The Importance of Risk Communication for Environmental Engineering During COVID-19

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As defined by the Society for Risk Analysis, "risk is the possibility of an unfortunate occurrence," (Aven, et al, 2018, Society for Risk Analysis Glossary). The study of risk, and how to mitigate its impacts, is known as "risk analysis", and includes the aspects of assessment, characterization, perception, communication, management, governance, and policy of risks to individuals, public- and private-sector organizations, and to society at local, regional, national, or global levels (Aven, et al, 2018, Risk Analysis: Fundamental Principles). The use of the risk analysis paradigm is well known to the environmental engineering community. For example from 1995 through 2019, the Office of Research and Development of the United States Environmental Protection Agency included entities such as the, "National Center for Environmental Assessment (NCEA)," "National Exposure Research Laboratory (NERL)," and "National Risk Management Research Lab (NRMRL)". Furthermore, a stated goal of the National Institute of Environmental Health Sciences (NIEHS) is, "… promoting research findings to networks of scientists, community advocates, educators, healthcare providers, and public health officials who can translate evidence into credible and understandable information and actions that individuals and communities can use to decrease their risk, prevent harm, and improve their health," (NIEHS, 2018, "2018-2023 Strategic Plan: Advancing Environmental Health Sciences). Assessing the significance of a risk, developing interventions to manage a risk, and communicating both the significance and the interventions is an inescapable responsibility of professional engineers who have an ethical obligation to, "hold paramount the safety, health, and welfare of the public," (NSPE, 2019, Code of Ethics for Engineers). Environmental engineers, in particular, understand the importance of engaging successfully with the public in risk communication – lessons that we have learned from industrial tragedies such as the 1984 Bhopal disaster and municipal tragedies such as the 2014 Flint, Michigan water crisis.

In January of 2020, the World Health Organization declared a Public Health Emergency of International Concern in response to the global spread of the SARS-CoV-2 virus and the rampant emergence of COVID-19 symptoms. Under the leadership of the WHO, both interim and final guidance were distributed for, "Risk Communication and Community Engagement Readiness and Response to Coronavirus Disease (CODID-19)." These tools were, "designed to support risk communication, community engagement staff, and responders working with national health authorities, and other partners, to develop, implement, and monitor an effective action plan for communicating effectively with the public, engaging with communities, local partners, and other stakeholders to help prepare and protect individuals, families, and the public's health during early response to COVID-19." Practically speaking, risk communication should be clear, consistent, and concise. It

should also be useful to diverse health professionals – including environmental engineers – as well as to the public. Unfortunately, poor risk communication has been a repeated failure of the COVID-19 crisis. Below, we identify how risk communication around the concepts of "flattening the (epidemiological) curve," "social distancing," "PPE" (aka personal protective equipment), and "COVID-19 deaths" have contributed to confusion and engendering a lack of trust among the public; exactly the opposite of the clarity needed for informed public decisions.

As early cases of COVID-19 symptoms were confirmed to be SARS-CoV-2 infections, the debates within national health authorities shifted from an emphasis on containment to an emphasis on mitigation – when transmission of the virus exceeded containment which could be achieved with contact tracing and quarantine. By mid March, 2020, epidemiological models suggested that deaths in the United Kingdom would exceed a half a million people, while deaths in the United States would exceed two million people; unless extreme measures of mitigation were undertaken (Adam, 2020, Special Report: The Simulations Driving the World's Response to COVID-19, Nature). Initially the closing of universities and ultimately the issuing of stay-at-home orders for non-essential workers were all used in an effort to "flatten the (epidemiological) curve," (Kruzel, 2020, Doctor Behind "Flatten the Curve" Urges Bipartisan Response to Outbreak, The Hill). While catchy and widely employed in risk communication, the concept of "flatten the curve" is unclear to the public. In the original context, the idea is to reduce the maximum number of infectious cases at any single point in time without reducing the overall number of cases throughout the entire course of the infection (i.e., the total number of sick people remains the same, but the peak occurrence of sickness at any given time is lower). Many in the public have misinterpreted the purpose of the stay-at-home orders with some arguing incorrectly that opening the economy will result in a return to the run-away spread of the virus, while others argue incorrectly that no further mitigation measures are needed because the curve has been flattened. Instead, the latest advice re-emphasizes the value of containment with WHO special envoy for COVID-19, Dr. David Nabarro, claiming, "test, track and trace, and isolate," are essential. "Flatten the curve" is an example of unclear risk communication.

Examples of inconsistency in risk communication during COVID-19 include the terms, "social distancing" and "PPE". Mental health experts have warned that the use of the term "social distancing" should be replaced with the use of the term "physical distancing" so that people remain "socially connected" while "physically separated". Regardless of the validity of this claim, switching terms during a global pandemic creates confusion and unnecessary distraction among the public who need to be focused on behavior change rather than the appropriateness of catchy phrases. PPE has been another area where risk communication has been inconsistent. Early in the pandemic, members of the public were told that there was no need to wear any type of facemask because limited supplies of PPE needed to be reserved for first responders and improper use of PPE provided limited protection against the acquisition of a viral infection. As the pandemic evolved, members of the public are now being told to wear any type of facemask to protect transmission from

asymptomatic carriers. This second use of a facemask – protecting the public from transmission from asymptomatic carriers – is NOT personally protective (rather it is protective of the public), and therefore the current public guidance to wear any type of facemask is strictly speaking NOT a form of PPE. This has lead to confusion in the public where some perceives the use of a facemask as a sign of submission to government control, while others perceive the failure to wear a facemask as a sign of selfishness.

Finally, risk communication should be concise, and here we note that "COVID-19 deaths" fails the public in this regard. Some members of the public share the view that "COVID-19 deaths" are limited exclusively to deaths directly related to fluid in the lungs of patients with viral pneumonia. Health professionals, and other members of the public, use a more expansive definition of "COVID-19 deaths" which includes "excess deaths", based on historical trends, as well as deaths that occurred during the COVID-19 pandemic (i.e., victims of other illnesses who did not seek proper, life-saving medical attention, during the pandemic – either from the lack of access to healthcare or fear of accessing the healthcare system). Furthermore, because SARS-CoV-2 infections result in a significant greater likelihood of death in susceptible sub-populations, reporting "total" COVID-19 deaths creates the false impression of "only a few deaths among a larger general population" rather than a more accurate impression of "a significant proportion of deaths among a much smaller susceptible population".

Engineers who graduate from ABET (Accreditation Board of Engineering and Technology) accredited programs should demonstrate proficiency in both engineering design as well as effective communication. Engineering design explicitly includes the consideration of risk, and effective communication explicitly includes a range of audiences – such as other professionals as well as the public. For environmental engineers, risk communication is a vital part of pre-professional training and professional practice. The COVID-19 pandemic has demonstrated the importance of clear, consistent, concise risk communication to support interprofessional health professions as well as clarity on the part of the public.

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