Researchers prove a simple device can reduce rates of child diarrhea

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A researcher examines chlorinated water from a shared community tap in Dhaka, Bangladesh. Credit: GMB Akash

It kills a child under 5 every minute on average. Diarrheal disease, the second leading cause of death for children globally, could become even

more difficult to control as poor urban areas with limited clean water access expand. An international team of researchers led by a Stanford epidemiologist finds reason for hope in a low-cost water treatment device that reduces rates of diarrhea in children, provides good-tasting water and avoids the need for in-home treatment—improvements over other purification strategies that could significantly increase uptake. Their results were published Aug. 8 in *The Lancet Global Health*.

In developing countries, few cities are able to maintain fully pressurized water systems that consistently pump water around the clock. Even if it is safe at the source, water in these systems is at risk of becoming contaminated while sitting in pipes. About 1 billion people who access water via piped systems receive water that does not meet international standards for safety.

"Group level water treatment among people who share a water supply removes the individual burden on households to treat their own water," said study senior author Stephen Luby, a professor of medicine in the Division of Infectious Diseases and Geographic Medicine at the Stanford School of Medicine. "So, it offers the prospect for extending safe drinking water to vulnerable slum residents globally."

Bad taste

Chlorination is one of the cheapest and most widely available ways of disinfecting water, but the chemical's taste and odor are significant barriers for many people. Also, most available water treatment devices have been intended for use in the home, generally after collection at a community tap, and therefore require a change in behavior. These barriers have prevented many people from accessing safe water.

"The study demonstrated that this simple, electricity-independent technology could be transformative in scaling up water treatment in

slums and reducing child diarrhea, without requiring people to do anything differently when they collect their drinking water," said study lead author Amy Pickering, an assistant professor of civil and environmental engineering at Tufts University who received her Ph.D. at Stanford where she also worked as a postdoctoral scholar.

Working in two poor communities of Dhaka, Bangladesh, the researchers tested a way of treating water, called Aquatabs Flo, that works at community pumps rather than in the home. It requires no electricity and automatically doses a precise amount of chlorine into water as it flows through the device. The chlorine lasts long enough to protect water stored in containers against recontamination.

To avoid bad-tasting water, the researchers polled Dhaka residents to find out how much chlorine could remain in the water without being objectionable. Then, they set the chlorine dosers to deliver low levels of chlorine the first few months so people would get used to the taste. Later, they upped that amount to a level that purified the water effectively, but remained acceptable taste-wise. The treated water was more than four times less likely to contain E coli., a bacterium that indicates sewage contamination.

The researchers tested the device by having it deliver chlorine in some communities and Vitamin C in others. Out of 1,000 children, The ones who received the chlorinated water had 23 percent lower rates of diarrhea. While the result may seem obvious, previous studies had been ambiguous either because people didn't consistently use the household chlorination systems being tested or because they weren't able to compare to communities without water treatment.

The device was particularly effective in children living in an urban setting, which the researchers suggest could be due to a few different causes. One is that water in urban settings often spends more time in

unpressurized pipes. Also, before the chlorine treatment, nearly 90 percent of taps in that setting were contaminated with E coli, almost twice the rate of the more rural study area. Finally, the two locations contained different pathogens, some of which could be resistant to chlorine. Either way, the results suggest that a device that delivers a precise low-dose of chlorine can purify water while tasting good enough to drink.

Looking toward a safe water future

The study was an outgrowth of the Lotus Water project—a joint effort led by Stanford's Program on Water, Health and Development—which received early funding from the Stanford Woods Institute for the Environment. The project aims to provide water disinfection services through a business model that relies on monthly payments from landlords, who typically own shared water points in Dhaka. The team's earlier research indicates that slum residents are willing to pay higher rents in exchange for higher-quality water. Linking the device's lease to service payments would hold landlords accountable to their tenants (read related story).

Although Aquatabs Flo is currently only compatible with water points connected to storage tanks, Tufts and Stanford are collaborating with an industry partner to commercialize a chlorine doser compatible with any tap.

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