how new data will change existing recommendations (Hodson et al., 2023). This method of reasoned transparency ensures audiences understand how evidence-based decisions are made and fosters trust in the process of updating recommendations. The District of Columbia

Health wastewater surveillance webpage demonstrates reasoned transparency by clearly and explicitly stating the limitations of using such data to inform public health recommendations (DC Health, 2024).
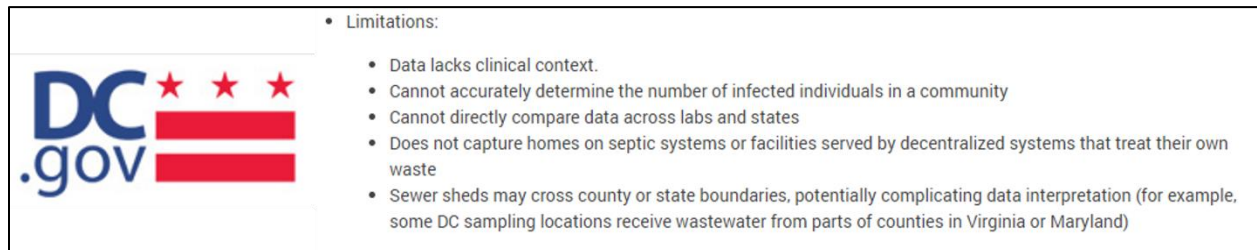

Figure 7; Example of reasoned transparency.

Guideline 11: Create an Expectation of Change

Along with reasoned transparency, fostering an expectation of change facilitates audience acceptance of evolving data and guidance. As discussed above, audiences rely on heuristics (mental shortcuts) to process new information. One such heuristic is expectancy, the degree to which new information conforms to ideas of known information (Ault et al., 2017). This heuristic is violated when new information is presented as incongruent with previous expectations. However, communicators can shift the focus of expectations away from the information itself and toward the process of generating information and create an expectation of change (Hodson et al., 2023). Consider the following example:

> *The guidance presented here is based on the best available evidence.*
> *These recommendations may change as we collect more information and*
> *better understand how to keep our community healthy.*

When information changes and audiences expect that change, the expectation heuristic is met, and the information is accepted. This effect can be strengthened if change is

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framed positively as a strength and a goal; "Change is not a divergence from the plan, change *is* the plan" (Hodson et al., 2023).

Misinformation Prevention and Response

Public health information is occasionally the subject of controversy, misinformation, disinformation, and politicization. Misinformation is incorrect or misleading information. Disinformation is the deliberate propagation of misinformation. Politicization is defined by Bolsen and Druckman as "emphasizing the inherent uncertainty of science to cast doubt on the existence of scientific consensus" (2015). All these challenges undermine credibility by generating audience uncertainty (Bolsen and Druckman, 2015). However, communicators can prevent and counteract misinformation, disinformation, and politicization (Green et al., 2023). Guidelines 12 and 13 provide steps to prevent and respond to misinformation, disinformation, and politization.

Guideline 12: Emphasize Consensus

Because misinformation, disinformation, and politization cast doubt on scientific or organizational consensus, communications that emphasize existing consensus prevent manipulation from occurring and counteract existing campaigns that undermine consensus (Bolsen and Druckman, 2015; NAS, 2017). Emphasizing consensus is most effective when presented *before* misinformation, disinformation, or politization occur (Bolsen and Druckman, 2015; Druckman and Lupia, 2017; NAS, 2017). The pre-exposure of consensus is like a vaccine that renders future misrepresentations less effective (Cook, 2017).

<u>Guideline 13: Distribute Warnings and Corrections</u>

When misrepresentation does occur, communicators can issue warnings or corrections. Warnings convey that scientific consensus exists and call for the dismissal of attempts to challenge that consensus (Bolsen and Druckman, 2015). When viewed before misinformation, warnings are very effective at preventing misinformation (Bolsen and Druckman, 2015). Communicators can also correct misinformation. When correcting misinformation, avoid repeating the misinformation as fact followed by a correction (Chan et al., 2017, NAS, 2017). Instead, explicitly label misinformation as false and counter with detailed refutations that match the tone and format of the misinformation (Chan et al., 2017). Similarly, avoid presenting refutations more complex and lengthier than the misinformation (NAS, 2017). Both corrections and warnings are effective in reducing misinformation, disinformation, and politization, but, as with many other public health activities, prevention is key (Bolsen and Druckman, 2015).

Rubric for Evaluating Public Health and Epidemiology Communications

Category	Guideline	Good — 3	Fair — 2	Poor — 1	Score
General	1. Proper grammar	*Absence of grammatical and formatting errors*	*Minor grammatical errors or minor formatting errors*	*Presence of multiple grammatical and formatting errors*	
	2. Cohesion and Coherence	*Sentences have clear subjects and actions, subjects are near verbs, new information follows known information, and first and last sentences match within a paragraph*	*Most sentences and paragraphs have internal cohesion*	*Sentences and paragraphs do not flow logically and require multiple read-throughs for understanding*	
	3. Concision	*Sentences are short, have simple words and subjects, and omit needless words and qualifiers*	*Sentences are technical, but well-written. Text is more appropriate for formal, academic writing than public communications*	*Sentences are lengthy, have complex words and subjects, and are burdened by excessive words and qualifiers*	
	4. Credibility and Shared Values	*Appeals to shared values and leverages scientific or institutional credibility*	*Leverages institutional or scientific credibility without emphasizing shared values*	*Does not appeal to shared values or credibility. Conveys ultimate authority in a top-down approach*	
	5. Realistic Scope	*Presents 5-9 pieces of information to communicate a single, actionable, and timely message*	*Presents 5-9 pieces of information, but lacks a single, clear message*	*Presents 10+ pieces of information without a clear purpose*	
	6. Rhetorical Devices	*Uses explicit framing, narratives, metaphors, or analogies*	*Uses ineffective or unclear framing, narratives, metaphors, or analogies*	*Presents "just the facts" without additional aids or context*	

Category	Guideline	Good — 3	Fair — 2	Poor — 1	Score
Data and Visualizations	7. Number Formats	*Numbers are presented as numbers (e.g., 2) rounded to the nearest integer, in a logical order, and are accompanied by qualifiers and examples. Units and denominators are consistent. Risk is presented as ratios of whole numbers (e.g., 5 in 10,000)*	*Numbers are presented as numbers (e.g., 2) rounded to the nearest integer and in a logical order but are not accompanied by examples and explanations*	*Numbers are presented as words (e.g., two) and/or include decimals. Units and denominators are inconsistent. Risk is presented as relative risk using percentages*	
	8. Visualization Formats	*Data is presented in simple charts or graphs with legible text and images*	*Data is presented as a complex or technical visualization*	*Data is presented outside of a visualization*	
	9. Realistic Scope	*Presents 2-3 numbers or figures accompanied by explanations and examples*	*Presents 2-3 numbers or figures without explanations or examples*	*Presents 4+ numbers or figures*	
Uncertainty	10. Transparency	*Directly addresses uncertainty by clearly explaining reasoning and data limitations*	*Mentions uncertainty without sufficient detail or explanation*	*Absence of an explanation of uncertainty*	
	11. Expectation of Change	*Positively acknowledges the possibility of changing data/conclusions*	*Acknowledges the possibility of change without a positive frame*	*Absence of discussion of change*	
				TOTAL	/ 33
Preventing Misinformation	12. Consensus (if applicable)	*Emphasizes scientific consensus*	*Mention of scientific consensus but not emphasized*	*Absence of discussion of consensus*	
	13. Warnings and Corrections (if applicable)	*Warns information may be subject of misinformation or politization. Corrections are distributed widely and contain sufficient detail*	*Warns of potential misinformation but corrections lack detail and are not linked to the incorrect information*	*Absence of misinformation warning or corrections*	
				TOTAL	/ 6

Additional Resources

- For a comprehensive review of English grammar, consult the *Handbook of Technical Writing* by Gerald J. Alred, Charles T. Brusaw, and Walter E. Oliu.

- For a more condensed and navigable overview of grammar, visit the Purdue Online Writing Lab (OWL) at https://owl.purdue.edu/owl/index.html.

- To view the more detailed scientific writing lessons presented in the Essentials for Clear and Concise Writing section, visit the Duke University Writing Center webpage at https://sites.duke.edu/scientificwriting/.

- Similar scientific writing lessons are available on George Gopen and Judith Swan's blog *The Science of Scientific Writing* available at https://www.americanscientist.org/blog/the-long-view/the-science-of-scientific-writing.

- Check the concision of your writing with the Simple Measure of Goobledygook (SMOG) Calculator at https://charactercalculator.com/smog-readability/.

- The CDC's Public Health Image Library (PHIL) (https://phil.cdc.gov/default.aspx) contains useful public-health-related images.

- For assistance in translating public health language into more easily understood words, use the CDC's Everyday Words for Public Health Communication Toolkit at https://www.cdc.gov/ccindex/everydaywords/index.html.

- The University of Michigan Plain Language Medical Dictionary (https://apps.lib.umich.edu/medical-dictionary/) similarly provides translations of medical jargon into everyday language.

- View Pope Tech's Designing Accessible Data Visualizations video
  (https://www.youtube.com/watch?v=KcDyUm6WhLQ) for more detailed
  guidelines for designing data dashboards and other visualizations.

- For more detailed guidance on creating accessible data visualizations, visit
  Harvard's Guidelines for Accessible Data Visualizations, Charts, and Graphs at
  https://accessibility.huit.harvard.edu/data-viz-charts-graphs.

- Check color contrast using Adobe Color accessible at
  https://color.adobe.com/create/color-contrast-analyzer.

- ColorBrewer (https://colorbrewer2.org) provides colorblind-friendly color palettes
  for data visualizations.

- The Web Accessibility Initiative's (WAI) Tips for Designing Accessible Websites
  (https://www.w3.org/WAI/design-develop/) provides further advice for designing
  accessible webpages.

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