EPA scientists develop new method to determine when gastrointestinal illnesses may be due to waterborne pathogens

To ensure that safe drinking water is available to American consumers, public drinking water systems are required by the U.S. Environmental Protection Agency (EPA) to monitor their supply systems for indications of microbial contamination. Recreational waters are also monitored for contamination that may impact swimmers' health.

Waterborne pathogens (disease-producing agents) such as noroviruses and *Cryptosporidium* have been linked to gastrointestinal illness, and exposures to such pathogens can be more severe in sensitive populations like children or the elderly. Exposures can come from several routes, including ingestion of contaminated food, or water, or contact with infected individuals.

Overview

To strengthen EPA's ability to protect public health, scientists in the Office of Research and Development conceived and designed a new method, and applied it in a pilot study to determine whether exposures to specific pathogens in drinking water may be responsible for causing gastrointestinal illness.

Compared to taking blood samples, the developed method is noninvasive. The scientists use the presence of antibodies in people's saliva to detect episodes of specific infections from several pathogens.

The EPA multidisciplinary team included experts in microbiology, immunology, epidemiology, and statistical analysis; and was supplemented with advice and insights from stakeholders and local officials.

Approach and Impact

Saliva samples were collected weekly and monthly from 25 EPA volunteers in Cincinnati, Ohio. Collecting samples involved rubbing volunteers' gums with a specially-designed sponge to obtain saliva samples. The team then applied a sophisticated, commercially-available technology to analyze them.

The method uses color-coded microspheres (microscopic-sized beads). EPA scientists coated different sets of beads with proteins of particular pathogens including several noroviruses, *Cryptosporidium* and *Helicobacter pylori*, that they chose to examine.

Their technique detected the presence of special proteins that the human body produces to fight infection (antibodies). The antibodies reacted with the microbial proteins on the microspheres in a manner similar to how they attack these pathogens in the human body.

Because the saliva samples had been collected over time, scientists could observe a steep increase in antibodies which demonstrated that a particular person had experienced a specific infection.

This new method has the potential to make large-scale studies of waterborne infections easier to conduct, and provides another tool for use by EPA in evaluating the public health benefits of various drinking water treatments.

A manuscript presenting the scientists' new method and initial results was recently published in the *Journal of Immunological Methods:* Griffin, S.G.; Chen, I.M.; Fout, G.S.; Wade, T.J.; and Egorov, A.I. "Development of a multiplex fluorescent microsphere immunoassay for the quantitation of salivary

antibody responses to selected waterborne pathogens."

Pilot Studies

EPA researchers piloted the new method in epidemiological studies in Lawrence and Lowell, Mass., and in Boquerón Beach, PR.

The Lawrence/Lowell project was designed to compare rates of specific infections before and after the city of Lawrence improved the circa 1938 drinking water treatment system. Lowell was the control community. Scientists followed almost 3,000 volunteers and collected 10,000 saliva samples in "before" and "after"' phases of the study. Results from the statistical analysis of these data are expected to provide valuable information that may help EPA and state water quality regulators assess public health benefits of improved water treatment. Saliva samples were also collected from nearly 5,000 participants in EPA's National Epidemiological and Environmental Assessment of Recreational Waters (NEEAR) study in Boquerón Beach in 2009. These collected samples will be analyzed to detect infections which could be related to swimming-associated illnesses.

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More Information

o Novel Methods of Measuring Infections to Assess Benefits of New Drinking Water Treatment (Evaluating Health Benefits from Improved Drinking Water)
o Research Approaches to Assessing Public Health Impacts of Risk Management Decisions, January 2008, Session IV: Waterborne Disease Pilot Project

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