BIZCOMMUNITY

Environmental surveillance could provide an earlier and clearer picture for public health interventions

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If there was any doubt, the coronavirus pandemic (Covid-19) has clearly revealed that we inhabit a world where people, animals and environments are interconnected and interdependent. This mutuality brings with it new challenges and opportunities in controlling not only infectious diseases but also chemical substances (often man-made) that have a negative impact on human, animal and environmental health.

External pressures on our environment, such as climate change, unplanned urbanisation and poverty also exacerbate the spread of disease, while global connections linked to international trade and tourism means that diseases are only a few flights away from being transported to the next location. Through a deliberate focus on the human-animal-environment interface, and using an integrated (one-health) and sustainable approach, there is an opportunity to improve and maintain health within these three sectors.

Human health is inextricably linked to environmental health

On 26 September, World Environmental Health Day allows us to focus on how environmental dynamics are affecting the well-being of humans and our ecosystem as a whole. In light of the Covid-19 pandemic, this year's theme, as declared by the International Federation of Environmental Health (IFEH) is *Environmental Health, A Key Public Health Intervention in Disease Pandemic Prevention*.

Based on estimates provided by the World Health Organization (WHO) and other institutions, the global disease burden attributed to environmental factors is approximately 24% while 23% of all deaths globally are due to some environmental factor with children experiencing the highest death rates; and of the 102 disease groupings covered in a 2004 WHO report, 85 of these disease categories had some environmental factor associated with it.

Some of the commonly known and wide-spread environmentally related diseases occurring include diarrhoea, respiratory infections and malaria. In some cases, non-communicable diseases such as cancers and cardiovascular diseases have also been shown to be environmentally related. Improved water, sanitation and hygiene (WASH) measures, better management of harmful chemical substances as well as the existence and implementation of occupational policy around environmentally related work has seen a reduction in the environmental disease burden.

However, a lot remains to be done, particularly in the upstream prevention of disease such as addressing issues related to the use of water and land by animals and humans, sensitising communities about the environmental impact of their activities and undertaking effective monitoring and surveillance activities.

Environmental surveillance is increasingly becoming a complementary tool for clinical disease prevention

It is often a difficult task to link an environmental factor to the occurrence or spread of a disease and as a result it is sometimes necessary to determine indirect health effects and investigate widespread or prominent environmental incidents to understand the progression or likelihood of a disease in a human population or ecosystem. Furthermore, with certain infectious diseases such as polio, very few individuals will exhibit symptoms (approximately 1 in 200) and therefore a clinical monitoring programme is unlikely to pick up the presence of a disease which can then begin to circulate quietly in a community.

Environmental surveillance, through the continuous monitoring and profiling of water and wastewater sources for substances that can serve as indicators or biomarkers of the collective status of environmental health is increasingly being used worldwide for detecting and avoiding emerging and unrecognized hazards that may cause health disparities and for guiding forensic investigations of cause-effect linkages involving communities and stressors. This approach is based on the fact that any substance (e.g. infectious agents, illicit drugs, food or environmental toxicants) that may be present in the environment will be washed into the aquatic system, either directly through the draining of water or via excretion by humans or animals.

A number of countries around the world have also initiated environmental surveillance programmes for SARS-CoV-2 (the causative agent for Covid-19) in wastewater, to serve as an early warning tool and as a complementary approach to track the prevalence of infections in communities. Besides Covid-19, environmental surveillance has historically been used as a tool to complement the clinical tracking of Norovirus, Poliovirus and Hepatitis virus spread and infection.

A number of water fingerprinting (a process where vital biological and chemical information is detected and collected from water samples) applications which complement disease surveillance have also very recently been tested and published. Some of the examples include: detecting and monitoring drugs and counterfeit pharmaceuticals use and abuse; tracing the source of pollution and wastewater inflow into raw and drinking water sources and comparing the environmental health status of different geographic areas.

The Water Research Commission (WRC) has funded a number of case studies in South Africa which provide data on the occurrence of pathogens and chemicals in the environment. Highlighted examples of these studies include those conducted

on the occurrence of Cholerae mainly in the Eastern Cape led by the University of Fort Hare and reports of these studies are freely available for download.

These studies have developed methodology and monitored the presence of cholera and non-cholera Vibrio pathogens in water (including wastewater and irrigation water), vegetables and aquatic animals. Such comprehensive environmental monitoring is key as it points to where humans might be at the greatest risk to exposure to infectious disease and can aid the National Institute of Communicable Disease (NICD) as well as national/ provincial and district outbreak response teams by providing access to better disease prediction models especially in areas where human clinical surveillance activities might be non-existent or minimal.

Even where human cases of disease have been detected and are increasing as was and (in some areas) is still the case for Covid-19, environmental testing is worthwhile. A recently completed proof-of-concept WRC funded study led by a team from Waterlab, CSIR and the University of Pretoria, screened wastewater for the presence of SARS-CoV-2 virus in various hotspots across the country.

This study was in line with a number of countries around the world who also undertook surveillance of their wastewater in an attempt to correlate the presence of clinical infections with the occurrence of viral RNA in wastewater. SARS-CoV-2 RNA was successfully detected in wastewater during the study and subsequently a number of various groups within the country have also confirmed the presence of viral RNA under their own testing conditions.

If implemented at scale with the required precision, a national wastewater surveillance programme will offer key benefits such as an early warning system which will enable future spikes to be brought under control quickly and resources (for testing) and implementing of policies/regulations to be directed where they are most needed.

As environmental surveillance activities increase in order to maintain a healthy human population and ecosystem, there is a greater need to understand and prevent disease. The growing number of new technologies and tools aid in that understanding and include equipment (laboratory, hand-held, point-of-use) that can conduct high throughput genetic analysis, analysers and samplers that can detect minute concentrations of chemical substances as well as computer programming and models that can integrate large amounts of data to generate meaningful information.

Wastewater-Based Epidemiology (WBE) is a new epidemiological tool that has been found to be complementary to disease surveillance activities. In their paper titled *Future perspectives of wastewater-based epidemiology: Monitoring infectious disease spread and resistance to the community level*, authors from the University of Bath, UK provide limitations on current public health and infectious disease surveillance techniques. They illustrate the gaps that WBE can fill, as the approach gives a comprehensive and unbiased reflection on the health of communities. The concept is primarily based upon the extraction, detection and then subsequent analysis and interpretation of chemical and/or biological compounds.

The University of Bath is collaborating with the University of Stellenbosch in a study partially funded by the WRC which looks at urban wastewater based epidemiology with one of the aims being evaluating human exposure to emerging substances of concern which include illicit drugs. Additionally, it is important to continuously train and upskill environmental health promoters at community level to understand these new techniques and how their work can complement these new and emerging environmental surveillance techniques.

Effective design and use of environmental surveillance requires significant investment but could reduce inefficiencies in public health research

Although 26 September focuses on the environment and its relationship to health, it is important to re-emphasise the need to effectively link environmental, human and animal research and surveillance to ensure that there is synergy and a reduction in the waste of resources on duplicate health challenges.

Environmental surveillance can be costly, therefore it is critical that thought is given to the upfront investment and start-up costs that will be required in implementing an effective surveillance programme especially for rural areas where often other

types of surveillance might not be conducted and infrastructure is not readily available.

There are also ethical concerns around the potential misuse of environmental surveillance data which have not been clearly addressed by policy, regulation or law as the current focus is often on collecting data for the greater good - protecting the health and safety of millions for instance in a pandemic situation. Without transparency regarding data use and data sharing activities, there is a real possibility of the marginalisation and or discrimination of communities.

Finally, we must realise that surveillance of any kind (human, animal or environmental) can only help protect and maintain health if the right corrective action is taken immediately once credible information on the spread of an infectious agent or toxic substance is known. Human, financial and administrative resources are needed in order to implement effective corrective action and measures. Surveillance therefore only accounts for a fraction of the cost needed to ensure effective human and ecosystem health.

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