The water in the Senegal River under mobile monitoring

By Nathalie Kinnard

Thanks to a research partnership between Montréal and Dakar, the health of communities living near the Senegal River will be protected by mobile devices! Starting in August 2016, residents of Senegal should receive warnings via text message each time water quality becomes problematic.

In many tropical countries, watercourses are used for not only consumption, but also laundry and food washing, personal hygiene and recreational swimming. These multiple uses lead to microbial contamination problems that are often difficult to detect quickly.

For example, in the Senegal River, a parasitic worm is the source of stomach troubles in much of the population. It causes schistosomiasis, an intestinal or urinary infection that has become a leading reason for hospital visits in Senegal, second only to malaria. This illness results in high levels of absenteeism not only in schools, but also in workplaces, in the fishing, rice cultivation and agriculture industries, which are important drivers of the local economy.

Faced with this alarming situation, Université Cheikh Anta Diop (UCAD) in Dakar and Université du Québec à Montréal (UQAM) decided to pool their computer technology expertise and implement an epidemiological monitoring system based on a sensor network and mobile telephony.

An insidious parasite

In 2013, Halima Elbiaze, a professor in UQAM's computer department, launched the project with a grant from the **Canada-Africa Research Exchange Grants** program, funded by IDRC and managed by Universities Canada. She is leading the Canadian team, and her colleague, Bamba Gueye, who specializes in biosensor networks at UCAD, is coordinating the Senegalese team. "This project will benefit Senegal's rural communities, who have few ways of fighting schistosomiasis," says Mr. Gueye. "There is effective medication to treat the infection, praziquantel, but the illness needs to be diagnosed, or the parasite detected in the water." Therein lies the problem.

A person can host the parasite for many years without developing any symptoms. Unaware of the parasite, this person can contaminate other members of the community by urinating or defecating in the water. "We must wait for people to become sick and go to the hospital to diagnose the illness and confirm the presence of the parasite," says Bamba Gueye. "However, villagers don't necessarily go to the hospital when they are sick, so it is impossible to determine why they are ill and treat them."

The solution: detect the parasite before it harms anyone. The worm is dangerous to humans only once it has reached its second larval stage. The larvae, now called furcocercariae, penetrate the skin of any person who comes into contact with the infested water. The larvae continue to develop in the human body until they become adult worms, or schistosomes, which live in the blood vessels and lay their eggs there, causing an immune response and progressive lesions in the organs. Victims suffer from abdominal pain, diarrhea and blood in the stools. Over the longer term, complications can occur, such as renal lesions, genital lesions, cancers of the bladder and sterility. The human body also evacuates some of the eggs in feces or urine, so the aquatic contamination continues. The eggs become larvae called miracidia, which parasitize mollusks to become furcocercariae. And the cycle continues.

Halima Elbiaze and Bamba Gueye are proposing that sensors be used to detect the chemical substances released into the water by the parasite before it reaches the larval stage that is harmful to humans. "These sensors will continuously measure the composition of the water using different techniques, such as UV spectrometry and fluorescence," explains

Ms. Elbiaze. "The data will then be sent, in real time, to processing receivers on the ground. If there is contamination, software will send a warning to targeted people and community radio stations." The warning will be a simple text message containing colours and symbols warning the population to stay away from the infected waterbody. The area will be quarantined until the water and the population are treated.

Parasitizing the parasite

Senegalese biologists are currently trying to determine the conditions conducive to the development of the larva—temperature, water pressure, food—in order to rear it in monitored impoundments. This will make it possible for them to understand how the parasite evolves and identify the chemical substances that can be measured in the water.

As for Ms. Elbiaze, Mr. Gueye and their teams, they are looking for suitable sensors that can be immersed in the Senegal River and that will transmit the data to the mobility network. Tests are being conducted in small tanks in the lab to validate the protocols and computer algorithms. Another test phase will take place under natural conditions in Senegal.

If everything goes as planned, the Senegal River will be under mobile monitoring by August 2016. The expertise developed during this project will be adapted to monitor other utilitarian watercourses, like the Nile in Egypt, which is polluted by the discharge of industrial effluent.