

DUAL PURPOSE: POINT-OF-USE FILTERS CAN ALSO HELP MONITOR AND INFORM WATER QUALITY

Household point-of-use filters can be used for large volume, long term microbial water quality monitoring.

Although there has been much development in the area of real-time monitoring of drinking water distribution systems, widespread implementation has not yet occurred. A University of Arizona study showed a proof of concept for a low maintenance, readily available method for monitoring large volumes of drinking water over long periods of time.¹ This type of monitoring is of particular importance in areas experiencing boil water notice events to better understand exposure and impact to public health.

Why this work is important:

Despite federal standards and routine monitoring of municipal water treatment facilities in the U.S., 42 drinking water outbreaks occurred from 2013-2014, resulting in 1,006 cases of illness, 124 hospitalizations, and 13 deaths.² Researchers estimate the true burden of waterborne disease to be closer to 19.5 million illnesses per year, resulting in 1,000 deaths.^{3,4}

There are many reasons the concept of monitoring large volumes of water over long periods of time is important to public health, including infiltration of contaminants⁶, back siphonage events⁶, distribution construction or repair⁵, and microbial regrowth⁶. Some of these events are unanticipated vulnerabilities in the distribution system outside of a municipalities control that can cause an unavoidable time delay from discovery to public notification.

Point-of-use (POU) water treatment devices offer a final barrier approach for the removal of contaminants at the consumer's faucet that may be introduced post-treatment or as the water moves through the distribution system. POU systems may include nominal or absolute filtration mechanisms, either designed to remove microbial contaminants or as a pre-treatment to subsequent water purification steps.

Goal:

The goal of this study was to develop a method for improved monitoring of tap water quality at the household level, with respect to microbial contaminants of human health concern. Monitoring POU filters near the end of their life expectancy provides a method for directly detecting fecal bacteria and human viruses that may be present in large volumes of water over long time periods or following suspected contamination events that may occur after system maintenance, storm events, or general treatment failures.

Methods:

In collaboration with a local household water filter provider, 0.5-micron, nominal POU filters, utilized as pre-treatment to reverse osmosis membranes, were collected at the end of their lifecycle from 75 households throughout Pima County, Arizona during scheduled maintenance. To minimize variability and the chance of cross contamination, filters were provided by a single, senior technician trained in proper handling. Hand sanitizer was used to cleanse technician hands and gloves were worn when handling the devices during removal and transfer to Ziploc bags for controlled temperature transport.

Results:

All samples (n=75) were processed for fecal bacteria analysis and integrated cell culture, along with qPCR for human enteroviruses. Filters were washed with 3% beef extract and eluates were concentrated using membrane filtration and assayed on MI agar for *E. coli* and BGMk cells for human enteroviruses. *E. coli* and total coliforms were detected on 53 filters (71%). No samples tested positive for enteric viral pathogens.

Discussion:

Results indicate household water treatment filters can be used for large volume monitoring of drinking water quality at the point-of-use, however, retention of introduced pathogens on the tested filters is low and may still underestimate public health risk. Data from this study provides new insights into environmental monitoring at the point-of-use and novel applications for risk characterization in the future. Applications for future implementation of POU devices for monitoring could be for routine survey as well as during outbreaks, boil water notices, or other emergency events.

References:

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