WATER QUALITY & HEALTH COUNCIL
PERSPECTIVES

In the Balance: Drinking Water Chlorination and Disinfection Byproducts

By the Water Quality & Health Council
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In a nutshell…

Drinking water chlorination requires balancing well-known risks of waterborne disease with potential long-term risks of exposure to disinfection byproducts (DBPs). This article highlights how the spread of misleading communications about DBP research can weaken public support for drinking water chlorination.

We've written extensively about drinking water chlorination, ranging from its remarkable U.S. public health history to its global role in helping meet the United Nations Sustainable Development Goal of safely managed drinking water and sanitation for all. Our website includes a virtual library (just try the search function) of articles on technical and social challenges associated with drinking water chlorination and available alternatives.

A frequent topic is balancing the need for drinking water chlorination with potential risks from disinfection byproducts (DBPs). This article focuses on how recent news media reports of basic disinfection byproduct research can, perhaps unintentionally, undercut public support for drinking water chlorination.

Why Drinking Water Chlorination?

Before U.S. cities began routinely treating water with chlorine, starting in 1908, diseases such as typhoid fever killed thousands annually. As more and more communities began treating (and filtering) their drinking water, death rates dropped sharply. Over a century later, U.S. drinking water chlorination is going strong. It continues to provide lasting protection across vast networks of tanks and pipes to bring safe drinking water to your taps.

Disinfection Byproduct Formation

Disinfection byproducts are complex mixtures of chemicals. They form in low levels whenever chlorine and other disinfectants react with water containing organic matter, such as naturally occurring chemical substances from trees and dissolved leaves. The U.S. Environmental Protection Agency (EPA) *requires* treated tap water to have a detectable level of chlorine (or chloramine) to help prevent recontamination of piped water by bacteria and viruses. Major groups of disinfection byproducts have been regulated by EPA for over 40 years. New disinfection byproducts and additional information about established disinfection byproducts continue to be reported in the science literature. Cost-effective methods to reduce their formation and to enhance their removal from treated water are widely available. Moreover, measures to reduce regulated disinfection byproducts also help reduce potential risks from other (unregulated) disinfection byproducts.

The Research Article

In early January, a team of researchers from Johns Hopkins University (JHU), University of California, Berkeley, and the Swiss Federal Institute of Aquatic Science and Technology, published study results in the journal *Environmental Science &*

Technology. They reported that mixing water containing phenols[1] with "excess chlorine" from bleach created a large number of potentially toxic disinfection byproducts that had not been previously reported in treated drinking water. The research and study results were highly technical and focused on the disinfection byproduct formation mechanisms and their identification in water.

This type of basic analytical methods research is published regularly and supports the water research community. We firmly support disinfection byproduct research. The issue is that these particular "bench research" results were communicated to the public without appropriate consideration of what this might mean for full-scale drinking water systems.

News Release and Media Coverage

In late January, a news release prepared by JHU appeared on PHYS.org. It included multiple quotes and opinions of the significance of study results from the lead researcher. Although she began with "There's no doubt that chlorine is beneficial; chlorination has saved millions of lives", she later commented "In other countries, especially in Europe, chlorination is not used as frequently, and the water is still safe from waterborne illnesses…we need to evaluate when chlorination is really necessary for the protection of human health and when alternative approaches might be better."

These kinds of sweeping statements and opinions about waterborne disease risk are troubling. Such risks are highly variable due to, for example, differences in water and wastewater infrastructure and treatment as well as source water protection. Out of context, such propagated statements can undercut public support for drinking water chlorination. And drinking water chlorination is all about public health protection.

Several science news articles (like this one) followed the initial news release and shared many of the same quotes, opinions, and a general concern with the safety of U.S. drinking water. The science news stories were followed by a January 30th article in the Atlanta Journal-Constitution and culminated with a national article in USA Today on February 3rd. Unfortunately, both mainstream news reports included many of the same quotes and basic messaging that U.S. drinking water may not be safe.

Risk Balancing

As we noted in a 2019 article, Chlorinated Tap Water: Benefits and Risks, after decades of study and debate, a causal (quantitative) relationship between exposure to environmentally-relevant concentrations of disinfection byproducts in drinking water and human cancer has not been established. Further, we concluded that "When it comes to chlorine and public health, the real danger would be eliminating its use in drinking water disinfection." Here's what the World Health Organization has to say, "In attempting to control DBP concentrations, it is of paramount importance that the efficiency of disinfection is not compromised and that a suitable residual level of disinfectant is maintained throughout the distribution system."[2] We agree.

Risk vs. Risk Considerations

There is no way of eliminating risk, but we can choose to replace or balance higher risks with lower risks. Deciding which risks a society is willing to accept and which are unacceptable is a two-step process. The first requires quantifying each risk accurately in a non-biased manner. The second involves making value judgements (individual and societal) regarding those risks that are acceptable and those that are not. In the absence of the first step, decisions are often based on emotions like fear as well as ignorance. The evaluation of the relative risks posed by exposure to disinfection byproducts and non-chlorination of drinking water is the comparison of largely theoretical risks to proven risks of sickness and death posed by waterborne diseases like cholera.

[1] Phenols are chemicals that can occur naturally in the environment and are abundant in personal care products and pharmaceuticals. They are commonly found in low levels of drinking water.

[2] WHO. 2017. Guidelines for Drinking-water Quality, 4th Edition, Incorporating the 1st Addendum. P. 173.