

Why EPA is Thinking About Developing Water Quality Criteria for Coliphage:

**What is the latest science surrounding this
effort?**

Presentation to the SCCWRP Commission

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BACKGROUND

- **Enterococcus is the indicator you presently use for measuring beach water quality**
 - AB 411 also requires measurement of total and fecal coliforms
- **EPA is considering adding another indicator: Coliphages**
- **Goal of this presentation is to let you know about the latest science surrounding this effort**

WHAT ARE COLIPHAGES

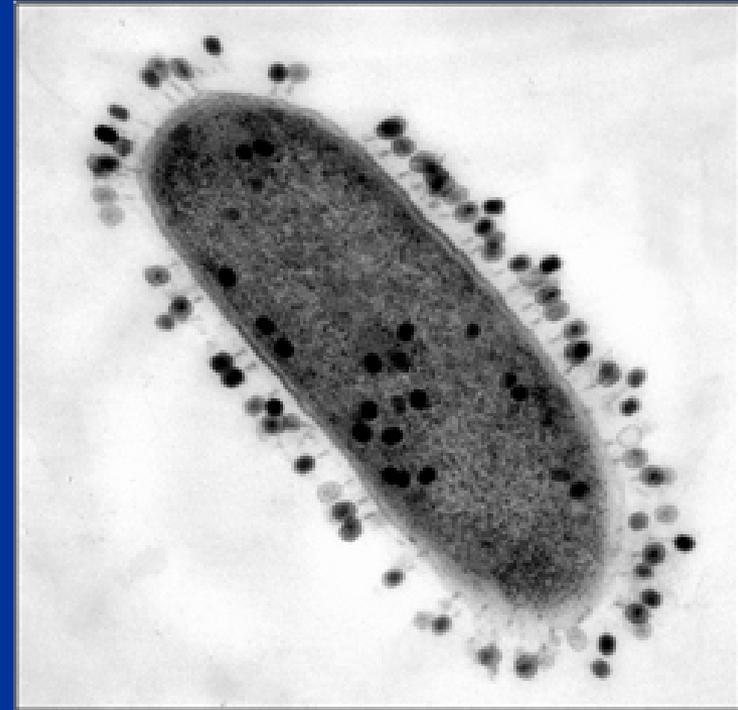
- **Viruses that infect E. coli**

- Two main types
 - Male-specific (F+)
 - Somatic (F-)

- **Non-pathogenic**

- **Consistently present in high numbers in human sewage**

- **Easy to measure**



WHY IS EPA CONSIDERING AN ALTERNATIVE INDICATOR?

- **False Negatives**

- Wastewater treatment inactivates enterococci much more readily than viruses
- Viruses can remain when levels of enterococci indicate conditions are safe

- **False Positives**

- Enterococci are known to grow in the environment
- Can lead to high levels of enterococci when pathogens are not present

WHY COLIPHAGES?

- **Unlike enterococci, they are not bacteria**
 - Similar in size and structure to human viruses
- **More numerous and easier to measure than are human viruses**
- **Behave more like human viruses than do enterococci**
 - Fate and transport in the environment
 - Survival in wastewater treatment processes
- **Already approved by EPA and FDA for other applications**

ALREADY APPROVED BY EPA AND FDA

- **EPA Groundwater Rule uses coliphage as an indicator of viral fecal contamination**
- **FDA/ISSC moving toward coliphage standard for shellfishing areas impacted by POTW's**
- **Two EPA approved measurement methods**
 - Method 1601 – Requires an enrichment step to amplify signal
 - Method 1602 – Direct counts of viral plaques, no enrichment step

EPA IS MOVING FAST

- **April 2015 – Published *Review of Coliphages as Possible Viral Indicators for Fecal Contamination for Ambient Water Quality***
- **March 2016 – Convened Coliphage Experts Workshop**
- **April 2016 – Coliphages a focus at EPA Recreational Water Conference**
- **May 2016 – Coliphages highlighted by EPA at UNC Water Microbiology Meeting**

COLIPHAGE EXPERTS WORKSHOP PARTICIPANTS

Name	Affiliation
Nicholas Ashbolt	University of Alberta
William Burkhardt	U.S. Food and Drug Administration
Kevin Calci	U.S. Food and Drug Administration
Jack Colford	University of California, Berkeley
John Griffith	SCCWRP
Vincent Hill	Centers for Disease Control and Prevention
Juan Jofre	University of Barcelona, Spain
Naoko Munakata	LACSD
Rachel Noble	University of North Carolina, Chapel Hill
Joan Rose	Michigan State University
Mark Sobsey	University of North Carolina, Chapel Hill
Timothy Wade	U.S. Environmental Protection Agency

MAJOR FINDINGS OF WORKSHOP

- **Epidemiology studies confirm a health risk relationship with coliphage**
 - Not clear if superior to *Enterococcus*
- **No clear winner between male-specific and somatic coliphage**
- **No clear winner among measurement methods**
 - Both EPA approved methods deemed acceptable

COLIPHAGE AND HEALTH OUTCOMES

- **Nine studies have examined relationship between coliphages and GI illness**
- **Six found a positive association with GI illness**
 - Four of these studies were conducted by SCCWRP
- **Varied in strength of health risk association and type of coliphage associated with illness**
 - Low number of observations limits statistical power of individual studies

META ANALYSIS

- **Combining data from multiple studies increases statistical power**
- **SCCWRP worked with UC Berkeley to develop meta analysis**
- **Pooled data from six beaches that analyzed water samples for both coliphage and enterococci**

COLIPHAGE AND ILLNESS

- **Relationship between coliphage and GI illness was only significant under high-risk conditions**
 - Treated wastewater
 - Flowing drain
 - Contaminated groundwater
- **Same pattern has been found in studies of *Enterococcus***
- **Health risk relationship no stronger than that for *Enterococcus***
 - May be due to lower levels of coliphages than *Enterococcus* detected at many beaches
 - Might have found a stronger relationship if we had data on both types of coliphage under both methods from all beaches



OTHER OUTCOMES OF META ANALYSIS

- **No difference in associations with GI illness between somatic and male-specific coliphage**
 - Past studies found stronger evidence for male-specific coliphage
 - Limitation: data on both types of coliphage were not available at all beaches
- **Detected a difference between EPA approved methods**
 - Method 1602 had a stronger association with illness than Method 1601
 - Required enrichment step in Method 1601 may bias results

WHAT CHALLENGES REMAIN FOR EPA TO ADOPT CRITERIA?

- **Method that performed best (1602) is insensitive**
 - May need to increase sample volume or concentrate to improve sensitivity
- **Where does coliphage work best?**
 - May have chosen the wrong beaches to test health risk relationship
 - No disinfected wastewater
 - No environmental growth of *Enterococcus*
- **Coliphage presumed not to grow in the environment**
 - Assumption needs to be tested
- **Don't know the most effective treatments to reduce coliphage and viruses in wastewater effluent**