Environmental Surveillance Methodologies:

What tests, when and where?

Overview for the GTFCC Surveillance Meeting Lab Working Group
April 17, 2018
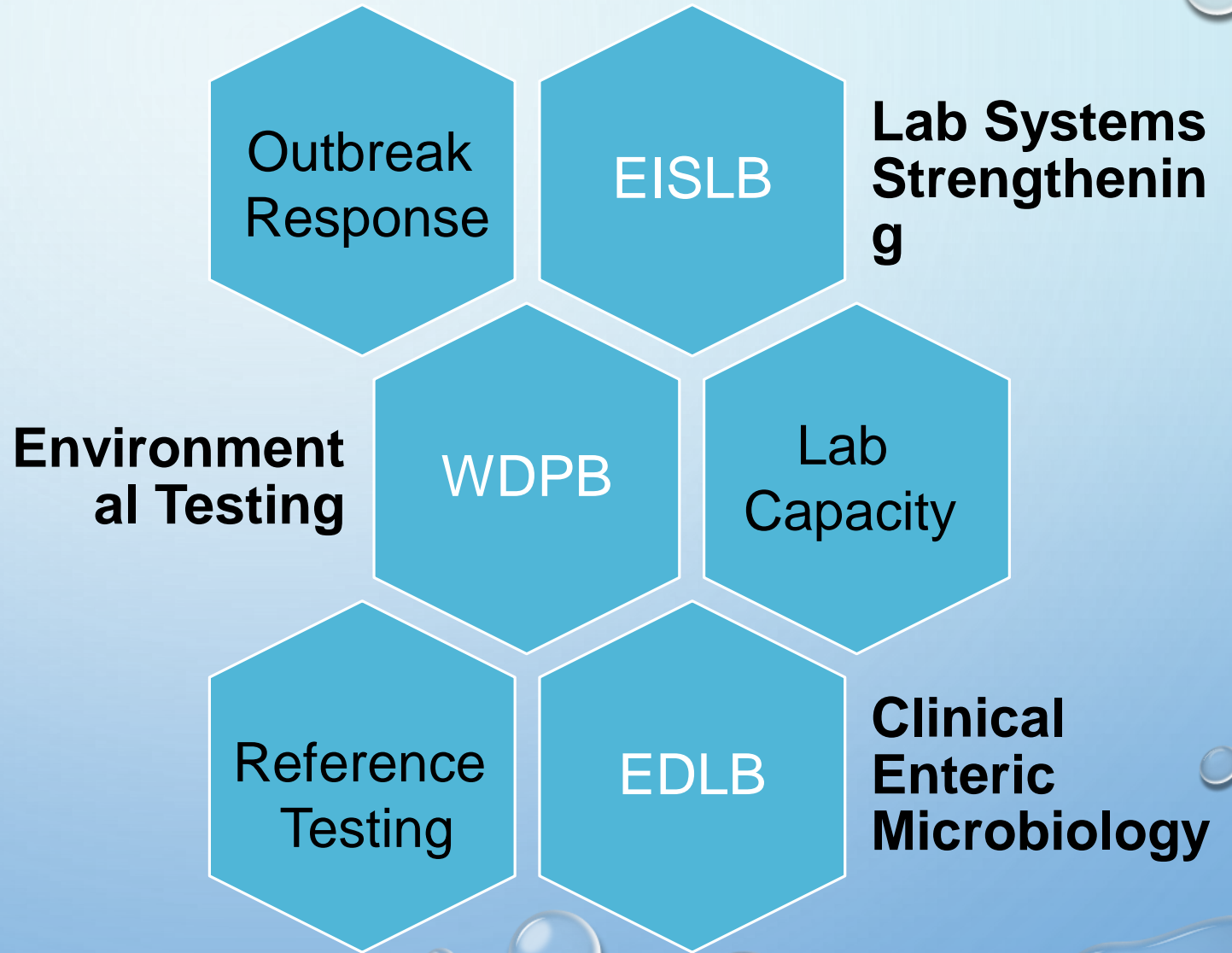
Contributions

CDC
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Outbreak Response

EISLB

Lab Systems Strengthening

Environmental Testing

WDPB

Lab Capacity

Reference Testing

EDLB

Clinical Enteric Microbiology

Objectives

- Review of environmental sampling techniques and methodologies
- Provide recommendations on environmental testing algorithm
  - Sampling scheme
  - Testing scheme
- Provide guidance in the development of reporting standards
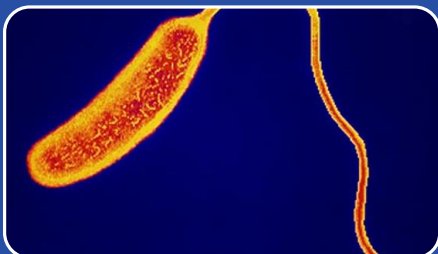
Environmental Sampling

Physical and chemical analytes

- Chlorine, including free residual chlorine (FRC)
- Turbidity, pH, temperature, conductivity
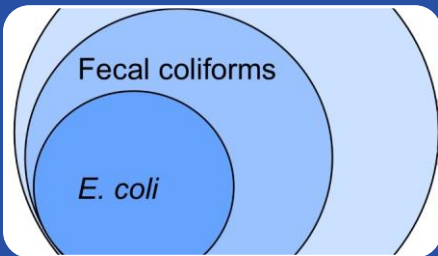
Microbial analytes

- Microbial indicators of fecal contamination
- e.g. Total coliforms, *E. coli*, enterococci,

Pathogen Testing

- Bacteria *(V. cholerae, Salmonella, pathogenic E. coli*)
- Parasites (Cryptosporidium, Giardia, free-living amebas)
- Viruses (norovirus, hepatitis viruses (A and E), adenovirus, enterovirus)

Physical & Chemical Analytes

Chlorine VS. Bacteria

- The presence of free residual chlorine (FRC) in drinking water
  - should effectively inactivate disease-causing organisms
  - is used as one measure of the potability of water

- Colorimetric tests to measure chlorine levels vary in terms of availability, cost, analytical sensitivity, ease of use

- The selection of methodology is dependent on how the data will be used
  - Sampling scheme

- Other physical attributes (e.g. turbidity, pH) affect FRC levels
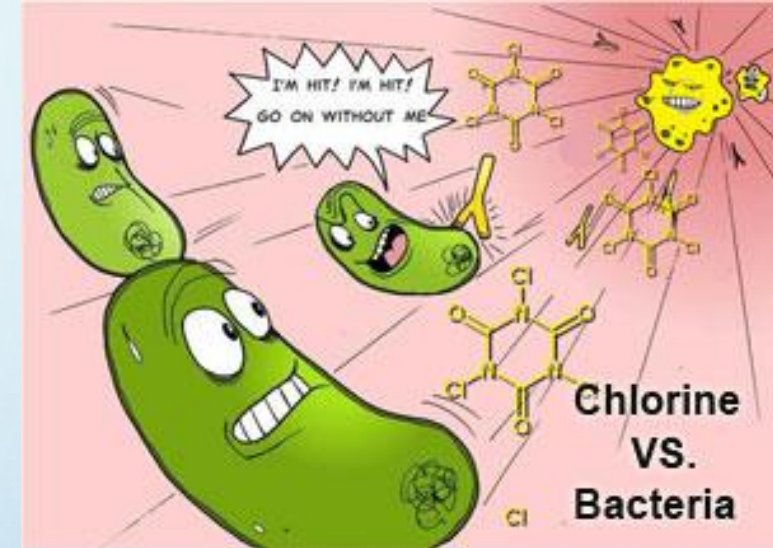
Microbial Analytes

- Indicates presence and degree (with quantification) of fecal contamination of any water source

- Microbiological indicators are bacteria associated with disease-causing organisms, but do not cause disease themselves

- Three common microbiological indicators are:
  - total coliform bacteria
  - fecal (thermotolerant) coliform bacteria
  - *Escherichia coli*
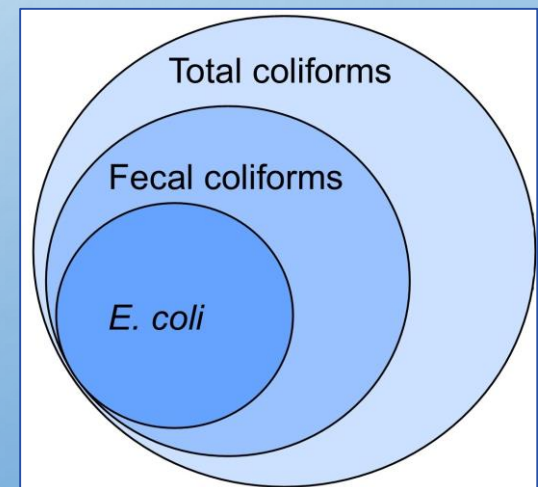
Pathogen Testing

The utility of *V. cholerae* environmental surveillance is dubious from the picture of public health:

- Has yet to provide outbreak alert
- Epidemics detected and monitored clinically not environmentally

Environmental monitoring of *V. cholerae* is complex; results need to be interpreted with caution:

- Abundance of non-toxigenic *V. cholerae* in the environment
- Viable but non-culturable (VBNC) bacteria cannot be detected by traditional culture methods

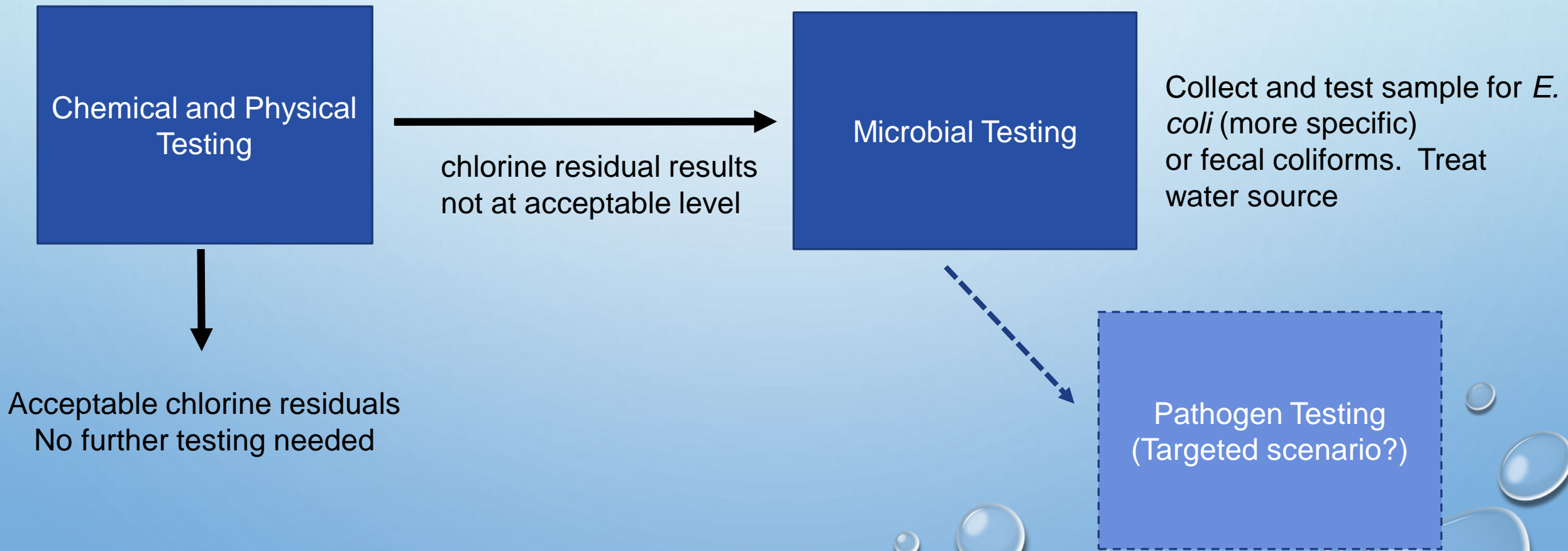PNGTree

Pathogen Testing – when to test?

- Academic research; aquatic persistence of reservoir *Vibrio* species

- Strongly suspect sample sites including sewage, or wells with repeated associated with known infected persons

- Group discussion – other scenarios?

Pathogen testing - considerations

- Sampling:
  - Source, e.g. municipal, piped water, well, surface water, household (point of use)
  - Collection volume (e.g swabs, small (10mL-1L), large volume (10L-100L)
  - Site selection and sampling frequency
- Detection:
  - APW enrichment
    - Culture
    - PCR
    - RDT
  - DFA

Debes et al ASTMH 2016; Rashid et al TMIH 2016; Chakraborty et al Frontier. Micro 2013; Alam et al. PNAS 2007; Kahler et al ASTMH 2015

Environmental Source Testing Strategy (for WG consideration)

Possible reporting standards (for consideration)

- GPS waypoint

- Source type

- Chlorine levels (total & FRC)

- Turbidity

- pH

- FRC acceptable levels? (yes/no)

- Microbiological data:

  - How do we interpret and report total coliform data relative to health risk?

- *V. cholerae* testing data