Finding the Needle in the Water Column

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Waterborne pathogens present a public health threat as a result of natural, accidental or deliberate contamination events. In addition, increasing extreme weather events brought about by climate change alter stormwater flows, which can affect pathogen delivery to surface waters. The EPA recommends fecal indicator bacteria (FIB), enterococci and \textit{E. coli}, as part of its recreational water quality criteria. Monitoring for contamination currently involves using a toolbox of standard and, more recently, rapid analytical methods such as qPCR. However, the relationship between fecally transmitted pathogens and levels of FIB remains questionable, especially in subtropical and tropical environments like Hawaii where FIB survive for extended periods and may regrow. Unfortunately, monitoring water directly for pathogens remains expensive, labor intensive and unreliable. Over my years of studying microbial water quality, it has become clear that monitoring, and consequently risk assessment, is limited by our ability to detect the low number of randomly distributed pathogens that might be present in potable, source, irrigation and recreational waters. The work that I have done since completion of my doctorate has confirmed that concentration of potentially harmful microorganisms from water is an essential component of water quality assessments. My most recent research focuses on pathogen detection, including development and evaluation of a portable, multi-use automated concentration system (PMACS, patent pending) based on dead-end ultrafiltration, a device that appears to fill this critical gap. It simultaneously concentrates all classes of microorganisms from large volumes of water, enabling detection of microbes that are missed by standard methods, and the resulting concentrated sample is compatible with analysis by a wide range of detection methods from culture to metagenomics. Successful field tests have been conducted with a variety of water types including surface water, cooling tower water, produce wash, ground and potable water to enable detection of targets including human-associated markers. My program would include using the PMACS to monitor Hawaii’s recreational, source, stormwater run-off and irrigation waters for relevant autochthonous and allochthonous microorganisms, including significant pathogens and human-associated markers. Furthermore, I envision using the system for assessments of water quality changes due to climate change including droughts and floods. The knowledge gained from this research would enhance risk assessments and assist in preserving the quality of this critical natural resource in Hawaii.