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Lessons about pandemics

Preparing for epidemics in South Africa

There's a lot of official information about COVID-19. South Africa's website for COVID-19 notes that it's a virus and that on "7 January 2020, 'Severe Acute Respiratory Syndrome Coronavirus 2' (SARS-CoV-2) was confirmed as the causative agent of 'Coronavirus Disease 2019' or COVID-19". The National Institute for Communicable Diseases (NICD) Covid-19 website explains how the "novel coronavirus has a possible zoonotic origin". 'Zoonotic' refers to infectious diseases caused by pathogens on animals that then jump over to humans.

This public information on COVID-19 doesn't even begin to touch on the extensive amount of operational work, research and development that is happening in South Africa around the epidemic. The National Science and Technology Forum (NSTF) held a Discussion Forum on 'Preparing for epidemics in South Africa – human and animal' which provided insight into this. It was hosted with the NSTF Science Councils and Statutory Bodies Sector and ran from 25-26 February 2021.

Previous public health emergencies
There have been numerous public health emergencies in South Africa and globally, each providing an opportunity to learn and build on previous experience. Dr Kerrigan McCarthy was one of the presenters who spoke on this. She is a Consultant Pathologist, Centre for Vaccines and Immunology, NICD.

The NSTF provides neutral collaborative platforms where issues and sectors meet:

- One of the National Science and Technology Forum (NSTF) functions is to hold discussion forums, bringing the private and public sector together to address important issues and engage with government policy.
- Feedback from these discussion forums is given to role players and stakeholders.
- Recommendations are put forward to government as part of the SET community's (science, engineering and technology) efforts to make input into SET-related policies and implementation.
- The NSTF Science Councils and Statutory Bodies Sector has 16 member organisations participating as key stakeholders of the SET and innovation community.

In 'The COVID-19 Pandemic – what lessons have we learnt for the future?', she uses three examples: Life Esidimeni, the listeriosis outbreak and the COVID-19 pandemic. The focus is on aligning operational breakthroughs with SET innovation, so important in South Africa where there is a lack when converting planning to action.

Take the World Health Organisation's Incident Management System Framework. This emerged from learnings around the Ebola Crisis of 2013-2014. The NICD adapted this to coordinate patient relocation back to Life Esidimeni. (In a failed attempt to de-institutionalise mental healthcare in Gauteng, patients were unsuccessfully moved to NGOs in 2016.)

McCarthy says without a good coordinating mechanism, resources are misused or poorly allocated. Other lessons included the importance of stakeholder communication (especially with the community and family) and rapidly creating data management systems that are accessible and user friendly. In fact, flexibility and adaptability become core principles as new information often means decisions must be revisited.

The listeriosis outbreak (2017-2018) first led to the contamination of casings and meat and then other products on the shelves. The NICD coordinated a multisectoral response to the outbreak, similar to the Life Esidimeni plan.

This emergency highlighted the importance of including the public. McCarthy says public cooperation is critical for health interventions. The surveillance of outbreak-prone diseases also came to the fore. It included further development of local and international networks for epidemiology and surveillance.

COVID-19 response
Reflecting on the COVID-19 response, McCarthy believes South Africa has done well, learning lessons from previous public health events. Once the virus reached South Africa, it was quickly followed by legislation to support lockdown (which started on 27 March 2020). From a dramatic increase, numbers of infections then levelled out post lockdown.

Coordinating structures at national level
Further coordinating structures were created in response to requirements around the pandemic. These included a National Command Council to make key decisions, a Ministerial Advisory Committee involving academic specialists, the NICD's incident management team and the National Department of Health (NDoH). McCarthy says that government created an environment conducive to multi-sectorial coordination at a high level.

COVID-19 brought home the importance of working across sectors, from those dealing with animals, humans and health to the environment and legislation. This is of particular note since departments classically work in silos.

For a detailed explanation of the legislative framework and coordinating structures, see 'Policies and Regulations for Dealing with Disease Outbreaks & Epidemics in South Africa'. This was presented by Dr Wayne Ramkrishna, Deputy Director: Communicable Disease Control, NDoH.

More than a year into the pandemic, more lessons have been learnt. McCarthy says it's clear that coordinating structures need to be replicated at provincial and district level as these are service delivery points.

Risk communication and community engagement
Previous experience had already shown that risk communication and community engagement are key. They support public trust in authority structures and engender cooperation with public health interventions.

McCarthy says that COVID-19 created communication difficulties due to uncertainties among scientists about the effectiveness of public health interventions. It created gaps for misinformation. There is now renewed emphasis and greater appreciation on the importance of clear communications.

McCarthy notes that good communication should state the facts, explain what is unknown and what is being done to address the uncertainties, and then what the public can do to protect itself.

Prof Stephanie Burton added to this – see her presentation. She is in the Faculty of Natural and Agricultural Sciences and Professor at Future Africa, University of Pretoria (UP). Burton says we need to communicate that the COVID-19 virus is likely to become endemic, how to live safely, and how the virus works. It's also important to understand the public's specific questions to provide relevant factual answers.

Burton says that information needs to be understandable, accurate and evidence based. There should be reasons to trust the information and the people providing it. Consequently, we need to increase educational and awareness programmes. This moves us towards a greater science culture, one where the public grasps scientific developments and takes part in debates. It also means being able to separate fact from fiction by knowing how to access and assess information. People also need to understand why information changes ie that science changes as evidence changes.

Data management and analysis
McCarthy explains that an early challenge was the lack of data sharing between private labs and the NICD. A data interface has been progressively established between all the parties, allowing access to data. This is critical for surveillance.

There was a need to track the epidemic ie cases, admissions, patient progress, reported deaths, excess deaths etc. Initially, there was no system in the public sector. DATCOV, a portal for logging hospital admissions of COVID-19 patients, was then set up by the NICD.

To further understand the causes of deaths, the NDoH mandated that post-mortems be conducted on all community deaths ie not just hospital deaths. Then the South African Medical Research Council (SAMRC) assisted with the interpretation of data on deaths. There were issues such as a lack of clarity on case definitions and delays in capturing the cause of death. This is partly due to each province having its own health systems and approach.

McCarthy says one of the most important lessons is the importance of real-time quality data and good management systems. We need investment in data management infrastructure and the associated people skills.

Other sources of data – wastewater and earth observation
Complementary sources of data can add to the picture, says Mr Jay Bhagwan, Executive Manager: Water use and waste management, Water Research Commission (WRC). He spoke on 'Monitoring of outbreaks – what can wastewater reveal?'.

Wastewater-based epidemiology can reveal pharmaceuticals and other substance use, diet choices, and genetic markers, for example. A qualitative analysis of environmental samples can be used for determining general pathogen circulation within populations. Regarding COVID-19, the analysis detects RNA fragments (ie traces of the virus). Note that the live virus is not in the water.

Researchers can use wastewater-based epidemiology to track the number of infections and then map hot spots in communities. This is useful for determining risk levels and for supporting

decisions around lifting or imposing mitigation interventions.

Bhagwan says we're just starting to see the range of possibilities. The WRC is working on a COVID-19 National Surveillance Programme as part of early warning systems. It has already reached pilot phase.

More complementary information came from earth observation data via the South African National Space Agency (SANSA), says Ms Naledzani Mudau, Remote Sensing Scientist, SANSA. Various technologies and outputs, such as satellite imagery, can help monitor health services and available resources. It includes mapping and monitoring water quality, air quality, pollution, and heat extremes.

Depending on the application, you can gain data from global to street view, as well as an historical view. SANSA can also create co-data sets, for example, vegetation monitoring over time can be integrated with data from the weather service.

The most important lesson has been around increasing stakeholder engagement, says Mudau. Decision makers need to be more aware of the type of data available and how to use it.

Data modelling

Another important area is data modelling, explains Prof Sheetal Silal, Director: Modelling and Simulation Hub Africa, University of Cape Town. She is part of the South African COVID-19 Modelling Consortium, which provides mathematical modelling support to national government during the COVID-19 epidemic.

Mathematical models can be understood as tools that create synthetic populations in silico (on computer) that have features similar to the targeted real-world populations. Silal says mathematical modelling is so much more than path diagrams and mathematical equations.

In a real-world application, a lot of data is not available in a numerical format. In fact, some of the data isn't even collected. The modellers need to meet with experts to understand the disease, the affected population and the public health system, among other factors. This information becomes part of the mathematical model.

Silal explains it as using maths, combining it with computer programming and knowledge about the disease, to create a tool for better decision making by gaining insight on the behaviour and trajectory of the epidemic.

Mathematical modelling has been used in numerous ways in South Africa for COVID-19. One is to project future trends and the severity of infectious disease. It has also been used to predict the impact of interventions in the population, such as the impact of mask wearing. It has also been used to estimate the cost and number of resources required.

Silal emphasises that modelling predictions cannot be seen 'as a crystal ball'. Mathematical modelling is about 'what if' scenarios: "If we make certain assumptions based on available data, this is the likely outcome." COVID-19 had and still has a lot of unknowns.

Mathematical modelling is also used as a tool to understand complex relationships between features of infection. This can be seen when the second wave of COVID-19 came. The drivers of the resurgence were unknown until the new virus variant emerged. The consortium developed a resurgence monitoring framework with outputs such as a dashboard, the SAMC Epidemic Explorer.

The focus is now on the third wave – variants and vaccines, looking at new lineage, reinfection, and vaccination – and developing a modelling framework around that.

Silal says that numerous lessons have been learnt. These include further highlighting uncertainty in disease models and making public communication a full time effort. Furthermore, there is an urgent need for improved surveillance data infrastructure.

Research around COVID-19

A great deal of research has been generated around COVID-19. Topics range from surveillance (such as investigations of COVID-19 in people with HIV) to biobanks (where researchers can investigate possible genetic markers for predisposal to severe COVID-19). There is also research on which diagnostics to use, as well as developing our own. Besides being part of the Oxford AstroZeneca trials, there is research being done in South Africa around prevention and treatment. And this is to name but a few, explains Ms Glaudina Loots, Director: Health Innovation, Department of Science and Innovation (DSI) in her presentation. Of particular note, says Loots, is the establishment of the Network for Genomic Surveillance in South Africa.

The list of R&D activities is extensive. Loots says that while the research is informing government, there's definitely a gap when it comes to communicating South Africa's successes and results to other stakeholders including the public.

Communicating research has its own complications including not interpreting scientific results accurately. This was shown by Prof Lucia Anelich (from Anelich Consulting and the Central University of Technology) when looking at whether COVID-19 is transmitted via food. To be clear, evidence shows that the virus is not transmitted via food; however, the reporting has been confusing.

Role of indigenous knowledge

Prof Nceba Gqaleni from the African Health Research Institute (AHRI) asks 'if there is a role for indigenous knowledge in fighting epidemics or pandemics?' He notes that Indigenous Knowledge Systems (IKS) play an essential role in empowering people, catalysing grassroots innovation, and enabling commercialisation and stable livelihoods. This is of particular importance when faced with a legacy of colonialism, economic dominance, and western systems hegemony. At the same time, one of the objectives of IKS is to build links between community-based knowledge systems and formal scientific institutions.

Investigating preparedness

Prof Jeffrey Mphahlele, Vice-President: SAMRC, notes that countries need to be prepared and to continue to strengthen their response to pandemics. Most countries were caught off guard. (He spoke on 'Influenza pandemics – lessons for COVID-19 – human and animal'.) This comment was widely endorsed by the speakers, with Ramkrishna pointing to preparing for emergencies with an all-hazards approach. Think beyond communicable disease to the health consequences of droughts and cyclones.

Research is critical during and after epidemic outbreaks, says Mphahlele. It includes identifying research gaps and priorities, as well as strengthening biosecurity, the research infrastructure, and the legislative framework.

McCarthy notes that outbreaks are a signal that something underlying is wrong. COVID-19 is more than a virus; it's a conflation of social weaknesses with the virus that has exploited gaps in our society. This results in the weak and vulnerable and those with less access to resources suffering an unfair distribution of the disease.

Beyond policies and regulations, Ramkrishna spoke of the burden of zoonotic diseases in general. Already in 2018, a World Bank Report showed that zoonotic diseases accounted for just under one billion cases and a million deaths annually.

He notes that the occurrence and impact of known and novel disease outbreaks are likely to increase with changes in land use, agricultural practices, climate and weather, travel and trade, and urbanisation. Ramkrishna says we need to strengthen health systems to be resilient.

Alternative perspective
Dr Yogan Pillay, Country Director: Clinton Health Access Initiative, spoke on non-pharmaceutical interventions.

Pillay stressed that work needs to be done across sectors and across all levels of government. This includes interventions at all levels, especially community level. Involving the community and local government made a big difference, for example, putting experts at decentralised levels to analyse data at a local level. Action can then be taken in real time.

At the same time, there is a need for more agile decision making by management, as well as greater autonomy for front line workers. He says that all of government and all of society should be responding to COVID-19. We need to be co-creating health and wellness.

Understanding zoonoses

- **'What can we learn from other zoonoses (besides COVID-19)?':** This was by Prof Wanda Markotter. She is the Chair of the NRF-DSI South African Research Chairs Initiative: Infectious Diseases of Animals (Zoonoses), as well as Director: Centre for Viral Zoonoses, Department of Medical Virology, Faculty of Health Sciences, University of Pretoria. Her presentation provides a great deal of information on the complex issue of spillover from animals, as well as biosurveillance.
- **'Legislation and government initiatives to curb epidemics among livestock':** Dr Mpho Maja is Director: Animal Health, Department of Agriculture, Land Reform and Rural Development. Her take home message is that disease control is a collective effort.
- **Developing a biodiversity sector response plan to zoonotic disease:** Dr Kiruben Naicker is the Director: Information Management and Biodiversity Science Policy Interface, Department of Environment, Forestry and Fisheries. The presentation includes a coordinated national prevention and response to current and future zoonotic diseases at the human-animal-environment interface.
- **Advances towards detecting and preventing the spread of multispecies disease – bovine TB:** Dr Wynand Goosen is the Project Manager: Biomedical Sciences, Division of Molecular Biology and Human Genetics, Stellenbosch University.

Speakers can be contacted through the spokesperson, Ms Jansie Niehaus. Further information can be found on the NSTF website and the NSTF YouTube channel.

About the NSTF

The National Science and Technology Forum (NSTF), established in 1995, is a broadly-representative stakeholder body for all science, engineering and technology (SET) and innovation organisations in South Africa, which seeks to influence policy formulation and delivery.

The NSTF Awards are unique in SA, recognising the outstanding contributions of individuals and groups to SET and innovation.

The science bursaries page provides information on bursaries and bursary providers for science, engineering and related studies.

STEMulator.org attracts learners and students to the exciting world of science, technology, engineering and mathematics (STEM). It provides a virtual world full of stimulating content to excite and inform the youth, including STEM career guidance. Established under the auspices of the NSTF pro*SET* membership sector (Professionals in *science, engineering and technology*).

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