

# **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
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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**