Pathogens & Large Microbial Diversity found in Source-to-Distribution Drinking Water of Remote Communities in Northern Australia (2017-2019)

Eduardo Cermeno

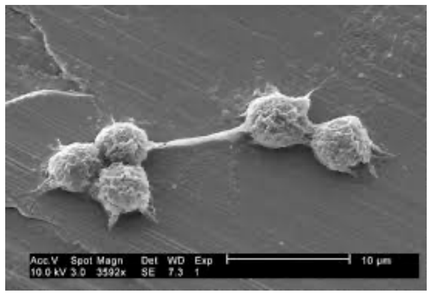
Ramapo College of New Jersey, Mahwah, NJ 07430

Animation of HF community's water treatment
https://vimeo.com/391431597

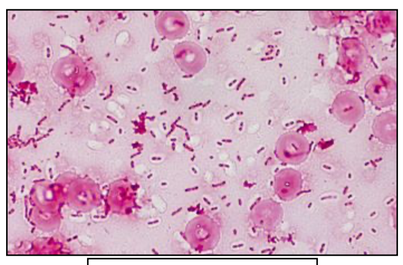
Abstract:

In Northern Australia, remote communities receive their drinking water from bores that access groundwater. In the wet season, these aquifers contain high levels of iron, which is natural, yet not safe for human consumption. This gives iron bacteria and other pathogens the opportunity to thrive in these waters. Because of this microbiological issue, many in Northern Australia and Southeast Asia have fallen ill to Melioidosis, also known as Whitmore's disease. Many studies have been conducted and published in order to bring attention to the management for water supplies in the wet-dry tropics.

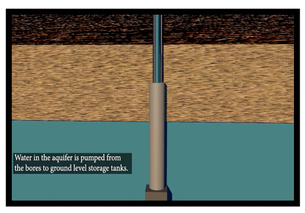
Water Curtain Filter

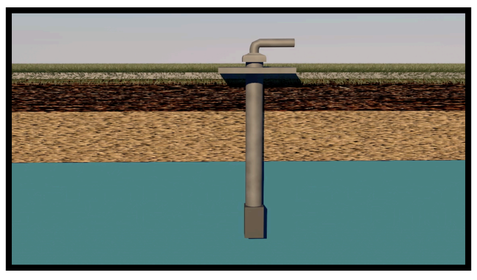


Hartmannella amoebae



B. pseudomallei.





Results:

- Community HF's water supply is sourced from 11 groundwater bores that access shallow aquifers (a body of rock saturated in water) in sandy soil. Their water is treated through a curtain filter and then dosed with sodium hypochlorite to remove the iron in the water. However, five sample collections from the sites indicated that there was an unchlorinated bore that is 14 meters into the ground where an unconfined aquifer (water seeping from the surface into the aquifer) comes into contact with ground surface water (i.e. rivers, ponds, etc.) This area is also susceptible to seasonal flooding.
- Community MF's water supply is sourced from 15 groundwater bores that access semi-confined aquifers in sandy soil/gravel. Their bores are often flooded during the wet season, allowing the surface to intersect with the groundwater. Water is treated through chlorine gas and ultraviolet. The three bores that were sampled were built between 1972 and 1984, with the material being normal steel. Two bores were built in a shallow location (10 meters down) and the third bore was built into a semi-confined aquifer.
- Community MF's water supply is sourced from 9 groundwater bores that access unconfined aquifers in sandy soil and sandy clay. Water is treated through chlorine gas and a fluoridation system. The three bores that were sampled were built 38-54 meters down, built in 2006.

Water and biofilms extracted from the unchlorinated tank in the HF and MF communities revealed ample microbial growth, testing positive for bacterias such as B. *Pseudomallei* and *Hartmanella* amoebae, which contain isolates that were whole genome sequenced.*** Three isolates from the B. Pseudomallei have been detected in the 1990's with reported cases of melioidosis from remote communities.

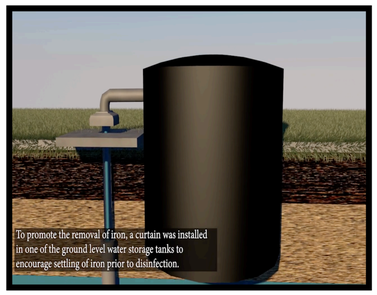
***__Whole-genome__ sequencing is a method for analyzing entire __genomes__, aiding in identifying inherited disorders, characterizing the mutations that drive cancer progression, and tracking disease outbreaks.

Community LF has the deepest aquifer, with the newest construction, and is the most acidic but has the least nutrients. There was less diversity of bacteria in the water due to the lower pH. Community MF had more metals and bacteria in their bores, with a neutral to slightly acidic pH with Gallionella as its major culture. Community HF was built in a coastal/swamp region with shallow aquifers, with its bores spreading metals throughout its pipes.

Chlorination proved successful in fighting against bacterias such as B. pseudomallei and P. aeruginosa. Especially as seen in the MF community with their application of UV treatment.

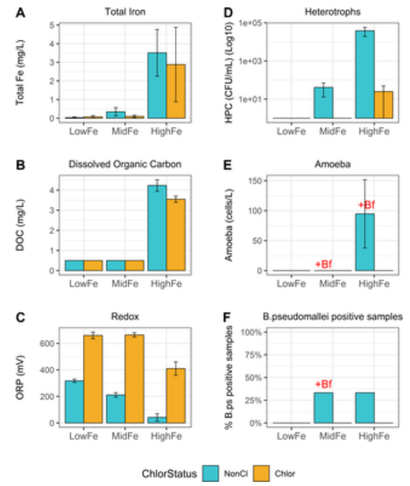
Overall, the geochemistry of the source water proves to have an impact on the growth of microbiota communities in these three water supplies.

Katherine River in the NT, Australia

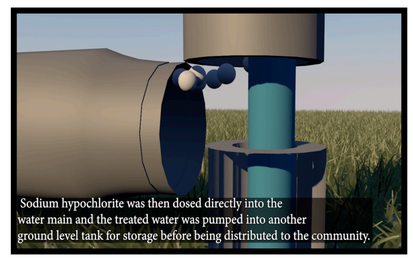


Methods:

Three major samples were taken from three different remote communities in the Top End of the Northern Territory, Australia. This region is known for its tropical savannah climate ranging from a very dry to wet seasons throughout the year. The three communities were labeled as "HF", "MF", and "LF." These terms signify high, medium, and low levels of iron in each location. With bacteria and other pathogens thriving in the drinking water, there have been reports of melioidosis, with HF reported 3 cases, MF with 11 cases, and LF reporting 4 cases.



Data of water samples



References:

Kaestli M, O'Donnell M, Rose A, Webb JR, Mayo M, Currie BJ, et al. (2019) "Opportunistic pathogens and large microbial diversity detected in source-to-distribution drinking water of three remote communities in Northern Australia." *PLoS Negl Trop Dis* 13(9): e0007672. https://doi.org/10.1371/journal.pntd.0007672