UJ Mobile lab to combat disease outbreaks

As witnessed during the recent floods in KwaZulu-Natal, Mozambique and Zimbabwe, clean water sources can become contaminated with bacteria that can cause diseases. Without adequate testing facilities on site, finding and processing water at the source can prove difficult. UJ's Health Science faculty has come up with a solution.

The principal risk associated with water in rural communities is the transmission of bacterial infections such as typhoid, paratyphoid fevers, bacilliary dysentery, cholera and other diseases related to faecal contamination.

In November last year, two hundred SANDF technical team members were called to the Vaal Dam to assist with engineering, infrastructure and other expertise required to resolve the crisis of about 150 megalitres of raw sewage being spilled into the Vaal River daily. This severely affected the quality of water of residents in the area.

In a similar incident, a dysfunctional pump at the Mahatma Gandhi Pump Station resulted in the spilling of sewage into the Durban harbour causing millions of Rands of damage, while in neighbouring Mozambique and Zimbabwe, flooding caused by cyclones Idai and Kenneth wreaked havoc.

"In all these scenarios, the water that thousands of people rely on was contaminated either by sewage or by pollution from flooding. This put people at risk of waterborne diseases. These life-threatening conditions can affect everyone, but babies, the elderly and those with suppressed immune systems are most at risk," says Professor Tobias Barnard, director: Water and Health Research Centre, University of Johannesburg (UJ).

"In these situations, it is critical to test water and get the results quickly. When armed with the results, water can be treated and made safe for use."

Barnard explains that the major problem with sample collection and testing is that these events usually happen far from big cities, which is where the laboratories that can analyse water samples are found. Driving back and forth between site and laboratory can be time consuming and means it takes much longer for water to be tested and consequently treated to ensure safe potable water for human consumption.

UJ researcher and community member collecting and labelling water samples.

Mothers and water

"The idea for this lab started a few years back. The moment that really sticks in my head happened during the Carolina diarrhoea outbreak. The then-minister of Water and Sanitation said, 'I had to listen to moms crying about babies who were critically ill, asking: 'Why can't we sort this out now!?' And we knew we still had to sample and drive three hours back to the laboratory, before we could even start the analysis," says Prof Barnard.

"We knew that if we had a laboratory on site, we could do things much faster. It would make a huge difference to the people getting ill. We could start testing water at a household level. We could say to people: 'Bring in your water, and let's make sure it is okay. We could assist with treating water on site. We could assist the water treatment plant with testing additional to their own, so the water supplied to the community would be safe for consumption," he adds.

Building labs from scratch

As a response to the difficulties they experienced with this set up, the UJ Health Science Faculty research team launched the mobile laboratory on wheels, that can be customised to suit the needs of the team using it, whenever such a need arises.

Prior to this, the team often had to drive for hours to deep rural communities to test water, and had to build a field lab from scratch, sometimes through the night.

"For each trip, we packed up everything we needed from the UJ laboratory, and carried it from our building to a trailer outside. It could take nine hours to drive to the site. When we arrived, we would often find we had a derelict hut to work in. Sometimes we had to clear out animal faeces or cement blocks first," says Dr Kousar Hoorzook.

"The team would have to clean the space, and sterilise it. Only then could we start testing the water samples, and it would be close to midnight. she adds

Hoorzook is the co-designer of the lab with Barnard and Robin Robertson, an industrial designer. She was awarded seed-funding from the Technology Innovation Agency (TIA) in partnership with the Department of Science and Technology (DST). Currently she is getting the lab ready for field trips at the Process Energy and Environmental Technology Station (PEETS) at the UJ Doornfontein Campus in Johannesburg.

Round-the-clock water testing

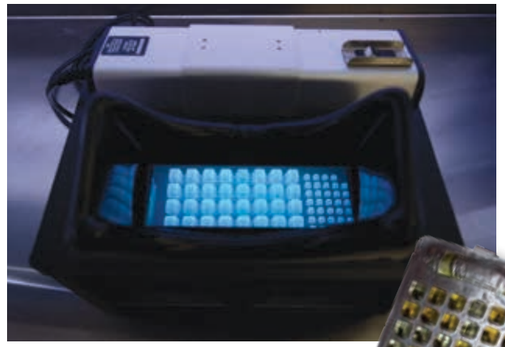
Prof Barnard explains that there are other mobile analysis options available globally, but what makes the UJ mobile lab different is that it can be parked on site and some staff can start working, while others collect the water samples. "You can do science on site, continuously, 24 hours a day, without the need to go back and forth between accommodation and a fixed laboratory in a city. The shift that needs sleep can camp in the side tent of the lab.

"We built the lab around the typical tests we would do, which are guided by the South African national standards for drinking water quality. We built it to do the basic tests, which include E. coli testing as an indicator of faecal pollution. If you find E. coli in the water, there is a good possibility that other organisms that cause disease could be present. Then you know to expand the testing," says Barnard.

"The organisms we typically test for are the bacteria that cause dysentery, typhoid fever and cholera. These types of diseases cause severe diarrhoea, sometimes vomiting. They spread quite fast. You need low numbers of bacteria in the water to get ill and these can be transferred from human to human," he adds.

Off-the-grid

The laboratory design is really a 'shell' that can be customised, Barnard says.



Above: *Pfanu Nevhudogwa, researcher appointed on contract to assist with sample analysis in the centre.*

Left: *With the mobile lab, the detection of bacteria that cause illnesses is set to become much simpler.*

Right: *The organisms typically tested for are the bacteria that cause dysentery, typhoid fever and cholera.*

The space inside is such that you can set up so you can bring in different types of equipment to do different types of analysis, to test for different types of bacteria. It was designed with a lot of space so that multiple testing equipment can be incorporated. It can adapt easily to the required setup for various tests.

The mobile lab runs its sample fridge and incubator, analysis equipment and air-conditioning on solar panels, a generator and batteries. The lab carries its own safe water supply and a side tent to accommodate more testing equipment and staff needing shelter. Because it can operate without grid electricity or water, the mobile lab can stay on site for several days if needed.

Testing for schools, clinics and hospitals

The lab is designed to answer all sorts of questions. What bacteria are contaminating the water supply? Are people washing their hands properly with safe water before eating or preparing food at home? What about schools, clinics and hospitals - is there a problem in a canteen's food preparation, food storage or cleaning procedures? Did repairing a leak in a city water supply pipe introduce contamination?

Because of this, the lab can be a cost-effective option for monitoring water treatment plants, community water supplies, schools, clinics, and hospitals for potential Water-Sanitation-Health (WaSH) problems.

Although regular monitoring across the country is a huge challenge, the lab is designed to address WaSH questions in an integrated manner.

Prof Barnard and Dr Hoorzook are developing short courses to train lab staff in the standards and protocols required to operate a mobile lab like this.

With regular WaSH monitoring, fewer children under five are at risk, fewer school learners lose sleep because of upset tummies, fewer employees take sick leave, and fewer people arrive at hospitals and clinics as a result of preventable problems.

"We believe this laboratory and the technology in it, will be able to take high-end water testing closer to rural areas and other places far from standard laboratories. Communities then have access to a laboratory that can do water analysis in their area or in their village," Barnard concludes. ❑