

2016 Coliphage Experts Workshop: Discussion Topics and Findings

Summary

EPA is developing Clean Water Act §304(a) Recreational Water Quality Criteria (RWQC) for coliphage, a viral indicator, to ensure public health protection when recreating in water bodies that may be affected by human fecal contamination. On March 1-2, 2016, EPA convened the Coliphage Experts Workshop to engage twelve internationally recognized experts on the state of the science of coliphages and their usefulness as viral indicators in recreational waters. Experts represented a spectrum of perspectives from academia, the wastewater industry, and other federal agencies including the Centers for Disease Control and Prevention and the Food and Drug Administration. Experts addressed charge questions related to five topic areas over the course of the two-day meeting.

Background

Viruses cause the majority of illnesses associated with primary contact recreation in surface waters impacted by human sources. While EPA recommends coliphage as an option for evaluating fecal contamination in groundwater, the Agency does not currently have a recommended indicator of viruses in surface waters that is protective of human health for primary contact recreation. Coliphages, viruses used to indicate the presence of a health risk, are not themselves dangerous to human health. Coliphages are useful for evaluating surface water quality because they exhibit numerous desirable indicator characteristics. For example, they:

- are of fecal origin and present in high numbers in sewage;
- are physically similar to viruses causing illnesses associated with primary contact recreation;
- do not re-grow in surface waters, thus their presence specifically indicates fecal contamination;
- are non-pathogenic;
- can be counted cheaply, easily, and quickly;
- show correlations to gastrointestinal illness; and
- are similarly resistant to sewage treatment and environmental insults as enteric viruses of concern.

Discussion Topics

- **Topic 1: The Need for a Viral Indicator** - Workshop participants were asked to comment on EPA's conclusion that the literature (including epidemiological, risk assessment, outbreak, and microbiological) indicates that viruses are an important cause of illnesses associated with exposure to ambient recreational waters and that coliphages can be used as an indicator of fecal contamination. The participants also identified the most important advantages and disadvantages of using coliphage for assessing fecal contamination in surface waters compared to traditional fecal indicator bacteria (FIB).
- **Topic 2: Coliphage as a Predictor of Gastrointestinal Illnesses** - Workshop participants were asked to comment on the overall strength of the association between coliphage and human health illness in epidemiological studies conducted in ambient recreational waters, identify specific characteristics that influence the association between coliphage and human health illness, and identify specific conditions under which traditional FIB are not adequate to protect public health.

- **Topic 3: Coliphage as an Indicator of Wastewater Treatment Performance** - Workshop participants were asked to comment on EPA's conclusion that human pathogenic viruses are entering surface waters via wastewater treatment effluent. Participants summarized the most important reasons coliphages are useful models of the behavior of enteric viruses in wastewater treatment and disinfection processes.
- **Topic 4: Male-specific versus Somatic Coliphage** - The participants identified the most important advantages and disadvantages of using these two types of coliphages as predictors of human health illness in recreational waters and as indicators of wastewater treatment performance.
- **Topic 5: Systematic Literature Review of Viral Densities** - EPA has conducted systematic literature reviews to understand and document densities of key viral pathogens (norviruses and adenoviruses) and coliphages in raw wastewater. Participants reviewed the approach and information collected to date.

Workshop Findings

Topic 1: Need for a Viral Indicator

- Individual experts agreed that viruses are a source of illness in recreational water exposures.
- Viruses can enter surface waters via wastewater treatment plant (WWTP) effluent. Especially during wet weather and when WWTPs exceed design flows.
- Coliphages are more similar to human pathogenic viruses than the traditional FIB and they mimic the persistence of human pathogenic viruses.
- Coliphages have been shown to be useful in evaluating individual wastewater treatment processes, disinfection efficacy, and shellfish harvesting waters.
- Currently available, inexpensive coliphage test methods could be developed into simple kits. Rapid, commercial methods (results under eight hours) exist, which could be useful for swimming advisories at beaches.

Topic 2: Predictor of Gastrointestinal Illness

- Future epidemiological studies should specifically include coliphages as measured indicators.

Topic 3: Indicator of WWTP performance

- Coliphages are consistently present in municipal sewage and provide a baseline for looking at different WWTP processes under varied conditions. Experts indicated the literature suggests coliphage and human viruses have more similar log-reductions during wastewater treatment, compared to traditional FIB.

Topic 4: Male-specific vs Somatic Coliphages

- Opinions ranged on whether somatic, male-specific coliphage, or both would be better for various applications. There is evidence for both showing relationship to gastrointestinal illness. Male-specific coliphage behave more similarly to RNA viruses under some conditions and are currently used successfully by the Interstate Shellfish Sanitation Conference and Food and Drug Administration for shellfish waters. Somatic coliphage may persist longer than male-specific coliphage and may be present in greater concentrations in raw sewage. Laboratory bacterial hosts exist that can detect both coliphage types.

Topic 5: Review of Viral Densities

- Individual experts supported how the systematic analysis was structured and conducted.

Where can I find more information?

EPA plans to publish more detailed outcomes of the workshop in a peer-reviewed workshop proceedings document in early 2017. For additional information on EPA's efforts to develop recreational water quality criteria for coliphage, please visit EPA's water quality criteria website at: <https://www.epa.gov/wqc/microbial-pathogenrecreational-water-quality-criteria> or email Sharon Nappier at nappier.sharon@epa.gov.