COVID SURVEILLANCE

Poop scoop: world honours for SA study

A groundbreaking Water Research Commission (WRC) funded project using novel sampling methods to trace the spread of the coronavirus in informal settlements has won international acclaim. Matthew Hattingh reports.

All photographs supplied

We are what we eat. Or taken to its logical conclusion and put more bluntly, our poop can talk.

For a long time, researchers have collected samples at municipal wastewater treatment works to reveal fascinating and useful insights into public health. Many of the things we ingest as well as the illnesses we contract show up in tiny, but discernible, traces in our faecal matter and urine. This spans a host of things, from the illicit drugs and pharmaceuticals some of us use, to the diseases coursing through our bodies.

Sewage surveillance offers a number of benefits over clinical testing and the diagnosis of individual patients. It's done anonymously and because it studies populations en masse, fewer trained personnel and less specialised equipment and facilities are needed, simplifying logistics and slashing costs.

By using molecular techniques to analyse samples, researchers can develop a snapshot of the health of an entire community, including how many people are carrying a particular infection, regardless of whether they are showing symptoms. Sewage surveillance helped scientists in many countries, including South Africa, respond early to the Covid-19 pandemic and to keep tabs on the SARS-CoV-2 virus, including emerging variants. It assisted authorities to track rising infection and predict hospital admissions.

The National Institute of Communicable Diseases and partners

have been monitoring 85 wastewater treatment works across the country, covering many hotspots. The trouble is, about one-third of our countrymen don't have sewered toilets, so sampling only wastewater plants, although convenient and proven, provides an incomplete picture of public health in our cities and towns. But what if rather than relying solely on samples grabbed at the heads of wastewater plants, collections were made from runoff and rivers in informal settlements, where human waste tends to collect?

"This has been the largest non-sewered surveillance programme undertaken globally"

That, in a nutshell, is what a WRC-funded study has succeeded in doing. Gina Pocock, Leanne Coetzee, Bettina Genthe, Karabo Simelane and Prof Janet Mans reckon their study has shown how non-sewered surveillance for SARS-CoV-2 could be done across multiple sites. And they provided a framework to guide citywide research in other developing countries.

"To the authors' knowledge, this has been the largest non-sewered surveillance programme undertaken globally," said the team, who represent private company Waterlab and the University of Pretoria. But don't just take their word for it.

A poster-presentation that summed up their work shared top honours at the International Water Association's World Water Congress in Copenhagen, in September, finishing ahead of more than 500 other submissions. The team was honoured in the poster category along with two other teams: from the Indian Institute of Technology Roorkee, for their presentation on efforts to rejuvenate that country's Ganga River basin; and from Hokkaido University, Japan, for their work on decomposition of the contaminant 1,4-Dioxane.

Jay Bhagwan, executive manager at the WRC, said: "This is a significant acknowledgment of this pioneering work at the highest level, which offered inclusivity and established a pathway and opportunity for broader environmental water quality monitoring."

WRC research manager, Dr Sudhir Pillay, who attended the congress in the Danish capital and learnt of the award a few hours before the presentation at the closing ceremony, said the team was delighted. Paying tribute to his colleagues, Pillay said: "It showed the work was unique and valuable… recognition of the top researchers that we have in the country.

"We have great researchers; it's world-leading stuff," he said, hoping the award would encourage others working in water to stretch themselves. "Because something is difficult or challenging, it doesn't mean we shouldn't try."

What were some of these challenges? Pocock, the lead researcher, told ***The Water Wheel*** that getting hold of the samples proved to be the biggest difficulty – at least initially. "You can't just arrive and start sampling outside someone's shack. People find it threatening," she said, explaining that people in the study areas were aware the team was looking for Covid, which carries a certain stigma.

The solution, she said, lay in getting the community's trust, which they did by piggybacking on "networks and contact in the field". Earlier proof-of-concept studies meant the team knew they were on the right track. They understood samples

The project team (left to right) are Ms Leanne Coetzee, Prof Janet Mans, Dr Gina Pocock and Ms Karabo Simelane (Photo insert: Fellow team member, Bettina Genthe)

The WRC-funded study illustrated how non-sewered surveillance for SARS-CoV-2 could be done across multiple sites.

Sampling took place at 22 sites across four provinces. Samples were gathered mainly from river and surface water.

from greywater and streams at informal settlements could vary considerably more than samples from wastewater plants. They had already figured out how best to go about sample processing and analysis, with nucleic acid extraction and viral amplification work, to detect and quantify viruses, entrusted to the University of Pretoria's Department of Medical Virology.

The team set to work at 22 sites across four provinces. Sample gathering – mainly from river and surface water – continued from March to September of 2021. Thereafter, the study was extended for a further 12 weeks at a number of existing and new sites, to see if further lessons emerged.

Efforts to sample sludge from individual urine-diverting dry toilets were abandoned after proving unfruitful, expensive and impractical. These off-sewer toilets, in outlying eThekwini, failed to yield positive signals of SARS-CoV-2.

Sewage surveillance is fairly straightforward at wastewater treatment works, where staff are well versed in taking grab samples and their proper care. But in informal settlements, and with so many sites, the team sought a different approach.

With the help of river action groups, community leaders, universities and research facilitators, they took grab samples and tethered passive sampling devices to the banks of streams as well as in channels between shacks. Sampling was done up- and downstream of settlements so the researchers could take into account any viruses already in the water before it passed a particular settlement.

Passive sampling proved a better, faster and cheaper way to gather data than grab sampling in informal settlements. Immersing the devices for about 24 hours worked best, making up for times when the water might be diluted, typically from rain. But leaving the torpedo-shaped devices (3D-printed in plastic and containing medical gauze) in for longer risked fouling.

It all entailed a lot of "very challenging" logistics and project management work, said Pocock. Sampling teams had to be trained or put in place with the help of partners. Cooler boxes of samples had to be collected by Waterlab or couriered back and forth between the company's Pretoria offices and the sites in Gauteng, Mpumalanga, the Western Cape and KwaZulu-Natal. And the samplers were kept on the hop, making regular visits to install and retrieve the devices, which on a few occasions went missing.

But in the end, said Pocock, "It worked very well; it was worth it." She said the results were less detailed than those from wastewater treatment works, but did succeed in detecting Covid in wastewater specific to non-sewered communities. This complemented findings from conventional wastewater sampling and clinical testing.

"The inclusion of non-sewered surveillance within city-wide

surveillance programmes ensures that everyone benefits from surveillance programmes and health outcomes," the authors said. The methodology they developed was expected to support officials monitoring Covid-19 and planning the timing of interventions to tackle infection spikes.

"Regular screening of these sample points will also be useful to assist in early detection of the re-emergence of the virus… in communities, where there is both the risk of rapid spread and low likelihood of conventional testing," the study said. Pillay said the work was also included as a case study in the World Health Organisation's Interim Guidance document on environmental surveillance for SARS-COV-2. These highlight good practice, for the benefit of researchers internationally.

Beyond its value in assisting the authorities manage the pandemic, Pocock saw wider applications for their methodology and hoped it would "help other developing countries as we face future health challenges".

It provided a "new place for sampling", allowing the monitoring of other diseases, such as norovirus and hepatitis E – which were widely detected in the study. There were also opportunities to learn about emerging contaminants, lifestyle indicators, and antimicrobial resistance in communities. All this and more, and with few of the ethical concerns that often complicate research.

Regular screening of sample points are useful to assist in early detection of the re-emergence of the virus, especially in communities where there is both the risk of rapid spread and low likelihood of conventional testing.