NATIONAL SCIENCE AND TECHNOLOGY FORUM

PROCEEDINGS OF DISCUSSION FORUM

PREPARING FOR EPIDEMICS IN SOUTH AFRICA – HUMAN AND ANIMAL

25-26 February 2021

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DAY 1

WELCOME (MS JANSIE NIEHAUS, EXECUTIVE DIRECTOR, NATIONAL SCIENCE AND TECHNOLOGY FORUM (NSTF))

Ms Niehaus welcomed everyone to the discussion forum and introduced the topic of the discussion.

SESSION 1: THE COVID-19 PANDEMIC – WHAT LESSONS HAVE WE LEARNT FOR THE FUTURE?

KEYNOTE: REFLECTIONS ON PUBLIC HEALTH EMERGENCIES - LESSONS GOING FORWARD (DR KERRIGAN MCCARTHY, CENTRE FOR VACCINES AND IMMUNOLOGY, NATIONAL INSTITUTE OF COMMUNICABLE DISEASES (NICD))

Life Esidimeni Crisis

The Life Esidimeni crisis began when there was a global move of policy to support community management of persons with mental health disabilities (referred to as mental healthcare users in the South African legislation). As a result of a precipitous and poorly thought-through decision, mental healthcare users from the Life Esidimeni Institute were moved across the Gauteng Province to certain non-governmental organisations (NGOs) to facilitate their de-institutionalisation. The Health Ambud investigated the ensuing crisis and recommended that government move mental healthcare users back to a place of safety.

The NICD became involved in 2016 when it was asked by the National Department of Health (NDoH) to help coordinate the relocation of the patients. The Incident Management System (IMS) that is part the World Health Organisation's (WHO) Emergency Response Framework was used to support the relocation. A plan was drawn up with the aim of stabilising and restoring the health and dignity of mental healthcare users affected by the relocations and an operational structure was established involving teams in specific focus areas. This immense undertaking resulted in the successful relocation of more than 729 users within a period of 39 working days and the handing over of a database on mental healthcare users to the Gauteng Department of Health by the NICD.

Some of the lessons learnt from this tragedy were:

- Training in the IMS is essential prior to operations and it is essential to have a core of persons trained in the IMS.
- Finance, Procurement and Human Resource Management are critical support areas of the Emergency Operations Centre (EOC)
- Data management systems need to be created rapidly and be accessible and user-friendly
- Communication is key. Emergencies are high profile with lots at stake and it is essential to keep all role players informed.
- Flexibility and adaptability is critical as new information often means decisions must be revisited.

Listeriosis Outbreak

This outbreak took place in a factory that produces processed meats. Through incomplete oversight of the production factory, the brine cooling tanks in which polony specimens were cooled after cooking became contaminated with Listeria monocytogenes, a bacteria that thrives in saline solution and in cold. The polony had a national (and continental) distribution and contamination of the meat as well as the casings led to extensive cross-contamination in retail space, homes and institutional kitchens nation-wide. Over a thousand cases were identified with a 27% mortality.

The NICD developed a strategy to identify the source of the contamination. Through the implementation of molecular whole genome sequencing of the Listeria pathogens, it was identified that they were all of the same sequence type, indicating that it was a point-source outbreak and likely to be a contamination of a particular facility. A cluster of ten cases of febrile gastroenteritis were identified in a crèche and samples taken from the fridge were found to have the outbreak strain. This pointed the NICD team in the direction of the affected factory and they found that one-third of the swabs collected had listeria as a contaminant and 26 of those were the outbreak strain.

Soon after the source of the outbreak was identified, the NDoH asked the NICD to activate the EOC in order to coordinate a multi-sectoral response to the outbreak. A project plan was developed to control and end the outbreak, and to strengthen systems to prevent future Listeriosis outbreaks, and a number of teams were responsible for specific focus areas. Part of the responsibility of the epidemiology and surveillance team was to collect clinical and environmental isolates and conduct whole genome sequencing allowing it to track the progress of the outbreak strain as clinical and environmental cases were detected. The team was also responsible for developing a database to support ongoing surveillance going forward as well as international ties with colleagues to strengthen surveillance networks and integrate the NICD into the world health authority organisation responsible for food safety. Another team had the task of identifying all the processed meat production facilities in South Africa, developing material to support factory assessment and revising and re-presenting it in the form of training activities, duties and obligations of inspectors and the legislative framework. Training was conducted in all the provinces and all 157 processed meat facilities in South Africa were inspected and tested, supported by the NICD and other laboratories. Risk Communications and Community Engagement (RCCE) were critically important and the relevant teams conducted training on food safety and outreach activities, distributed printed material, and maintained a social media presence in order to support the improvement of public and consumer awareness of food safety. The Legislation and Policy Environment team spearheaded a number of changes in the legislative environment around food control.

Some of the lessons learnt from this outbreak were:

- Public co-operation with health interventions is critical
- Outbreak response is a multi-sectoral endeavour and requires co-ordination, communication and planning
- Up-to-date and flexible legislation supporting surveillance and public health measures is critical
- Prevention is key and an up-to-date policy environment supports prevention
- Surveillance, including molecular epidemiology, for outbreak-prone diseases is critical.

Coronavirus Disease (COVID-19) Pandemic

- Co-ordinating structures at national level

The virus was imported from Europe and was followed by the rapid promulgation of legislation to support lockdown. It became clear early on that the coordinating structures that existed in the departments of health were inadequate to meet the demands of the pandemic. On the Minister's request the NICD activated its EOC and set up an incident management team in response to requirements of pandemic, and also worked with the National Health Council (NHC).

The first few weeks showed that the structures and the reach of the NICD were too small to accommodate the scope of events and decisions that needed to be made. The President created a National Command Council (NCC) comprising Cabinet members who made key decisions around lockdown. The Minister appointed a Ministerial Advisory Committee (MAC) with sub-committees relating to public health, modelling and laboratory services. The NICD slotted into the incident management team that was run by the NDoH. This broadened the reach of government to create an environment conducive to multi-sectoral coordination at a very high level and increased the depth of experts who advised government. A further layer of management within the NDoH, called the project management office was added and was initially supported by the private sector to help coordinate the financial and human resources components of the COVID-19 response. The National Joint Operations Committee (NATJOC) was responsible for addressing security threats of any kind and was the actioning agent for the NCC.

- Data management and analysis

The burning question early on was how to track the epidemic. Challenges at the outset related to:

- Laboratory testing: There were only three laboratory testing groups in the country and there was no data sharing of laboratory results between private laboratories and the NICD
- Admissions: There was no system for tracking admissions in the public sector
- Deaths: There was a lack of clarity on case definitions and signing of death certificates, as well as longstanding extended delays in capturing the cause of death by the Department of Home Affairs and

Statistics South Africa (StatsSA).

These challenges have subsequently been addressed through the following interventions:

- An application programming interface was progressively established between all private laboratories and the NICD under mandate of Notifiable Medical Conditions (NMC) regulations.
- The DATCOV system, a portal for logging admissions of COVID-19 patients, was set up by the NICD. The Minister of Health issued a directive requesting compulsory reporting of admissions by the public and private sectors to the system.
- Recording deaths was a problem in terms of the ability to understand cause of death due to COVID-19. The existing records come in through two sources: DATCOV deaths amongst hospitalised patients and the community deaths that have tested positive for COVID-19 (through post-mortem testing). The most useful data is the excess deaths report that is issued by the South African Medical Research Council (SAMRC), but one of its limitations is that the cause of death amongst the excess deaths remains uncertain.

- Provincial-level responses

The outbreak progressed at different levels across the different provinces. Gauteng and the Western Cape had the highest R0 (representing the average number of people infected by one infectious individual), probably indicating a function of the localisation of reported cases to the urban centres. A deep dive found that the outbreak in the provinces commenced in the urban areas and there were a number of super-spreader events that led to seeding of vulnerable areas with consequent transmission. The Western Cape initially had a very robust contact tracing system but it became completely overwhelmed due to high numbers. Adherence to lockdown in the poorer socio-economic areas was not possible and cluster outbreaks in essential services seeded the outbreak into those areas and created hotspots. One of the challenges in all the provinces was the length of time it took from the identification of a positive case to the interview of contacts and the availability of test results. This made it impossible to contain the outbreak using contact tracing. A compounding factor was that laboratory services were slow to take off due to international supply problems, generating enormous backlogs that further complicated the ability to diagnose patients who were admitted with suspected COVID-19. This led to immense pressure in hospitals and may have contributed to limitations in healthcare services to manage the situation. The Western Cape took the lead in limiting the criteria for testing and this adversely affected the epidemic curve.

Some of the problems faced by the problems were:

- Delayed readiness of quarantine and isolation facilities
- Difficulty in social distancing and contact tracing
- Difficulty in small towns, especially during South African Social Security Agency (SASSA) grants payment days
- Data management needed strengthening
- Communication challenges relating to test results
- Supply chain management of Personal Protective Equipment (PPE) needed strengthening
- Backlogs in laboratory testing.

- RCCE

RCCE activities are key in supporting public trust in authority structures and in engendering co-operation with public health interventions. COVID-19 created difficulties because of uncertainties amongst scientists in effectiveness of public health interventions and this tension of uncertainty created gaps for misinformation. There has been a renewed emphasis and greater appreciation at global and national levels on the importance of clear communications.

Some of the lessons learnt from the COVID-19 pandemic were:

- Public trust in health authorities aids in dispelling misinformation, particularly in relation to the vaccine
- Co-ordinating structures (and training) needs to be replicated at provincial and district levels
- Data management to support real-time collection, analysis and sharing of quality data, as well as meaningful data is extremely critical
- Legislation to support public health interventions is key

- Surveillance, including molecular epidemiology, for outbreak-prone diseases is critical.

Conclusion
The reality is that every outbreak leaves a legacy that allows for the good or the gift found in that outbreak to be harnessed in terms of the way people organise themselves and more importantly, the way they look after and care for themselves as a community.

Looking back at the Life Esidimeni crisis, the key fault (apart from the lack of quality standards for the NGOs) was the communication with families and listening to the people. The health authorities had multiple opportunities to correct the mistakes they had made, but they were not open to listening. This highlighted the importance of the involvement of community and family infrastructures responding to the crisis. The Listeriosis outbreak taught lessons about the importance of surveillance including molecular epidemiology, particularly in relation to Listeriosis, which has become pertinent in the SARS-CoV2 outbreak management. It was also learnt that coordination across sectors was absolutely critical. The COVID-19 pandemic has taught lessons about the importance of real-time quality data, data management systems, clear messaging to the public and maintaining public trust in health authorities.

The broad principles that can be taken form this are:

- The recognition that outbreaks are a signal that something underlying is wrong or inadequate in the way that society is structured, and that something must be done to correct this. The COVID-19 pandemic is more than a pandemic – it is a conflation of social weaknesses together with a virus that has exploited the gaps in society such that those who are more weak and vulnerable and have less access to resources suffer an unfair distribution of illness and disease
- Responses to outbreaks require a multi-sectoral co-ordination and response. These structures need to be part and parcel of outbreak and crisis preparedness.
- Health emergencies are not just related to communicable diseases. They are such because of the health consequences of an event (such as a drought, a flood or a policy decision). It is therefore necessary to adopt an all-hazards approach to the preparation for emergencies.

The key lessons to take from the South African experience in outbreak investigation management and health emergencies are:

- It is necessary to continue with policy making to further refine and define the legislative environment in which emergency response takes place
- Investment in data management infrastructure is critical. Pre-emptive data sharing agreements need to be in place, and laboratory testing and clinical information (as well as environmental health related data, economic data and social data) need to be included in the data management infrastructure. It is essential to have the appropriate human resources to support data management and set up structures before the outbreak.
- Investment in training on and preparations for communications is crucial.

QUESTION AND ANSWER SESSION

Evariste Umba-Tsumbu: Is it possible that there could be another Listeriosis outbreak in South Africa? What are the preventive measures for such an outbreak?

Response, Dr Kerrigan McCarthy: Listeria monocytogenes is an organism that is found ubiquitously in soil and all fresh produce that has contact with the soil is contaminated with the organism. Principles of food safety apply in preventing cases. There is a background threshold of Listeriosis cases that are unavoidable and will happen in every country. The key thing is to ensure that food quality is of such a standard that the end product following food processing is free of Listeria. Structures are in place to ensure massive outbreaks do not occur. Listeria has become a notifiable medical condition. All isolates of Listeria monocytogenes are sent to the NICD and undergo whole genome sequencing. If sequences match, food interviews are done with patients to find common food stuffs. This will flag a point-source outbreak much earlier. There was loss of life. Globally it was immensely embarrassing that the outbreak reached the magnitude that it did. This spoke to the fact that we had a very poor food quality legislative environment and that the surveillance systems were inadequate. I am absolutely confident that there will not be an outbreak of this magnitude again.

Debbie Schultz: We heard how essential correct communication is in an outbreak and in terms of an emergency response. What do you mean by engagement with the community?

Response, Dr Kerrigan McCarthy: I am not a communication specialist, but there are a number of levels at which engagement with the community is important. The first is listening as it allows us to correct misinformation. The next is to promulgate the right messages, which can be done in a number of ways.

Aziza Kharwa: What is the incubation period of the Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) virus and when is a patient most infectious?

Response, Dr Kerrigan McCarthy: This was one of the key uncertainties and an unknown to us in the early stages of the outbreak, and made it difficult to tell people how to take care. Good communications messages should include the facts about the disease, state clearly what is unknown and what authorities are doing to address the uncertainties, and what the public can do to protect themselves. Because we did not know who was infectious and how the disease was spread, it was difficult to advise people on how to protect themselves from the disease. What we know now is that the virus is transmitted in greatest viral concentration within the first 5 to 7 days following infection and even before a person develops symptoms. We have also learnt that persons who are asymptomatic (approximately 40 to 60% of those who have the infection) can equally spread the virus just as well as those who are symptomatic. This emphasises the importance of public health preventative measures.

POLICIES AND REGULATIONS DEALING WITH DISEASE OUTBREAKS AND EPIDEMICS IN SOUTH AFRICA (MR WAYNE RAMKRISHNA, NDoH)

Coordination at National Level and Multi-Sectoral National Outbreak Response Team (MNORT), Provincial and Local levels

Our world is changing as never before. As populations grow, age, and move, diseases travel fast, microbes adapt and food risks increase, health security is at stake. The COVID-19 pandemic demonstrates the importance of prevention, preparedness and response measures for the control of communicable diseases. Control is a vital function of the protection and promotion of public health and it requires an enabling legislative framework. The MNORT is the overarching coordination body for outbreak response in South Africa, led by the NDoH with support from the NICD, WHO, United States Centres for Disease Control and Prevention (CDC) and other partners. Coordination structures at national level are cascaded to the provincial level through the multi-sectoral, multi-disciplinary provincial outbreak response teams that in turn cascade to district and sub-district levels.

Multiple sectors and partners are engaged in the COVID-19 preparedness and response framework for South Africa, led by the NDoH with the involvement of other government departments including Cooperative Governance and Traditional Affairs (COGTA) and the Department of Safety and Security, as well as NATJOC and the National Disaster Management Centre (NDMC), non-governmental partners and the private sector.

National Health Act and NMC Regulations

The National Health Act and Regulations relating to the surveillance and control of NMC influence the country’s level of preparedness and response. The legislative framework stipulates that:

- The Minister of Health has the responsibility to, within the limits of available resources, determine the policies and measures necessary to protect, promote and maintain the health of the population.
- The Director-General of Health has the responsibility to:
    - Ensure the implementation of national health policy in so far as it relates to the NDoH
    - Issue guidelines for the implementation of national health policy
    - issue and promote adherence to norms and standards on health matters
    - Coordinate health and medical services during national disasters
    - Facilitate and promote the provision of health services for the management, prevention and control of communicable and non-communicable diseases

- The NHC advises the Minister on epidemiological surveillance and monitoring of national and provincial trends with regard to major diseases and risk factors for diseases.

Provincial and district health councils also have similar functions as Communicable Disease Control Coordinators. Section 23 (a) (ix) of the Act requires provinces and health districts to compile Strategic and Annual Performance Plans that include disaster management plans.

The legislative framework also stipulates the rights of individuals versus the public, such as when an individual refuses to be examined or treated for a dangerous communicable disease. The NMC Regulations make provision for mandatory medical examination, isolation and quarantine of carriers, contacts and sufferers of specified communicable diseases. The regulations also make it mandatory for carriers, contacts and infected individuals to comply with instructions from health care providers regarding precautionary measures to prevent or restrict the spread of an infection.

In terms of the NMC notification system, based on clinical notifications, the Act states that specific infectious diseases must be reported on in a specified format to the local authority, which is responsible to investigate and do all it can to control any disease that is notifiable and/or communicable. Provincial and national departments of health are available to assist should extra resources and expertise be required.

The National Public Health Institution of South Africa (NAPHISA) Bill was developed for (amongst others) the establishment of a single national public entity to provide public health services to the country, which performs critical public health functions and requires a high level of coordination across functions, such as surveillance and research in order to provide the following:

- Support, expertise and advice to government
- Ccoordinated disease and injury surveillance, research, training and workforce development, monitoring and evaluation of services and interventions directed towards the major health problems
- Training, conduct research and support interventions aimed at reducing the burden of communicable and non-communicable diseases and injuries and aimed at improving occupational health, and environmental health.

Once the Bill has been passed, there will be greater level of coordination across the sectors and beyond the traditional outbreaks responses related to communicable diseases.

Policies at global level (International Health Regulations (IHR) 2005) and regional level (Southern African Development Community (SADC) Protocol on Health)

The IHR (2005) represents a binding international legal agreement involving 196 countries across the globe including all WHO Member States of which South Africa is one. Its aim is to help the international community prevent and respond to acute public health risks that have the potential to cross borders and threaten populations worldwide. The purpose and scope of the IHR (2005) is to prevent, protect against, control and provide a public health response to the international spread of disease in ways that are commensurate with and restricted to public health risks, avoiding unnecessary interference with international traffic and trade. The IHR calls for:

- Strengthened national capacity for surveillance and control, including in travel and transport
- Prevention, alert and response to international public health emergencies
- Global partnership and international collaboration
- Rights, obligations and procedures, and progress monitoring.

Countries have an obligation to implement the IHR in order to detect and contain public health threats faster, to contribute to global public health security, and to enjoy the benefits of being a respected partner. In return the WHO provides countries assistance in building core capacities; guidance during outbreak investigation, risk assessment, and response; advice and logistical support; information gathered by WHO about public health risks worldwide, and assistance to mobilise resources.

A Public Health Event of International Concern (PHEIC) is defined in the IHR (2005) as, "an extraordinary event which is determined to constitute a public health risk to other States through the international spread of disease and to potentially require a coordinated international response". It implies a situation that is serious, sudden, unusual or unexpected; carries implications for public health beyond the affected State's national border; and may require immediate international action. COVID-19 was declared a PHEIC on the 30 June 2020 following the IHR meeting and advice from the WHO Expert Committee.

A number of protocols, declarations, plans and programmes have been developed to combat communicable diseases in the SADC region that are a serious concern for social and human development in the region. Regional annual reports on Human Immunodeficiency Virus (HIV) and Acquired Immune Deficiency Syndrome (AIDS), Tuberculosis (TB) and Malaria contribute to the systems designed to monitor progress with regard to combatting these communicable diseases. The SADC Protocol on Health oversees a variety of declarations and strategic frameworks. Article 9 of the Protocol addresses communicable disease control, while Articles 10, 11, and 12 specifically concern HIV and AIDS, Malaria, and TB. The Protocol advocates that Member States harmonise their policies for disease definition, notification and management. Member States agree to cooperate in establishing reference laboratories and sharing information on diseases and epidemics, insofar as this information contributes to the reduction, elimination and eradication of communicable diseases.

The Africa CDC, in collaboration with African Union (AU), supports preparedness and response with regard to COVID-19 support, and collaborates with organisations such as the NICD and conducted sub-regional training for Member States.

Integration and Collaboration

The burden of zoonotic diseases has become a threat in recent years and accounts for around one billion cases and one million deaths annually. Worldwide, endemic diseases contribute to persistent disease and economic burden through impacts on health and livelihoods, as well as on agricultural production and ecosystems. 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. Zoonoses and other health threats at the human-animal-ecosystem interface pose ongoing and increasing risks to public health. African countries seem to be facing a disproportionate level of these risks. Health threats at this interface include those existing and emerging pathogens transmitted through contact with animals, food, water and contaminated environments. CoVID-19 is one such example.

A WHO Review Committee concluded that the world is ill-prepared to respond to a severe influenza pandemic or to any similar public health emergency. The WHO launched the Joint External Evaluation (JEE) in 2016 for countries to systematically evaluate their preparedness and response capacities and to address the gaps. The majority of the countries in Africa have completed the JEE and are in the process of drafting national action plans. WHO Member States have obligations in terms of the IHR (2005) to have systems in place for identifying and assessing potential public health threats, including zoonoses. However, these threats cannot be addressed by one sector alone.

The complexity of interactions along the interface requires strong and consistent collaboration among the sectors responsible for human health, animal health and the environment. Recognising this fact, the NDoH of South Africa facilitated the establishment of the One Health Forum in 2015. The goal of the Forum is to strengthen collaboration and coordination between public health, animal health and environmental sectors for prevention and control of zoonotic diseases, as well as to meet the IHR obligations. South Africa is in the process of drafting a One Health Framework, which will guide the activities of stakeholders involved in One Health and entail shared responsibility as well as shared benefits.

Policy Decisions to Strengthen Service Delivery (using The National Influenza Policy and Strategic Plan as an example)

Influenza causes approximately 10 000 deaths and 40 000 hospitalisations annually in South Africa. In response, the NDoH developed The National Influenza Policy and Strategic Plan, which promotes annual vaccination against influenza as the best strategy for preventing disease and severe complications from the disease. Other measures such as health education, basic hygiene, and Infection Prevention and Control measures are also emphasised. Implementation of the policy requires an integrated approach involving several clusters and multi-sectoral expertise.

Summary and Way Forward
It is necessary to strengthen health systems to be resilient and prepared to face existing and future disease threats. The various sectors such as public health, animal health, plant and environmental health, and researchers need to join forces to support the One Health approach to effectively detect, respond to, and prevent public health events including outbreaks of zoonoses and foodborne diseases, and to combat anitimicrobial resistance. It is equally important to encourage collaboration and sharing of resources, epidemiological data and laboratory information across sectors and national boundaries.

WHO, the Food and Agriculture Organisation of the United Nations (FAO) and the World Organisation for Animal Health (known as OIE, the French abbreviation) are commended in their efforts to promote multi-sectoral responses to food safety hazards, risks from zoonoses and other public health threats at the human-animal-ecosystem interface. However, support and guidance on how to reduce these risks are required. It is necessary to conduct regular monitoring and evaluation of policy implementation activities, including risk assessment, and to strengthen the One Health approach nationally, regionally and globally.

IS THERE A ROLE FOR INDIGENOUS KNOWLEDGE IN FIGHTING EPIDEMICS OR PANDEMICS? (PROF. NCEBA GQALENI, AFRICAN HEALTH RESEARCH INSTITUTE (AHRI), UNIVERSITY OF KWAZULU-NATAL (UKZN))

Africa is recovering from a legacy of colonialism, which is the policy of a nation seeking to extend or retain its authority over other people or territories, generally with the aim of economic dominance. It was accompanied by propaganda to stigmatise African traditional ways of life in order to make Western systems a hegemony. Colonisation and disempowerment impacted on the sovereignty of African people in terms of their own laws, their own ways of feeding and healing themselves, and on their own ontologies (existential realities) and epistemologies (ways of knowing), including languages as practical tools of communication and ways of being on the land.

Indigenous knowledge can be broadly defined as the knowledge that an indigenous (local) community gains over generations of living in a particular environment. This definition includes all forms of knowledge technologies, know-how skills, practices and beliefs that enable the community to achieve stable livelihoods in their environment. Indigenous Knowledge Systems (IKS) play a vital role in society as it helps shape and define its very existence and provides the foundation for beliefs and traditional practices.

The broad objective of IKS in South Africa is as a catalyst for radical economic empowerment of Africa and its rural population, ensuring the evolution and diffusion of grassroots innovations and building linkages between excellence in formal scientific institutions and community-based knowledge systems.
The former Minister of Science and Technology, Minister Naledi Pandor, stated that “IKS offers an opportunity to explore avenues for innovation and commercialisation in order to contribute towards addressing the triple challenges we face of unemployment, inequality, and poverty.”

COVID-19 has exposed the inequities in society, and has also revealed empathy and a willingness to share. However, living on hand-outs is not sustainable and there is a need to create a new normal that includes placing IKS at the centre of recovering and reclaiming people’s health, livelihoods, culture and education. The Constitution of the Republic of South Africa makes provision for IKS and the IKS Act addresses the protection, promotion, development and management of indigenous knowledge. The Traditional Leadership Act talks to promoting IKS for sustainable development and disaster management.

Lessons can be learnt from HIV/AIDS in this context. President Mandela made this important statement, “Traditional Health Practitioners (THPs) often have greater accessibility and acceptability than the modern healthcare sector and should be used as a vehicle for health promotion.” An editorial comment in the Journal *AIDS* echoed this by stating that, “Traditional health practitioners are key to scaling up comprehensive care for HIV/AIDS in Sub-Saharan Africa.” However, the political climate at the time was hostile and THPs and traditional medicine became associated with myths and HIV denialism, and this led to a lack of funding for expedited research and development (R&D) in this sector and there was mobilisation against the sector for a public good.

Interventions from foreign governments and some funding allowed the sector to begin to play a role in the IKS work in the area of HIV/AIDS through a project involving THP in the fight against HIV and other communicable diseases. The provinces and the Human Sciences Research Council (HSRC) have also been involved in this work. The objective of the project was to strengthen relationships between public health and traditional healthcare workers of KwaZulu-Natal (KZN) Province through the development of a uniform referral system for adoption and use by the KZN Department of Health, Municipal Health Units and THPs across the province. A KZN Provincial programme made the facilitation aspect of the project possible. THPs were integrated with medical personnel in training programmes on HIV/AIDs/TB. During the training, THPs presented themselves for HIV counselling and testing (and treatment where necessary), and for medical male circumcision. The project had an impact in terms of increased numbers of individuals testing for HIV and detected cases of TB, as well as increased distribution of male condoms in the non-health sector. In addition, there have been success stories in clinical research involving biomedical and traditional healing collaborations. The project brought awareness of the benefits of involving THPs from the onset of an epidemic or pandemic, and evidence of the maturity of the THP leadership in their willingness to participate in various structures and be part of the solution.

With the onset of COVID-19 pandemic, THPs complained about not being consulted and that their role as healthcare workers was not recognised, particularly in terms of enforcement of the lockdown regulations as informal traders offering herbal medicines were not allowed to operate. The NDoH has begun to engage with THPs and clarify their role as healthcare workers, and consider them as frontline healthcare workers in government's programme to roll-out vaccines.

Early on in the pandemic claims were made that Madagascar had an organic remedy for COVID-19, but there was a lack of evidence to prove this claim. The WHO, Africa CDC and the AU Commission set up a panel of experts to design a clinical trial protocol such that the research could be fast-tracked on traditional medicines and data shared easily to accelerate the work of regulatory bodies in the light of the health emergency. The involvement of politicians complicated scientific processes because international relations protocols have to be followed and this delays scientific research and decision-making. Nevertheless the initiative has helped to set a baseline in terms of the level of scientific research required before such claims can be made to the public.

The Minster of Science and Innovation made announcements that South Africa will be looking to African medicines to fight COVID-19. A consortium was formed with the Agricultural Research Council (ARC) and a range of other players, and progress made with research relating to indigenous plants with a history of use for respiratory diseases or anti-viral conditions and traditional medicines was discussed at a recent meeting with the Minister.

The KZN Provincial Government has developed an indigenous knowledge-based strategy to help mitigate COVID-19 and complement current biomedical efforts. This includes the evaluation of local natural medicines and involves a number of departments, integrating NGOs and THPs, the House of Traditional Leaders and other local institutions including universities. The strategy addresses the need to strengthen indigenous food supply and agro-processing, as well as other factors such as exposure to sunshine and playing indigenous games that allow for social distancing. The programme helps bring communities together and has been adopted alongside other interventions.

As the third most biodiverse country in the world, South Africa has not yet fully exploited the hidden possibilities of its indigenous plants, nor tapped into the wisdom and knowledge of THPs and others for the benefit of humanity, particularly in times of crisis. In times of epidemics and/or pandemics, national and global politics and economic interests may cloud the objectivity towards IKS. It is necessary to adopt an inclusive approach and consider every proposed solution with an open mind, to look for evidence through funded research investigation and adopt that which is supported by evidence.

MONITORING OF OUTBREAKS – WHAT CAN WASTEWATER REVEAL? (MR JAY BHAGWAN, WATER RESEARCH COMMISSION (WRC))

Wastewater-Based Epidemiology (WBE) is a new approach utilised to give comprehensive health information on communities. The concept is primarily based upon the extraction, detection and subsequent analysis and interpretation of chemical and/or biological compounds. Through WBE, wastewater can reveal illicit drugs use, pharmaceuticals and other substance use, diet choices and genetic markers as well as biomarkers. It becomes a resource of information and knowledge that contributes to the management of epidemics and other diseases in society.

Way of using this environmental disease surveillance data include:

- To determine general pathogen circulation within populations
- To characterise trends and/or changes in the number of infections in communities
- To help determine the risk levels in communities and support decision-making on the lifting and imposing of mitigation interventions
- To provide a full spectrum of genetic diversity of pathogenic strains, epigenetic changes, altered gene expressions and gene fusions (both known and novel)
- To assess occupational human health risks based on the detection of live and infectious pathogenic strains, and inform on the risk of infections and appropriate PPE

The WRC has a number of key themes addressing disease surveillance and water-related research topics, and environmental disease surveillance fits into its general Water Quality, Sanitation and Health Progamme. Some years back, environmental disease surveillance was identified as a strategic area where research capacity and long-term research knowledge were needed and could be used to influence the sector to adopt this kind of surveillance as an essential tool based on the strategic relevance, economics and value it offers. The WRC built the national wastewater surveillance platform as part of its broader strategy. The onset of the COVID-19 pandemic in South Africa accelerated the research and emphasised the urgency of the platform, particularly as the testing wastewater samples has led to the detection of SARS-CoV-2 Ribonucleic acid (RNA) fragments.

When the Water Research Institute in The Netherlands picked up RNA signals in wastewater, it sparked interest in the topic throughout the world. However, the media failed to communicate that the RNA fragments, not live viruses, were detected. The Institute has been instrumental in showing that this monitoring serves as an early warning system that allows authorities to prepare for and manage interventions complementary to health interventions. Monitoring is also able to trace asymptomatic individuals in the population.

Several countries are using wastewater surveillance very effectively, as a complementary data and support around health systems and COVID-19 case tracking, and have passed policy decisions to ensure that all their wastewater treatment plants are sampled for the SARS-CoV-2 virus and contribute to the national COVID-19 dashboard. Through doing this, a lot of synergies and greater value from a cost perspective have been identified. South Africa is still overwhelmed by the vaccine and case study dogma and the health sector has not yet begun to take the benefits of water surveillance seriously.

The WRC's three-pronged approach includes:

- Building communication instruments in order to ensure accurate communication of the science to the wider population.
- Establishing the national wastewater surveillance platform for COVID-19
- Stimulating and accelerating R&D.

The COVID-19 National Surveillance Programme comprises three phases:

- Phase 1: Proof of concept: Sample design, testing and fine-tuning sampling protocol, preliminary sampling and characterisation based on current Water Lab approved proposal.
- Phase 2: Pilot scale monitoring: Partnership-wide monitoring of provincial hotspots using established sampling protocols and design
- Phase 3: National wastewater surveillance: Full-scale national sewershed surveillance, including data analysis, integration, communication and research.

Part of phase 1 involved a six-week study of 24 sites (divided into different typologies) in some of the hotspots. While the developed world only looked at wastewater, South Africa has the unique challenge of doing non-sewered surveillance as a large portion of its population lives in non-sewer areas, and a relevant programme was also developed. The WRC has published a report on the proof of concept study. This phase of the programme brought together the community of practice, involving both the public and private sectors, which was an essential step in moving to phase 2 of the programme.

The programme is currently in phase 2. The WRC has partnered with the NICD (whose mandate is to organise the South African sector in the long-term around the boarder surveillance pathway) and has established a national platform called the South African Collaboration Community on Epidemiological Surveillance Systems (SACCESS). It is a voluntary network comprising universities, science councils, metropolitan municipalities (and more) that shares methodology, experience and data. This enabled the development of a spreadsheet of all the sampling and results collected in relation to WBE from the beginning of the pandemic to date. In the next phase of the programme, this information will be put into a geographic information system (GIS) platform to start the quantification aspect. The programme has been scaled up from 25 sites to nearly 80 sites. As more resources become available, more wastewater treatment plants will be added to the platform. However, metropolitan municipalities (other than those in the Western Cape Province) have been slow to adopt the WBE approach. The first wastewater sampling guide has been produced through the SAMRC and a compendium of testing methodologies in the laboratory has been developed. The WRC awaited buy-in from the relevant national departments in order for them to take charge of national surveillance using the WBE approach.

In conclusion:

- Science and techniques keep on improving
- The challenge is to decrease the cost of testing and surveillance
- Interlab testing validating methods are being done and the results are available
- Operational uncertainties such as influent variability, temperature and so on are all the focus of ongoing detail research
- Many countries and institutions have demonstrated the effectiveness of WBE, which is being adopted by national governments worldwide, and by big industries and universities to manage their populations.
- WBE and environmental disease surveillance is seen as an important contributor to complementing current activities.

The WRC work has opened pathways to the surveillance of many other waterborne disease surveillance techniques. It has programmes at research level that assess the prevalence of pathogenic bacteria, determine the presence of enteric viruses and the presence of protozoan parasites. It has been demonstrated that WBE can be used as a surveillance technique to identify substance abuse in specific geographic areas and that wastewater sampling gives better signals for COVID-19 than throat and nose swabs.

LESSONS LEARNT IN THE CONTROL OF EPIDEMICS / PANDEMICS: SOUTH AFRICA'S RESPONSE TO THE COVID-19 PANDEMIC (DR YOGAN PILLAY, CLINTON HEALTH ACCESS INITIATIVE (CHAI))

The first wave of the COVID-19 pandemic peaked in July 2020 and the second wave in December 2020-Janaury 2021. The current question is about what needs to be done to prepare for the anticipated third peak and possible additional peaks beyond that.

Initially, there was reliance on non-pharmaceutical interventions (NPI) and the current focus is on vaccines as a significant approach to mitigating transmission. The South African vaccine delivery is structured according to a phased approach, which is necessary because of the initial limited supply of approved COVID-19 vaccines. During the various phases different target recipients and delivery strategies will be used. Approximately 40 million people would be vaccinated by the end of phase 3. Notwithstanding the vaccination programme, NPI need to be continued.

The NDoH was organised to intervene in a large number of areas ranging from governance and leadership, provision of medical supplies, ports of entry, environmental health, epidemiology and response modelling, facility readiness, case management, communication and community engagement, occupational health and safety, infection prevention and control, and human resources for health.

The key lessons learnt from both the first and second waves were:

- Community screening: Around 55 000 community health workers and outreach team leaders were mobilised to do screening in communities.
  - The laboratories were not able to cope with the number of suspected cases referred for testing. Asymptomatic individuals were missed.
  - A national epidemic community response strategy with clear roles at all levels was developed.
  - Inter-sectoral and intergovernmental engagements at community level were strengthened to increase coverage access to services. Local government and district authorities played a significant role in mobilising communities and working across government sectors. It was clear from the first wave the NDoH working alone would not be able to mitigate transmission or prevent avoidable mortality.
  - Community health workers were removed from their activities in TB, HIV and non-communicable diseases (NCDs) to focus almost purely on the COVID-19 response. One of the negative consequences was that other routine services suffered, with about 40% reduction in the number of people who tested for TB.
  - The use of mobile health applications to support data collection and reporting on community interventions was strengthened.
- Contact tracing: A lot of effort went into the various mechanisms and electronic systems used for contact tracing, but the rapid growth in the number of cases made it difficult to continue contact tracing. Concerns were around:
  - Digital tools and their use in terms of security, ethical and privacy issues, which was seen in the very low uptake of CovidConnect.
  - Technical difficulties with some of the management tools
  - A lack of social support for those doing contact tracing. Providing them with food, water and sanitation was difficult
  - Challenges in terms of the workforce to address the surge of cases and contacts
  - Stigmitisation and discrimination against people identified as COVID positive (as is the case with HIV and TB).
  - A continued mistrust of the system (government and technology)
  - A lack of perceived benefits in the contact tracing process, which led to poor uptake of isolation or quarantine facilities. Many of those who tested positive did not want to leave their homes due to safety issues and a lack of support for their families in their absence.

  Lessons learnt from the experience of contact tracing include:
  - The importance of testing, whether symptomatic of asymptomatic
  - Contact tracing only works only as part of comprehensive COVID-19 strategy and requires massive investment as it is a labour- and time-intensive process
  - New and emerging technologies can support but cannot replace traditional contact tracing methods
  - The vulnerable population (elderly, essential workers, those with co-morbidities) need to be protected
  - The health system needs to focus on social organisation, neighbourhood references, and close work with community leaders and others.
  - It is necessary to go back to an integrated approach including all services including HIV/AIDS, TB and NCDs
  - More experts are needed at decentralised levels to analyse data and take action in real time
  - It is necessary to avoid high community transmission by having strong investigation teams to find high-risk contacts, with methods to prioritise follow-ups
  - Contact tracing in relation to cross border travel needs to be strengthened, including having an early warning and response system.
- Active and informed use of epidemiological data (epidata): Epidata has been used to model and identify hotspots, to focus on prevention and control strategies in the hotspots, and to do tracking and

tracing. There have been challenges with the data, namely, a lack of standardised, synchronised systems for surveillance and reporting, duplication of data collection and inadequate coordination between COVID-19 response and other healthcare programmes. The digital platform must be extended and the surveillance system must be strengthened. The COVID-19 response has shown that the public and private sectors have to work more closely together as should the national, provincial and district levels of government. The only way to get ahead of a pandemic is to have electronic data systems. What is currently being built (surveillance systems including the modelling system as well as lab-based system) will stand the country in good stead in ensuring better preparedness for the pandemic from an epi and surveillance point of view. Surveillance through sewage is yet another instrument that can be used in the surveillance system.

- RCCE: All the mechanisms for communication have been used. Developing a community communication strategy at local level was key to getting local action. Challenges with regard to RCCE include:
    - The spread of misinformation and rumours on social media
    - Limited financial resources
    - Difficulties in managing communication disseminated outside of the NDoH.
- Risk adjusted strategy: A risk-adjusted strategy was developed and various economic and social measures were imposed that caused a significant amount of social and economic pain due to the lockdowns. Going forward, lessons need to be learnt about what works and what does not at each of the levels and what can be done differently. Significantly more community buy-in is essential before instituting an alert level and it has become clear that a balance must be found between saving lives and saving livelihoods.
- Health system strengthening: Early national lockdown provided an opportunity to increase health system capacity. A surge strategy was developed and provinces were engaged to align the strategy within the specific provincial context. The challenges with regard to the health system included:
    - Delayed approval of the surge strategy
    - Absence of a single integrated information system at hospital level to track demand
    - Suppliers' inability to meet the sudden increase in demand (an example is the supply of oxygen and ventilators).
    - PPE procurement was a major challenge as South Africa was competing with the rest of the world for limited supplies. South Africa has to become more self-sufficient in the production of commodities (ventilators, drugs, PPEs, coffins).There were further challenges surrounding PPE to do with corruption in the tender process and inflated prices.
- Recovery and resetting the South African healthcare system: The COVID-19 pandemic illustrated the world over the fragility of health, social and economic systems. The pandemic has had a greater impact of women and then men. While not all countries were equally affected, it became clear that all countries need to build resilient health and social systems, not only to deal with pandemics but also to cope with the changes in the burden of disease. The discovery of variants in South Africa has shown the robustness of genomics and surveillance using genomics in the country. Lessons learnt include:
    - The need for more agile management decision-making and greater autonomy to frontline workers and their managers
    - The importance of psychosocial support to frontline health workers and mental health of the population
    - Rapid development and deployment of digital technology (COVID Alert, Vula)
    - Increased involvement of patients and communities in co-creating health and wellness
    - Technical partners to address the backlogs in patient care as well as supporting the development, implementation and monitoring of the recovery plans need to be mobilised.
    - The weariness and complacency between waves needs to be addressed.
    - For the health and social welfare systems, resetting means investing in public sector workers of all types, providing quality care at an affordable cost and reducing the cost of inputs like diagnostics, vaccines and medicines. It also means changing the way that the health and social sectors provide services, as well as greater reliance on digital technology for surveillance, self-monitoring of vital signs and real time data for planning and intervention.

The lessons learnt from the two waves of the pandemic need to be used to prepare for agile responses to future waves. Equally important is to focus on recovery, reset the agenda and begin to build back better.

Take home messages are:

- There is a need for an all-of-government, all-of-society response to COVID-19
- The use of NPIs is key as is the need to accelerate vaccinations
- Many lessons were learnt from the first two waves and these must be used to prepare for the third and subsequent waves
- Planning the recovery and resetting/transformation of the socio-economic system is critical as is the need to become more resilient to deal with subsequent pandemics.

QUESTION AND ANSWER SESSION

Evariste Umba-Tsumbu: Is there any published research done to support social distancing and wearing of masks as preventative measures against COVID-19 and the new variant? If so, what was the sample used, which region and period of time was used and what were the results?

Response, Dr Wayne Ramkrishna: To my knowledge there is a fair amount of information available on the subject. I will comment of the lab studies that were done on the spread of droplets, which found that when people talk they dispel a considerable amount of droplets that could potentially spread infectious diseases. There are practical examples where people who didn't wear a mask became infected while those who wore a mask did not. Links to some of the studies will be shared with the NSTF.

Zoom Q&A: Concerning the legal framework that exists globally, what have the challenges been with regard to collaboration, coordination and implementation?

Response, Dr Wayne Ramkrishna: There is much room for improvement with regard to collaboration in terms of the participation of other stakeholders, for example in the COVID response. Although policies are in place at different levels, implementation remains a challenge. Organisations often work in silos according their own priorities. There is a need to collaborate, especially going forward. In terms of outbreak response preparedness, the relevant sectors have to come together, work together and share information, not only nationally, but internationally as well.

Evariste Umba-Tsumbu: How far is the research with Hypoxis hemerocallidea and Sutherlandia against HIV, and research with arthemisia or Umhlonyane in Zulu (Wormwood in English) against COVID-19?

Response, Prof. Nceba Gqaleni: What we lack are clinical trials and quality products registered by relevant authorities in SADC. West Africa is doing far better in this regard with some of their products listed in the Essential Medicines List.

Gordon Branston: Thank you for your contribution to highlight the critical relevance of IKS and traditional medicines within the context of future emergency planning and preparedness for future epidemics and pandemics. Please can you comment on the importance of co-ordination and roles with all relevant structures and the most effective strategy to bring this goal to fruition e.g. legislative requirements at Pan-Africa, regional and local levels or potentially within a strategic sustainable development context? What would be the result of not pursuing this IKS/ traditional medicines objective?

Response, Prof. Nceba Gqaleni: I think the AU would be best placed to guide at the continental level. The fundamental point is the acknowledgment that indigenous knowledge is integral and included in the policy and programmatic responses. Whatever dominates becomes the biomedical thinking.

Zoom Q&A: When it comes to the education / training of the THPs, were there any scientific or technical aspects of the pandemic or treatment thereof that were difficult to be understood or accepted by them?

Response, Prof. Nceba Gqaleni: Communication of these diseases is largely in English which requires translation into local languages. We find some of the words non-existent but working together we develop them. Once that it is done it becomes easier to move forward from a common standpoint.

Edward Rybicki: The One Health Forum is a wonderful concept, but some serious funding is needed to allow the kinds of surveillance and rapid responses that preventing outbreaks will require. Do you know if this is going to happen?

Response: Dr Wayne Ramkrishna; National governments are under ever-increasing pressure to improvement the One Health approach. Through evidence we have seen that one sector alone cannot manage emerging infectious diseases, especially zoonotic diseases. There is a lot of collaboration at global level and national governments are being encouraged to do the same. South Africa is in the process of formalising its One Health Forum, strategic committees and so on, and is trying to formalise this collaboration. This will materialise through the development and implementation of the One Health Strategic Framework. The document has been drafted in consultation with the relevant stakeholders and is going through the process of approval. Once completed, it is hoped it will give impetus to the One Health approach. In the meanwhile, coordination mechanisms and consultations are already in place.

Gordon Branston: Please can you share your thoughts on how best to upscale investment in a permanent, national WBE network that could prove economically vital in preparing for faster and more effective control of the inevitable next pandemic. In the future wastewater monitoring epidemiology will play a key role in revealing health disparities and the many vulnerabilities among communities by universal monitoring for biomarkers of noncontagious diseases - a key issue for public health in the years to come.

Response, Mr Jay Bhagwan: My view on this is that there is a weakness in capacity at the municipal level of environmental health monitoring. There is a strong bias towards engineering. The NDoH must provide leadership and investment as well as drive policy and regulations to ensure greater uptake. Big industry is already harnessing this opportunity for its staff and immediate communities.

Evariste Umba-Tsumbu: Could you show again slide 19 and 20 again and explain what your analysis and conclusions are in this regard? People could have been infected by COVID-19 as you successfully recovered the virus from wastewater in Gauteng, KZN and Western Cape? What are the current treatment measures of water to prevent exposure of the public?

Response, Mr Jay Bhagwan: The report with the graph is available in the report on the WRC website. The conclusion is that we can detect the RNA signal. It is possible to do quantification once we establish the viral loads in individuals. This then can lead to heatmaps and early warnings. At present the increase in amplification Ct against the clinical data tells us that there is a relationship. The quantification will help us also identify the asymptomatic cases. Disinfection of water supply offers a good barrier in drinking water systems. We have found no live viruses in the general water environment as yet. Good sanitation and hygiene is the most immediate measure required to prevent exposure.

Gordon Branston: Dr Pillay, please comment on the resilience strategy required to urgently begin to refine (fit for purpose) the COVID-19 pandemic experience to ensure the sustainable capacity i.e. capacity and resource scenario plans that exists to address a much more virulent future pandemic in the short term (one that is highly contagious where the infection rates are on the similar scale as Measles or Ebola variants).

Response, Dr Yogan Pillay: We are already planning the response to the third wave. The MAC has set up a technical working group of which I am a part, to look at four different areas so as to ensure that we have significant fewer cases and avoidable mortalities going into the third wave. A workstream is trying to predict when to expect the third wave, and if so, modelling an epi data. There is also a team looking at clinical issues at each level of the health system, another that looks at improving communication especially with regard to vaccine hesitancy and decreased adherence to NPIs, and another on the health system capacity, including everything from surveillance through to preparing communities as well as health facilities to better respond and prevent the number of cases escalating quickly and avoidable mortality.

Evariste Umba-Tsumbu: With regard to government interventions on vaccine, what is the difference in time between the different phases?

Response, Dr Yogan Pillay: The phases will depend on access to the vaccines. The more rapidly the government is able to procure large quantities of vaccines, the sooner the government will be ab le to announce the start of the second and then the third phases. The expectation at the moment (dependent on the manufacturers' ability to bring large volumes of the vaccines to the market) is that the second phase can start in mid-April to early May.

Guy Preston: Dr Pillay, is there scope to use sniffer dogs in terms of cross-border transmission? If so, is this option being pursued? They have been used so successfully in many biosecurity controls and there have been some reports of them being used in other countries for COVID-19. This could be a capacity developed for other zoonotic diseases and beyond border control.

Response, Dr Yogan Pillay: There is ongoing research on the use of rats and dogs to sniff out particular communicable diseases. There was a review done in term of rats' ability to sniff out TB. One has to compare these according to a gold standard, which is a laboratory test. We have deferred to the lab tests because they have proven sensitivity and specificities in order to diagnose. The National Health Laboratory Service (NHLS) has deployed lab personnel to the land borders and the airports to do testing of people arriving in and leaving the country.

Zoom Q&A: How does CHAI fit into the larger framework? Are you working with the NDoH?

Response, Dr Yogan Pillay: The CHAI has a MoU with the NDoH and supports the department on a range of health issues from maternal and neonatal health through to TB, HIV and Malaria. When the pandemic started in March 2020, the department asked the CHAI to support its response. CHAI is supporting the department together with a range of provinces. It is in partnership with the NDoH.

Ben Durham: Can Dr Pillay comment on pooled testing and sewerage testing as a means of increasing surveillance?

Response, Dr Yogan Pillay: CHAI started discussions about pooled testing with the NHLS in June-July 2020 when there were problems to get sufficient lab kits. The NHLS was engaged to start a pilot study in the Free State. Pooled testing can only be done in a way that is reliable if the incidence levels are low. You get a significant number of false negatives where the incidence is high. Pooled testing can be used in instances where there are low incidents and there is a shortage of test kits. We stopped doing that because the incident levels rose spectacularly in the first wave and the pressure on companies to deliver test kits decreased substantially. There was no shortage of test kits form about July-August onwards. The work that the WRC is doing with regard to surveillance through sewerage testing is highly commendable because we are clearly unable to test those who are asymptomatic. As the speaker from the WRC said, some provinces have integrated into the surveillance systems, and we would support other provinces doing the same.

Evariste Umba-Tsumbu: What are the safety measures in terms of assessment on efficacy of vaccines in phase 1 and 2 before getting to phase 3?

Response, Dr Yogan Pillay: The vaccine that is being rolled out is the Johnson & Johnson vaccine. It has not yet been registered by the South African Health Products Regulatory Authority (SAHPRA). The agreement with SAHPRA and the manufacturers is that this be treated as a 3B trial, which means that additional pharmacovigilance is being done and data is being collected on each of the individuals vaccinated to see if there are any additional side effects and to look at the issue of reinfections. The good news is that the Food and Drug Administration (FDA) in the US has just approved the Johnson & Johnson (J&J) vaccine for emergency use. It is being done as safely as possible. As soon as I am eligible, I will certainly get the vaccine because I think it has demonstrable safety and efficacy including for the new variant.

Evariste Umba-Tsumbu: The J&J vaccine has very little scientific data to move to the last phase of vaccinating millions of people, so it will be unwise for government to move to phase 3 unless there are 12 to 24 months of observations of subjects.

SESSION 2: PREPAREDNESS THROUGH DATA MODELLING, COMMUNICATION, AND SCIENCE AND INNOVATION

UNCERTAIN OUTCOMES: EVIDENCE-BASED MATHEMATICAL MODELLING IN A TIME OF COVID-19 (DR SHEETAL SILAL, MODELLING AND SIMULATION HUB AFRICA, UNIVERSITY OF CAPE TOWN (UCT))

Dr Silal presented on behalf of the South African COVID-19 Modelling Consortium (SACMC). The presentation provided an overview of the process followed by the consortium and the challenges it has faced throughout the last year. The SACMC was formed by the NDoH and coordinated by the NICD, and its purpose is to provide mathematical modelling support to national government during the pandemic in South Africa.

Although mathematicians have been busy with disease modelling for the past 100 years or so, mathematical modelling was brought to the forefront in the media and among scientific researchers during the COVID-19 pandemic. One of the primary outcomes and topics of communication of the consortium concerns the uncertainty of outcomes and what it takes to develop an evidence-base disease model for COVID-19.

Mathematical models are tools that create synthetic populations *in silico* that have features similar to real populations where options for disease control and elimination interventions are being considered.
Mathematical modelling is much more than equations and path diagrams so forth, particularly with the development in technology. Considerable amounts of data are necessary in order to be able to apply mathematical models in a practical way to real world situation. Not all data is readily available in numerical format or has been collected. In developing models, Mathematicians rely on input from virologists, economists, public health specialists, biologists and so forth, in order to discuss the data and properly understand the disease they are working in, the population being affected by the disease and the public health system in which the disease is being managed through. They then take the equations and couple these with the data, contextual and numerical data, and write up sets of computer code, using computer programmes to make projections and gain insight on the behaviour of the disease the trajectory of the epidemic.

Modelling can be useful at the start of epidemic, during an epidemic and retrospectively after an epidemic to take stock of what actually happened compared to what was projected. Modelling can be useful in a pandemic because it can project future trends and severity of an infectious disease; predict the impact of interventions in the population; estimate the cost of and resources required, and as a tool to understand complex relationships between features of infection and to support better decision-making.

There are different philosophies of disease modelling. Some focus on expanding the theory of disease modelling and the mathematical properties of models, while others focus on making the models as practically relevant as possible in order to support decision-making. The SACMC subscribes to modelling that is practical to support decision-making and focusses on being based on evidence (data). The consortium was requested to build a disease model at the start of the COVID-19 pandemic. It had to make decisions about the kind of disease model to be used and the questions that the model was trying to answer, and together these would determine the methodology to be used.

The work done in the context of the first two waves and in preparation for a third wave of the COVID-19 pandemic was as follows:

- In the first wave, the key questions that the SACMC sought to answer had to do with resources, cost and the seriousness of the pandemic. It chose to employ compartmental disease modelling based on ordinary differential equations because not much was known about COVID-19 at the time, there was no local data and not much global data. In developing the model, an effort was made to get as many data sources into the model as possible. As data was collected, national case and hospitalisation data from the NICD was incorporated, even though there was missing data as not all the hospitals in the public sector reported on the database. Data from Statistics South Africa (StatsSA) on the projected 2020 district populations was also incorporated. The SACMC was able to access Vodacom's mobile event database and Google COVID-19 Community Mobility Reports in order to track the movement of people around the country and the world, and to track deaths through the SAMRC's Estimated Excess Mortality Analysis.

The absence of considerable biological information in the local context forced the SACMC to look to the global experience by consulting academic literature to assess biological characteristics of COVID-19, even though the international literature was often irrelevant in the South African context. This led to collaborative research with groups of experts who advised the SACMC on certain parameters and data sources required in order to build robust models. Around five iterations of the model were built during the first wave, initially projecting for a short period and then for the course of the pandemic, updating as new data arose.

Behaviour of the population was taken into account and used to extrapolate the severity of the situation. The SACMC was able to support government decision-making by providing scenarios on the need for resources along with their anticipated use, as well as projections on deaths. It also supported hospital planning (the number of beds, staff required, quantities of drugs in stock, oxygen and ventilation planning, field hospitals), the NHLS as well as environmental health with the number and placement of mortuary containers throughout the country, and National Treasury with the health budget. Outcomes of the mathematical models were not communicated as resolute predictions, but as assumptions based on available data and noting the reliance on the population's acceptance of and adherence to NPI.

- The second wave started soon after the decline of the first wave with an unexpected increase in cases on the Eastern Cape. Instead of recalibrating its models, the SACMC began to ask why the cases were increasing, but could not identify a reason for the resurgence. The knowledge of a new variant was made known a few weeks later, but there was very little information about what this would mean from a disease perspective. The SACMC took the decision not to model or make projections, but continued to support decision-makers in government in other ways. It used its analytical expertise to monitor resurgence across the country and developed a dashboard called the SACMC Epidemic Explorer (www.SACMCEpidemicExplorer.co.za). A set of indicators track different features of the resurgence and this is used to support government's resurgence plan that categorises actions in control, alert and response phases. Each phase corresponds to a different set of actions. This, along with the series of indicators, supported decision-making to determine when resurgences would start in different areas around the country and what the appropriate course of action would be.

  In developing this resurgence monitoring framework, the SACMC along with government, made signal forecasting available to the public in the form of the dashboard. During this period, the SACMC made preparations for when it would be able to model again by collating new data, working with partners to find new sources of information. At this point in time, South Africa as a country has crossed the threshold for being at the end of the second wave.
- A possible third wave would be about variants and vaccines taking into account what is now known about the variants and coupling this with the vaccines that have been rolled out and have differential impact on the variants. The SACMC's work in progress concerns the development of a modelling framework that takes into account the new lineage with the variants, reinfection through immune escape from the original COVID-19 to the new variant, and vaccines that are being rolled out in the phases planned by government. Local data is imperative in developing this framework, and a lot more is now available and will help answer questions about the characteristics of the third wave and explore scenarios of how it might manifest so that planning can be done and preparations made for the next wave.

The lessons learnt through the entire process of modelling the COVID-19 pandemic are:

- Local data is not always available. This means that assumptions need to be made. Local context is often much better than referring to what is globally available. There is significant expertise in South Africa in order to fill some of the gaps where numeric data is not available
- Uncertainty in disease models must be highlighted. There must be awareness that the models are sometimes limited
- Public communication is a full-time and ongoing effort

- Modelling to support decision-making must be adaptable and requires continued interaction with partners
- Know when models are not appropriate and not responsible to use
- Modelling is a multidisciplinary field and not just for mathematicians.

In order to stay ahead of the curve and move beyond 2020, the SACMC is trying to anticipate the various forms in which a third wave may arise, possible triggers and associated outcomes, and support the roll-out of vaccines, establish priority groups for vaccines and optimise distribution and impact of vaccines. It is equally important to continue monitoring resurgence indicators to find any signals of a third wave. Limited modelling capacity throughout the world highlights the importance of developing capacity over time, in particular, by training young South Africans in the field of disease modelling to ensure that there is a cohort of modellers in the future. Examples of short courses available to those interested in the field are MASHA: http://www.masha.uct.ac.za/masha/training/mmid and SACEMA: http://www.sacema.org.

For more information on the SACMC is available at info@sacovid19mc.co.za.

"WHERE DO YOU GET YOUR INFORMATION?" - INFORMATION AND COMMUNICATION IN PANDEMIC TIMES (PROF. STEPHANIE BURTON, UNIVERSITY OF PRETORIA (UP))

The reality about the COVID-19 pandemic is that the virus is here to stay. We know that the coronavirus will become endemic – it will stay in the human population for as long as we can imagine - and that the chances are that it will become less dangerous, although we are not easily able to predict this. We also know that other viral pandemics are likely to occur in future, exacerbated by increasing pressure on the environment and biodiversity (zoonoses), and climate change will contribute further impact. The message is that the world was not prepared for this pandemic, but it does need to be prepared for the inevitable future epidemics.

The main responses are that it is necessary to:

- Communicate clearly about this message. Everyone needs to understand about viruses and epidemics, and everyone needs to have the information necessary to live safely.
- Develop resilience and adaptability and learn how to live differently
- Use the opportunities for innovation because development requires innovation.

These responses require access to information, but what information? The general questions that the public asks are about what COVID-19 is, what will happen if they get sick, the vaccines, who to believe, what the future holds, what to do differently and how to change the thinking going forward.

The current SARS-CoV-2 pandemic has brought a number of major global clinical, sociological and economic issues into sharp focus. Managing the situation is reliant on a constant stream of information. A plethora of dashboards has appeared globally that convey information on the number of people tested, those that are positive, the number of deaths and those that have recovered. This information is constantly being updated and forms the basis for important decisions that individuals and governments make. It is assumed that this is accurate and sufficiently comprehensive to be reliable. Everything else concerning the pandemic appears to be open to interpretation.

The kind of information that is needed has to do with the facts, which need to be understandable and accurate, and evidence based information, which is believable because it will lead to the formulation of reasonable expectations and the determination of our options for the future. More educational and awareness programmes and scientifically sound and accessible information need to be provided to the general public, partly to mitigate the infodemic that erodes public trust in the vaccine and other preventative programmes. In his recent paper titled, '*We should have locked down education before we locked up SA'*, Prof. Jonathan Jansen said that the public should be given basic information about vaccines, that it is important to be honest about the limitations of vaccines, to build trust in medicine and to demonstrate safety of the vaccine. Another paper authored by Profs. Mark Tomlinson and Ashraf Kagee addresses the need for an awareness campaign to overcome vaccine hesitancy and points out that trust is a key component, that communicating accurate information, clear messaging and excellent science would allay fears, and that THPs play a unique role in the effort to ensure the uptake of vaccines. The paper goes on to discuss the need for social marketing and public service announcements as a means to create awareness and interest among the public in receiving a vaccine and the role of science journalists in encouraging scientific mindedness. All in all, accurate and clear information can go a long way to counter conspiracy theories about vaccines and COVID-19 in general.

There is plenty of information and there have been thousands of studies about COVID-19 (the disease and the vaccines). There have been 12 international panels and 14 reports in recent months on pandemic preparedness, and more data is presented every day. People need to know how to access information and what to believe, and understand why information changes all the time. The key message is that the public need to listen to the scientists and trust the experts.

Specific information helps provide clarity as is demonstrated in the South African COVID-19 Vulnerability Index Dashboard run by StatsSA. This kind of information is very helpful. It is easy to use and easy to understand. Everybody needs the information - policy-makers, individuals, communities (including rural communities, informal settlements), healthcare providers, WHO staff and international organisations, who all need to be able to access the correct information appropriately. The Government Communication Strategy on COVID-19 formulated at the beginning of the pandemic is one of the official channels of communication and provides for an effective communication and awareness programme to stop the spread of the virus. In addition, the Government Communications and Information System (GCIS) is responsible for communication and strategies around communication, including providing messages in various forms to communities and training of government communicators. The GCIS communication plan has several phases, with phase 4 focussing on economic recovery and a path that saves lives and protects livelihoods. The GCIS has engaged in an enormous amount of communication activities, including the dissemination of almost 2 million pamphlets. However, what needs to be asked is how much of this work has been seen in communities and by the public at large.

The sources of information are principally the government and social media, but also scientists, community leaders, journalists and the media in general. Scientists and the scholarly community have to have a more visible presence in the media. Confusing information through widespread misinformation and disinformation needs to be avoided at all cost. In his paper, Prof. Jansen said that, "… in the absence of evidence-based knowledge on vaccines made available to ordinary people, there are any number of whackos in the wings ready and willing to fill that gap with lies, misinformation and conspiracies …". Further confusion occurs when different experts take information from different points of view.

The approach to information needs to be adapted to take the above into account. The European Commission report on improving pandemic preparedness and management indicates that:

- The degree of public compliance looks to be affected across the board by trust (in public authorities, in the message and in the messengers) as an overarching factor
- Greater trust in government leads to more compliance with health measures
- The pandemic has given rise to an infodemic leading to confusion and distrust
- The WHO is developing a Network for Information in Epidemics (EPI-WIN) based on the concept of 'trust chains', and has set up a 'myth-busting' site.

Planning for the future is all about trust and this requires establishing systems for effective communication, tackling disinformation and misinformation during crises and strengthening the role of official sources of information in this regard. It is important to develop communication strategies for advice and policy that are evidence-based, fit for purpose, flexible and nuanced, and that counter stigmatising and homogenising discourses that serve to exclude and marginalise.

Information needs to be accessible everywhere. Information will guide how people adapt. What is needed in South Africa are:

- Clear messages from government. Regular, professional communication, including the media, will build trust and enable the implementation of policies. Benefits will be derived from clarity in terms of compliance

- Science journalists playing a key role in the communication process
- Scientists speaking our more.

Beyond the COVID-19 pandemic, there are several opportunities for innovative communication, including:

- Science is changing. We live in a data intensive world and science is using data in new ways. Technologies link virtual, physical and biological worlds and Artificial Intelligences (AIs) are developing new knowledge.
- Open science and open access to research results and data. The public now has access to, and awareness of, research and data, and this requires that the data is managed.
- Science needs to engage with regional and local communities and there needs to be inclusivity and co-creation in engaging with different communities, and it is necessary to consult and inform government role players.
- Science engagement involves conversations. Scientists have opinions as well as responsibility, and people are interested in those opinions.

Building a science culture is about awareness, understanding and valuing science that needs to inform cultural practices, religious practices, traditional medicine, education, media and scientists. This kind of science culture will make it easier for the public to gain information and value it. Much more discussion is required around this topic.

It is equally important to build public awareness of key related issues through communication, such as the immediate politics surrounding the vaccine, opportunities for children (relating to education, mental health, food security, discrimination, planetary crises), the global and regional development agendas, and global trends (socio-political, economic, demographic, educational).

A recent opinion piece by Tedros Adhanom Ghebreyesus (from WHO) and Michael R. Bloomberg made a critical statement that “stopping the next pandemic starts now”. A number of actions need to be taken in order to prepare for the inevitable next pandemic. These include more research, more global surveillance, more domestic data, more vaccine platforms, more coordination, more community engagement and communication, and more primary healthcare.

QUESTION AND ANSWER SESSION

Peter Johnston: We could easily replace all the virus references and insert climate change, but the latter is much longer term so the response is deemed less urgent. I really hope role players in both fields can exchange experiences, approaches and lessons.

Zoom Q&A: Was government used to relying on mathematical modelling? Was it something that they used before or was it new to them? In either case, what was the one thing that you found to be a challenge and that you wished the end-users (government) understood more about the mathematical modelling?

Response, Dr Sheetal Silal: This was certainly not the South African government’s first experience of mathematical modelling. Many of us have worked with government on models for the HIV pandemic and during the Malaria investment case. It was government that formed the modelling consortium and they reached out to use to help support the COVID-19 response. I found this to be a very positive experience and I personally have worked with many governments around the world and have found that the South African government has been open to science, and has treated the science responsibly. Other countries I have worked with have tended to blindly follow the projections made. It was extremely reassuring that our government would be grateful for the modelling, but was clear that our work was but one part of the solution that supported decision-making. Government is more than a single arm. We have presented at various levels of government, including at the level of district and city decision-makers. Overall it has been very supportive and there has been a mature approach to incorporating results from disease modelling.

Evariste Umba-Tsumbu: A patient may not die of COVID-19 but illness associated with COVID-19. This is very important. Someone may have diabetic but also had COVID-19. If the person died because of being diabetic, the media cannot report the death as being COVID-19 related. This data needs to be well presented by health professionals and needs to be communicated as such.

Response, Prof. Stephanie Burton: I am not an expert in public health data or epidemiology, but I can say that the way to estimate this is to look at the long-term averages of excess deaths. This data is gathered in detail by national institutes and so on.

Zoom Q&A: Prof. Burton’s presentations appeared to talk to the mainstream centre (of the bell curve), but there are always dissidents. What do we do about them?

Response, Prof. Stephanie Burton: This is correct. It is a challenge to understand whether something is fake news or not. The only way to do that is to use a checking system and to try to convince the public to do this themselves. We need to be able to say which sources are credible and correct. Government has a very big role to play in this.

Zoom Q&A: Prof. Burton emphasises the sender and communicator of information. Is there not an important role in terms of educating people on how to discern information and identify facts? There is also the notion of accessibility in language that can come from the sender’s perspective and can be used to ensure that the messages are clear.

Response, Prof. Stephanie Burton: I am acutely aware that there are many levels of understanding. It is absolutely critical that we somehow pay attention to the fact that the public need to be able to discern the accurate and correct information form what is not. There is not much we can do other than use evidence, provide data, and making it clear and understood where the information comes form. It is about building trust - where all levels and sectors of the community are able to trust what is being said and not be confused by too much detailed information. All information communicated needs to have the stamp of correctness and credibility. Those who speak publically need to be very clear about where their information comes from and how they believe it to be true.

DEPARTMENT OF SCIENCE AND INNOVATION (DSI) COVID-19 RESEARCH SUPPORT (MS GLAUDINA LOOTS, DSI)

One of the most important lessons learnt from the COVID-19 pandemic is the extent to which people have shared their expertise and worked together.

In March 2020, before the first case in South Africa was detected, the DSI and the SAMRC were aware of the inevitability of an epidemic, and began to consider the steps that needed to be taken and the areas that required research funding. The Strategic Health Innovation Partnership (SHIP), based at the SAMRC, was useful in drawing on the proven processes over the past seven years. The first three projects that were considered were specifically around surveillance, community engagement and epidemiology. The DSI’s ability to repurpose funding and find additional funding for the basic health innovation component of the research meant that almost R70 million was made available to drive the research agenda. Adherence to the rigour and responsibility with respect to research funding was essential and selection committees comprising scientists and administrators were used to select appropriate projects for funding as well as projects to be terminated. Currently 21 projects were being funded by the DSI and most of these are ongoing projects. The main projects to do with surveillance are:

- Sentinel, hospital-based surveillance of adults hospitalised for Severe Acute Respiratory Infection
- Serological and genomic investigations of SARS-CoV-2 among HIV-infected and HIV-uninfected
- Epidemiological and phylogenetic investigation of COVID-19 in KZN Province (study design was used to develop community testing)
- Detection of SARS-CoV-2 in wastewater (this has shown to be an important tool in predicting the hotspots).

The DSI has made biobank infrastructure available in the form of a repository of whole blood samples for the investigation of possible genetic markers that predispose severe Covid-19 disease. A variety of projects support diagnostics development and the relevant capacity building. These include biomanufacturing of molecular biology enzymes, reagents and kits, the performance of rapid serological assays in real-life South African settings and ParaDNA low-range real-time point-of-care PCR machine development.

The initial projects that the DSI was involved in with regard to vaccines include:

- Rapid Development of SARS-CoV-2 vaccines, therapeutic antibodies and diagnostic reagents
- Plant-based manufacturing of antibodies for COVID-19
- The HIV component and the community engagement component of the Oxford-Astra Zeneca COVID-19 vaccine trials.

The DSI also supported projects dealing with prevention and treatment of COVID-19 in South Africa, such as those on the use of different anti-malaria drugs including Hydroxychloroquine for mild to moderate COVID-19 disease, and the cultivation, extraction and processing of South African medicinal plants for treating and preventing COVID-19. The DSI funds projects that address decision support for human settlements through earth observation and clean energy technologies through the roll-out of solar power packs to hospitals, medical facilities, and the South African Police Services (SAPS).

Existing platforms that had built capacity focussing on HIV and TB, such as the KZN Research Innovation and Sequencing Platform (KRISP) and the Centre for the Aids Programme of Research in South Africa (CAPRISA), became involved in the epidemiological and phylogenetic investigation of COVID-19 in the KZN Province. These groups joined with the AHRI, located in close proximity to each other, under took multiple SARS-CoV-2 epidemiological outbreak investigations (such as the outbreak at St Augustine's Hospital) that laid the foundation for enhanced infection control practices in healthcare settings. They also developed guidelines and tools for community testing for COVID-19. A number of very important articles have come out of this research.

The Network for Genomic Surveillance in South Africa (NGS-SA) comprises various platforms across the country that work with the NHLS to better understand the SARS-CoV-2 and other viruses. Through its work in this area, it was able to detect the emergence of a new SARS-CoV-2 lineage (501Y.V2) with a number of spike mutations and deletions. Studies were underway to gather data on whether there is any clinical and epidemiological evidence to suggest impact with regard to increased transmissibility and pathogenicity, as well as the variant's ability to escape neutralising antibodies. The DSI plans to make further funding available to the NGS-SA, with R25 million being reprioritised from the 2020/21 budget.

The HSRC has also undertaken research in support of the Covid-19 response. Projects include social-behavioural surveys relating to health workers as well as communities and perceptions of and attitudes towards vaccines. Another project looks at using the Presidential Youth Employment Initiative (PYEI) towards the training of fieldworkers for these studies. The Council for Scientific and Industrial Research (CSIR) has been able to leverage its capabilities to respond to the COVID-19 pandemic. This highlights the importance of investing in R&D capability development in dealing with future crises and opportunities. Ongoing R&D activities include developing relevant capabilities in order to fully support the State. Some of the ongoing R&D activities are:

- The Electronic Vaccination Data System (owned by the NDoH and developed (in part) by the CSIR)
- The National Ventilator Project (100% local manufacture)
- COVID-19 testing labs in support of NHLS
- Information and Decision Support Centre.

Much is happening in the DSI that is not widely known. It is an innovative department that stimulates innovation in various ways and sectors, and it was quick to get involved in the country's COVID-19 response.

QUESTION AND ANSWER SESSION

Marike Geldenhuys: Are the 3000 whole SARS-CoV-2 genomes publicly available and accessible and if so where can they be accessed?

Response, Ms Glaudina Loots: Yes they are available and can be accessed. A condition of the funding is that the information has to be publically available. The information can be accessed from the KRISP website under the NGS-SA section (https://www.krisp.org.za/index.php).

Evariste Umba-Tsumbu:
- Did your drug research discovery use a multi-disciplinary approach for COVID-19 treatment on a national level? Was this a combined work from pharmaceutical and traditional/indigenous treatment?
- Is there any possibility of doing a comparison study of the vaccine efficacy in a percentage against COVID-19 (Vaccine vs negative patient, vaccine vs COVID-19, a patient who has contracted COVID-19, and interactions, vaccine vs patient with both COVID-19 and the new variant, vaccine vs negative patient with diabetic, vaccine vs negative patient with TB and vaccine vs negative patient with HIV)

Response, Ms Glaudina Loots:
- The DSI funding for the African traditional medicines work is being managed within the department's IKS component. The other projects funded by the DSI are clinical trials that are ongoing around existing drugs and the repurposing thereof.
- The data for the J&J trial (to be released soon) includes this information. The roll out of the J&J vaccine in South Africa falls under the umbrella of a 3B clinical trial and these specific questions are being followed up as part of the vaccine roll-out. Similarly, the surveillance will be done for any other vaccines. The development of protocols for post-roll-out surveillance is underway.

WRAP-UP DAY 1

Comments and input from participants on the day's proceedings were as follows:
- It has become clear that many of sectors, organisations, institutions have learnt the same lessons from the COVID-19 pandemic, and this reinforces that there are valid lessons to be learnt.
- One of the points not highlighted in the presentations and discussions concerned the challenges at organisational level. More discussion is needed around these challenges and around where improvements in this regard are needed.
- There is a lack of coordination between different sectors with respect to the COVID-19 response and preparation for future pandemics. There is room for more effective cooperation, coordination and communication between the different role players.
- All sectors need to work together as diseases are multidisciplinary in nature and collaboration across sectors is essential in addressing them.
- Although there are excellent policies, legislation, strategies, collaborations and coordination at national level, these do not filter down to local or community level. This seems to be more than a governance issue. People from the ground up need to get involved in initiatives so that they have a sense of ownership.
- One of the problems that must be resolved is that there are different health systems in different provinces, and each province takes its own approach. There is often a lack of coordination between provincial and district levels. COVID-19 has highlighted the pain-points in the health system. It is necessary to ensure that these problems are not perpetuated going forward, and that they are addressed in the implementation of the National Health Insurance (NHI) in order to create a coherent system across the country.
- The NSTF should organise a follow-up session to discuss coordination in terms of local governance.
- There should not be a reliance on crisis management. Preparations must be made for pandemics in the long-term, but there are limitations to how much can be considered now in terms of preparing for the future.
- The way government has been fully involved in what needs to be done and in solving the problems is impressive. It is difficult to assess the amount of work that has been done in only one year.
- The discussion about the COVID-19 pandemic could also be about climate change. The same principles that apply to COVID-19 pandemic apply to climate change.

Ms Niehaus thanked the speakers for sharing their substantial insights, knowledge and experience with this forum. Although the negative news was sometimes overwhelming, it was important to note that the science sector in South Africa and the country itself had much to be proud of.

DAY 2

SESSION 3: VACCINATION, FOOD AND ZOONOTIC DISEASES

KEYNOTE: INFLUENZA PANDEMICS – LESSONS FOR COVID-19 (PROF. JEFFREY MPHAHLELE VICE PRESIDENT, SAMRC)

The WHO list of pandemic and epidemic diseases serves as a reminder that pandemics and epidemics occur all the time and that the world needs to be prepared for outbreaks at any given time in order to be able to respond optimally. The WHO Africa's weekly bulletin on outbreaks and other emergencies is evidence that Africa is prone to epidemics and pandemics. The ability to respond to an epidemic or pandemic depends on whether it is caused by a known pathogen without a licensed intervention, a known pathogen with a licensed intervention or an unknown or emerging pathogen. The latter can become devastating as intervention tools have to be developed, as in the case of COVID-19.

The WHO Emergency Response Framework Outbreak for COVID-19 lists the areas where action must be taken, including the use of vaccines. Research is critical when dealing with pandemics as a means to:
- Develop better risk modelling methods to make predictions about the pandemics
- Undertake prevention and surveillance for countries at risk of serious infectious disease outbreaks
- Identify research gaps and priorities for priority diseases at country level
- Ensure pandemic preparedness (especially country-owned research) with the overall objective of strengthening Biosecurity and Research Infrastructure
- Leverage on existing networks, platforms and expertise from all the sectors involved and in the context of One Health
- Optimise development of new health interventions such as vaccines, therapeutics and rapid diagnostic tools.

After the Ebola outbreak in West Africa, a number of research organisations came together in a network called the Global Research Collaboration for Infectious Disease Preparedness (GLOPID-R) to prepare to deal with future outbreaks and pandemics. GLOPID-R aimed to:
- Facilitate exchange of information in outbreak situations
- Establish a response plan and a strategic agenda for a coordinated and rapid research response
- Address scientific, legal, ethical and financial challenges to a rapid response
- Connect infectious disease research networks
- Support public health decision-making.

However, nobody ever expected a pandemic of the magnitude of the COVID-19 pandemic. Most countries were caught off-guard and no country was fully prepared for it. Important lessons have been learnt about strengthening preparedness and much can be learnt from influenza pandemics as these have a lot in common with the COVID-19 pandemic.

The influenza virus is an RNA virus and spreads very quickly via water droplets and small particle aerosols when coughing or sneezing. It enters the body through the nose, mouth and eyes. There are many types of influenza virus and these are found in humans and animals. Type A is the culprit when it comes to pandemics because it is found in animals and is able to adapt in humans. Key medical aspects of influenza are:
- It is a highly infectious disease
- It can cause acute infection of the respiratory tract (upper and lower)
- It can cause repeat infections due to viral mutations
- It is easily transmitted by the aerosol route
- The incubation period is relatively short (usually 2–3 days).

Unlike SARS-CoV-2 , influenza is a segmented virus. The segments allow the virus to undergo different mutations very easily. Mutation is frequent with Influenza A, less for type B and never for type C. Mutation allows the virus to escape immunity. In addition, annual changes in surface proteins pose a challenge to vaccination. Influenza epidemics occur every year, while influenza pandemics result from antigenic shifts due to genetic re-assortment or direct transmission from avian to human and occur every few decades at unpredictable intervals. The novel virus spreads quickly because the population has no immunity to it.

The last four influenza pandemics (Spanish Flu, Asian Flu and Hong Kong Flu) are estimated to have caused around 100 million deaths and have been fully documented. In 2009 there was a threat of another pandemic, H1N1 or Swine Flu, which has considerable similarities with SARS-CoV-2 and the way it established itself as a pandemic disease. The first report of H1N1 (12 April 2009) was as an influenza-like illness and it came from Mexico, and was reported to the WHO. By 23 April the virus was confirmed in several patients in Mexico and on 24 April, the WHO declared a public health event of international concern (PHEIC). It was declared a pandemic on 11 June. Within 9 weeks, all WHO regions were reporting cases of H1N1 and the first case in South Africa was on 18 June 2009. The clear message is that if influenza strikes as a pandemic it will spread across the world within a short space of time and leave a legacy, as has COVID-19.

The Spanish Flu of 1918/19 was one of the most deadly pandemics of communicable diseases to have affected the world. South Africa was the fifth hardest hit country and victims of the pandemic were 20 to 40-year olds, with around 500 000 deaths occurring. The pandemic overwhelmed the ability of the authorities to dispose of the corpses and paralysed the healthcare system.

The key lesson from past influenza pandemics is that they occur unpredictably and not always in winter. Other lessons are that the past pandemics had great variations in mortality, severity of illness, pattern of illness and age distribution; there was always a rapid surge in the number of cases over a brief period of time, and the pandemics tend to occur in waves with a duration of 6 to 8 weeks, with more or less severe subsequent waves. Most influenza pandemics originated from the Avian virus and a number of Avian Influenza outbreaks have occurred since 1997. The last one occurred in 2006/2007 and was thought to be the most likely cause of the next pandemic.

In 2007, the WHO was deeply concerned that the next influenza pandemic was imminent and warned that every country must be prepared for a tragic event that would cause large number of deaths, bring economic and social disruption and a shortage of medical supplies. Possible interventions would include NPIs (the same as used for COVID-19), pharmaceutical interventions including stockpiling and early use of antivirals (which cannot be used when dealing with a novel pathogen) and the development of pandemic vaccines.

Vaccination against influenza represents first-line intervention. Vaccines for most infectious diseases are regarded as the “most important medical intervention for preventing influenza and reducing its health consequences “. Vaccines are the primary weapons against annual epidemics and have shown proven efficacy (70 to 90%) in reducing morbidity, mortality and associated respiratory disease. The clinical effectiveness of the vaccine is significant and the cost benefits of vaccination are firmly established.

The lesson that should have been learnt from previous outbreaks and pandemics concerns the lack of capacity to produce and manufacture large quantities of vaccines (not just for Influenza) and this means that vaccines will not be available when needed in most countries. It is critical to increase vaccine manufacturing capacity not only for influenza, but also for other future pandemics in order to ensure early protection.

Take-home messages from previous influenza pandemics that can be applied to SARS-CoV-2 are:

- Pandemics usually involve a novel virus
- A virus has increased transmissibility and new variants with possible increased virulence and age shift in terms of the affected population
- There are always novel risk factors that transmit the virus and there is no seasonality

- Multiple waves are likely, with subsequent waves being more severe
- The virus will adapt in the human population, as does the seasonal influenza virus.

The world would have been more prepared for COVID-19 if the signals of a possible influenza pandemic had been taken more seriously.

SARS-COV-2: DOES IT CAUSE FOODBORNE DISEASE? (PROF. LUCIA ANELICH, ANELICH CONSULTING AND CENTRAL UNIVERSITY OF TECHNOLOGY (CUT))

New information on COVID-19 and SARS-CoV-2 is accumulating daily and this means that the information may change over time. To mitigate this, regular updates are posted on the website, www.anelichconsulting.co.za.

The first Severe Acute Respiratory Syndrome (SARS) virus appeared in the early 2000s and contained the protein spikes that are also seen on the current virus, SARS-CoV-2. The Human Coronavirus (one example is 229E) also has the typical crown-like appearance, as does the Middle East Respiratory Syndrome (MERS) virus that occurred in 2012 for the first time. These viruses belong to the Coronaviridae family and all share a fatty layer on the outside of the virus, which is easily disrupted (by, for example, washing hands with soap or using disinfectants, as is the case in the food industry) and thereby inactivated. It is a single stranded RNA virus and contains protein, club-shaped spikes on the outside that creates the so-called crown (or 'corona').

The first SARS virus was active between 2002 and 2004 and first detected in China, and had an R0 value of between 2 to 4 people, with an approximate death rate of 9.5%. The MERS virus became active in 2012 and remains active although very sporadically. It has an R0 value of less than 1, was first reported in Saudi Arabia and the approximate death rate is 34%, almost one third of those infected. MERS remains more prevalent in Western Asia than elsewhere and is believed to have zoonotic origins. The SARS-CoV-2 virus was detected in 2019 and has a current R0 value of between 2 and 4 people, which is expected to drop substantially due to the roll-out of vaccines. It was first reported in China and the approximate death rate is 2.3%, which accounts to 2.5 million deaths worldwide.

Transmission of SARS-CoV-2 is through person-to-person close contact and aerosols (droplets expelled when coughing or sneezing), which is problematic when it comes to crowding indoors and in areas where there is poor ventilation. The question is raised about transmission through contaminated surfaces. The scientific media has published numerous articles on studies conducted in laboratories aimed at understanding the survival of this organism on a variety of surfaces. All the studies were conducted under different environmental conditions and using extremely high viral loads, and some of them came up with significantly different results. It is important to interpret the results and extrapolate them to real-life situations and environments in order to assess risk. Furthermore, McKinsey published a report in May 2020 that showed that approximately 10% of all transmissions were due to environmental transmission, which included surface transmission. In July 2020, Goldman published an opinion in *The Lancet* that spoke about exaggerated risk of COVID-19 by fomites (an inanimate object such as a surface) and questioned the prevalence of transmission via contaminated surfaces. In February 2021, Lewis published an article called, *COVID-19 Rarely Infects through Surfaces – so why are we still deep cleaning*? in *Nature.*

Surfaces can become contaminated because people can cough and sneeze on them. The viral load, such as on high-touch surfaces, is what is important, for example in a food production environment. The food industry is well aware of this and has taken (and still is taking) steps to mitigate this form of transmission from the beginning of the pandemic. Nevertheless, a plethora of information (from international public health authorities and food safety authorities, the CDC, as well as an important position paper put out by the International Commission on Microbiological Specifications for Foods (ICMSF)) has been published that shows that this is not the primary route of infection. A peer reviewed paper, *SARS-CoV-2 and Risk to Food Safety*, co-authored by Prof. Anelich, was published in November 2020. It is Open Access and available on https://doi.org/10.3389/fnut.2020.580551.

With regard to foodborne transmission of SARS-CoV-2, on13 August 2020 the Chinese authorities reported that frozen chicken imported from Brazil tested positive for COVID-19. On 21 January 2021, ice cream samples tested positive for COVID-19 in China. In both cases, only RNA was detected and not the intact virus without which infection cannot occur. The entire batch of ice cream was recalled and the company's 1662 employees were placed under quarantine. In addition, China has begun to restrict trade based on the testing that was undertaken.

With regard to food safety, food could become infected by food handlers who shed the live virus. However, viruses do not grow on or in food or on surfaces as they need a living host in which to replicate. The SARS-CoV-2 virus is also killed by cooking, as determined by food standards agencies and authorities, and most viruses survive freezing where they remain in a dormant state. It was therefore not surprising to find 'viruses' on frozen food packaging. On 11 August 2020, China reported finding 'the virus' on outer packaging of frozen food products. A similar situation occurred on 28 September 2020 when repeated detection of coronavirus was found in imported cold chain foods. The authorities in China reached the conclusion that this proved that imported cold chain foods are indeed at risk of contamination. It is important to note that both cases detected RNA and that the significance of those findings is questionable.

On 19 October 2020, it was reported that traces of live coronavirus were found on frozen food packaging (only 22 out of almost 3 million samples tested positive) in China. The report states that the CDC in China did not say whether the outbreak in Qingdao was caused by the frozen food packaging. It is significant that authorities in New Zealand ruled out the possibility that one of its first infections happened at a cold storage facility.

The outcome of these cases in China was that frozen food imports from companies across at least 19 countries and regions were suspended even though there is no evidence that live virus present on or in food exists in high enough numbers to be transferred by hand to self-infect. Whether the testing is for the live virus or for RNA would make a difference in interpretation. Previous tests that were done on the SARS and MERS viruses and various human coronaviruses showed that viruses present on food or food packaging lose viability over time. If frozen foods were efficient in spreading virus to humans, globally there would have been hundreds of thousands of cases linked to this transmission route, but this is not the case. There is therefore a high possibility that workers in China who were already infected with the virus transferred it to the food packaging. This link has not been clearly shown by the authorities in all the testing that been done in China.

The gastrointestinal (GI) tract contains the ACE2 receptors with which the virus identifies, but infection via the GI tract is unlikely because the virus cannot survive in the stomach due to the high acidity levels, and the amount of virus in food is unlikely to be extremely high, so the virus is less available to host cells in the GI tract. Although diarrhoea is a symptom of COVID-19, publications have shown that it would most likely be from infiltration of the virus from the respiratory canal to other organs. No cases of faecal-oral transmission of SARS-CoV-2 have been reported. In this particular case, it is important to understand the difference between a hazard and a risk. Something that is potentially present does not automatically translate into a risk to human health.

The FAO has gone as far as to publish a number of documents about food safety and COVID-19, stating that there is no evidence that food transmits the new coronavirus and that handling, producing, processing and selling food is not considered a danger.

On 18 February 2021, a statement published on the United States Department of Agriculture (USDA) and FDA websites underscored that current epidemiology information indicates that there is no transmission of COVID-19 through food or through food packaging.

In conclusion, there is no evidence of SARS-CoV-2 transmission via food. It is therefore not regarded as a foodborne virus and does not cause foodborne disease. Food recalls are unnecessary and have a drastic impact on food security. It is highly unlikely that food packaging is a significant transmission route as such evidence has not been seen to date. Testing for viral RNA versus testing for infectious virus is an important point in terms of interpreting information. Therefore, the greatest risk remains transmission from person-to-person, which is an occupational health and safety matter and not a food safety matter.

QUESTION AND ANSWER SESSION

Debbie Schultz: From a pubic perspective, we have been told repeatedly that no single intervention prevents the spread of COVID-19 apart from the vaccine, and that the interventions such as NPI need to keep going because they cause a layering effect for prevention. Food safety is not regarded as a big risk but are the 'little things' not also important for prevention?

Response, Prof. Lucia Anelich: The point must be made that basing information on science means scientific evidence. The food industry is still required to sanitise surfaces because of the high throughput of people who touch the surfaces, utensils and so on. We do want people to continue to disinfect surfaces. However, it is also difficult to maintain a balance because we know that over-sanitising can cause other problems. A recent publication addresses an alcohol resistant strain of certain bacteria that have been found. The issue is to make people aware that this is not a foodborne virus and therefore the chances of getting foodborne disease are very low or a negligible risk. Food itself is not going to cause a foodborne situation if contaminated with the SARS-CoV-2 virus.

WHAT CAN WE LEARN FROM OTHER ZOONOSES (BESIDES COVID-19)? (PROF. WANDA MARKOTTER, CENTRE FOR VIRAL ZOONOSES, UP)

Addressing zoonoses requires an understanding of spillover, which is a result of a complex and varying process. A high diversity of pathogens (viruses, bacteria, parasites and more) exist in nature, often but not only, in wildlife. They do not make the animals sick or cause disease, and have evolved with animals. At some point the pathogens can spillover to other wildlife species, domestic animals or livestock, and sometimes directly to humans and on same cases there is human-to-human transmission. The diseases then spread worldwide through the movement of people and air travel. The good news is that not everything has to be understood in order to stop transmission or spillover. Outbreaks can be stopped if some of the factors are understood and measures are put in place to deal with them.

With regard to the history of pandemics and outbreaks, one of the concerning points is the existence of an estimated 1.7 million undiscovered viruses in mammalian and avian hosts. More than half a million of these could potentially spillover. It is important to note that spillover happens due to contact between and among the potential reservoir such as wildlife and livestock, and people. Much can be learnt from Influenza epidemics and pandemics, but it is not easy to predict where the next pandemic will come from and there is a variety of possible sources. Transmission of the virus needs a direct contact either with the infected animal or the environment and Influenza cannot be eradicated as the reservoir, mostly wild birds, cannot be contained. Preventative measures for Influenza have been very successful. These include:

- Controlling the disease in animals to reduce the risk to humans
- Prevention at the animal source through proper biosecurity measures
- Keeping poultry away from wild birds
- Quality surveillance (animals and humans) to allow for early detection and rapid response.

The Nipah virus is a good example of bat virus that can cause human disease. The reservoir is considered to be flying foxes, a specie of fruit bat, that causes respiratory transmission and disease in humans through faecal and urine contamination. Fatality from the virus can be up to 75% and it has the potential to cause pandemics if it spreads beyond the current isolated locations. Almost fifteen years of research has shown that there are similar viruses that move to other locations. This is a cause for concern. Nipah is interesting because although the bats are always involved, each outbreak has different transmission routes. The first outbreak in Malaysia had to do with pigs that got infected and people who were in close contact with them got the disease. However, the source was bats and not pigs. The bats fed on fruit from orchards growing close to large commercial pig farms and the pigs got infected from the bat urine. Malaysia responded by killing all the pigs and the disease completely disappeared. As a preventive measure, fruit trees may not be grown close to where pigs are kept. The Bangladesh outbreak did not involve pigs as the intermediate host. Containers of date palm sap attracted bats, which contaminated the sap and those who drank the (unpasteurised) sap got infected. It is uncertain how the outbreak in India occurred.

Agriculture intensification, without biosecurity and control, and where there is mixing of different species in environments where there is a high-density of livestock and farming animals is problematic when it comes to transmission of the Nipah virus. Outbreaks occur in cycles but this is not well understood. The reoccurrence of Nipah virus is possibly due to increased bat populations and the drop in immunity that allows a flare-up of the virus.

The first SARS outbreak was 18 years ago and at the time, live animal markets were closely associated with the origins of SARS-CoV. It was not surprising that SARS-CoV-2 came from Coronavirus group and from potential activities (live animal markets) that were implicated. It is known from the previous outbreak that animal handlers have higher seropositivity and that palm civets were infected in the markets and could amplify the outbreak and transmit the disease to other animals and humans. These observations triggered the research into bats, which, led to the identification of Rhinolophid horseshoe bats as the hosts of viruses related to SARS-CoV in 2013 and the understanding of the high diversity of coronaviruses in bats.

Interestingly, the detection of Avian Influenza triggered surveillance of Influenza worldwide, even in animal markets, to monitor the diversity of Influenza. Similarly, the wildlife trade and high risk interfaces need to be monitored and surveillance implemented in order to identify spillover from a wildlife reservoir, as well as tapping into the resources developed and knowledge created with regard to Influenza surveillance.

Biosurveillance is extremely complex and costly, but has a strong role to play in monitoring potential hosts or reservoirs for early detection of pathogens in spillover hosts, allowing for better decision-making about where to target efforts. The host/reservoir ecology as well as the human-animal interfaces need to be understood to identify the high risk activities and where best to target surveillance for early detection. Several species, apart from bats and including rodents, primates and some birds have been implicated. Surveillance needs to be towards higher diversity groups with the aim of getting more answers about what viruses are circulating in nature. These matters have been discussed on a global scale, but the information is not available at community level.

An analysis done in 2020 shows that the expenditure on preventative measures is much less than reacting in an outbreak and dealing with a pandemic. Additional benefits of prevention such as monitoring of the wildlife trade, biosurveillance programmes for disease detection and a reduction of deforestation to benefit the environment and climate change have longer-term economic benefits, but require a mindset change.

So much has been documented nationally and internationally about how to prevent outbreaks, One Health approaches, biodiversity and pandemics, health security and so on. Now is the time to put these documents into action.

In conclusion:

- The information already available from previous pandemic experiences and lessons learned for future preparedness need to be used and translated into action through policy and practical guidelines.
- It is necessary to continue and enhance (despite the challenges):
    - Biosurveillance and a more efficient information system to record pathogen prevalence in populations where it is not causing disease.
    - Basic understanding about the pathogens, reservoir and transmission routes,
    - Understanding reasons for spillover
- It is crucial to have an inter-disciplinary (One Health) and inter-institutional global approach. (The National One Health Forum could get involved in this by getting the sectors together in terms of information and sharing information that is accessible to everyone).

TOWARDS THE DEVELOPMENT OF A BIODIVERSITY SECTOR RESPONSE PLAN TO ZOONOTIC DISEASES (PANDEMICS) (DR KIRUBEN NAICKER, DEPARTMENT OF ENVIRONMENT, FORESTRY AND FISHERIES (DEFF))

The world is experiencing turmoil due to the complex changes that are happening. These complex issues are creating a radically different and diverse context for the present leadership in society.

South Africa is a mega-diverse country with a vibrant and active Biodiversity sector. The country's overarching policy position with respect to its biodiversity include dedicated programmes for the conservation of biodiversity, sustainable use of biological resources and the fair and equitable sharing of benefits arising from the use of biodiversity or genetic resources. For many, the biodiversity sector is an employer of choice and underpins the livelihoods and lifestyles of society globally, regionally, nationally and locally. There is a need for development, enforcement and compliance with policy and legislation because the biodiversity is worked with, eaten, lived with, used, researched and studies, and traded.

The COVID-19 pandemic has impacted human life, the economy and the environment in a variety of ways, and the biodiversity sector, highlighting:
- Issue of trade, particularly the international trade of endangered species
- The nexus between the biodiversity sector and health systems, with interlinkages with climate change, health ecosystems, biodiversity loss, well-being, sustainability and economic impact
- The importance of scientific expertise, the lack of specialist knowledge, data systems and information management.

A number of publications and discussions have emerged as a result of the pandemic. The key messages of the Traffic Report (Wildlife Trade, Covid-19 and Zoonotic Disease Risks: Shaping and Response) were:
- Not enough evidence is available that trade is responsible for pandemics
- Concerns on trade include:
    - Movement of live specimens, mixing in trade, transport and markets: wild animals, domesticated animals and people – consumption of meat and other products
    - Disease risk of animals under stress
    - Pathways could be legal or illegal – past zoonotic disease outbreaks often derived from legal wildlife markets and farms
    - Illegal trade brings additional risks of avoidance of health controls and inspection – trade out of sight
    - Lack of connectivity: Global, national and local practices.

COVID-19 is reframing risk management, as indicated in the recommendations of the Traffic Report, namely the necessity to:
- Better understand the risk by establishing which aspects of trade are linked to zoonotic disease and possible trends
- Map the risks related to species, markets, transport hubs, trade practices
- Understand risk management option
- Adopt an integrated approach and wider perspective that addresses public health, animal health, conservation, building on good practice.

The Intergovernmental Platform of Biodiversity and Ecosystem Services (IPBES) conducted research on biodiversity and pandemics. Some of the key points from the 2020 report are:
- Pandemics emerge from the microbial diversity found in nature
- Human ecological disruption, and unsustainable consumption drive pandemic risk
- Land-use change, agricultural expansion and urbanisation cause more than 30% of emerging disease events
- The trade and consumption of wildlife is a globally important risk for future pandemics
- Reducing anthropogenic global environmental change may reduce pandemic risk.

IPBES takes the approach that governments must ensure that the actions being taken to reduce the impacts of the current pandemic aren't themselves amplifying the risks of future outbreaks and crises, and provides the following important considerations:

- Strengthening and enforcement of environmental regulations by only deploying stimulus packages that offer incentives for more sustainable and nature-positive activities.
- Adopt a 'One Health' approach at all levels of decision-making recognising the complex interconnections among the health of people, animals, plants and our shared environment.
- Properly fund and resource health systems and incentivise behaviour change on the frontlines of pandemic risk.

DEFF carried out regional-wide stakeholder engagement to hear what the sector is saying about the pandemic. Input received addressed specific issues in the following areas:

- Elevation and capacitation of risk management
- Monitoring of transmission patterns and identification of drivers
- Identification of risks to protected areas
- Building capacity in the regulatory system, and in terms of the scientific capacity of government entities
- Cross sector and international cooperation
- Trade
- Socio-economic impacts
- Protected Area Management
- Conservation
- One Health Approach.

There are opportunities to build back better on a global level as we enter the United Nations Decade on Ecosystem Restoration and there is talk about a 'New Deal for People and Nature' in the development of the Global Biodiversity Framework of the Convention on Biological Diversity. On a regional level, the AU's Specialised Technical Committee for Agriculture, Rural Development, Water and Environment made a Ministerial Declaration to ensure that appropriate environmental policies and strategies responding to epidemics and pandemics are put in place, and implemented effectively to promote environmental sustainability. On a national level, the process to revise the White Paper on Conservation and Sustainable Use would be initiated in the coming months.

The approach taken by DEFF and the sector is to develop a biodiversity sector response plan to zoonotic diseases at the human-animal-environment interface. Zoonotics are connected to varying sectors including biodiversity, health, and agriculture. The biodiversity sector response plan to zoonotic diseases will follow a One Health approach that promotes coordinated, cross-sectoral dialogue and collaboration among various stakeholders in all relevant sectors at national, regional and international levels to address common concerns on current and future health threats covering human, animal, and environmental issues. The Plan needs to include interventions for the prevention and control of emerging zoonotic diseases that benefit all sectors with a view to optimise health for humans, animals and the environment.
The sector response entails conducting a scoping exercise on the interlinkages between biodiversity and health, undertaking a comprehensive risk assessment as well as a comprehensive mapping and analysis, and developing a Biodiversity Sector Response Plan with a ten-year implementation outlining short, medium and long term actions.

The key principles emerging form the co-creation model in support of a One Health approach are:

- Leadership is interdependent on the interactions of the key tenets that promote and optimise co-creation processes.
- Relationships matter
- Establish the relevance of the local context
- Establish trust and build credibility
- Ensure transparency and inclusiveness
- Promote conversation and dialogue as often as possible
- Develop strategic partnerships and relationships
- Reward and incentivise

- Promote continuous co-creation.

CONTRIBUTION OF EARTH OBSERVATION DATA TOWARDS PREPAREDNESS FOR HUMAN DISEASE OUTBREAK: CORONAVIRUS OUTBREAK LESSONS LEARNT (MS NALEDZANI MUDAU, SOUTH AFRICAN NATIONAL SPACE AGENCY (SANSA))

Earth Observation Technologies including Satellite Remote Sensing lay an important role in terms of preparedness and management of pandemics as well as identification of high risk communities when it comes to human and animal health. The technology enables the acquisition of images at various scales from global to high-scale village or street views and helps map and monitor the environment, and most importantly, to map the indicators that could be the source of health related outbreaks, such as water and air quality. An advantage of using Earth Observation data is that it provides historical views during previous pandemics, for example, in order to assess the environment, identify lessons to be learned and create models for future outbreaks to help mitigate the risk for humans and animals. The data is also used to assess accessibility to health services by communities. Satellite Remote Sensing is used to identify areas at risk by studying vegetation conditions and humidity in order to model the impact of a potential health disaster and put preventative steps in place.

SANSA creates core data sets that are used to map and better understanding the environment in terms of natural resources and human activity. One of the core data sets concerns vegetation layers showing the vegetated areas of the country, which allows for monitoring over time, and for changes to be identified. This data can be integrated with rainfall data, for example, to provide comprehensive data for modelling disease outbreaks. The monitoring of water bodies across the country provides the information necessary to understand an changes to the natural resource and provide information on water quality that helps manage the country's water resources and identifying sources of pollutants. Monitoring water bodies in residential areas, especially informal settlements, also helps to understand the quality of the water used by residents.

Another core data set concerns human settlements that maps out the location of human settlements as these are indicators of population size. Information on where people live becomes crucial during a pandemic as a means to ensure that interventions reach the entire population. Access to basic services is assessed using technology such as night lights, which help identify areas that have access to electricity or street lights. This information becomes useful when managing a disaster or a disease outbreak because it facilitates accessibility during an emergency.

Specific contributions of Earth Observation Data to decision-making with respect to interventions during the COVID-19 outbreak include:

- Identification of socially vulnerable communities (where there is a lack of basic services) through mapping the location of these communities (mostly informal settlements) the population density of such areas, particularly in terms of distribution, the proximity to health infrastructure, and access to roads and water.
- Spaza shop support programme, in collaboration with the Department of Small Business Development, was aimed at empowering shop owners to ensure that sufficient food supply was available within easy reach of communities during the lockdown. The programme would remain useful to the department in terms of supporting small businesses beyond the pandemic.
- Assessment of air quality before and during the lockdown showed a reduction in levels of Carbon Monoxide emissions. Trends in this regard assist in making informed decisions going forward.
- Very high spatial resolution satellite imagery allowed government departments to do an up to date detailed situational analysis of particular areas, especially hotspots, to help with the planning of the services required and to ensure the protection of communities.

To support the broader use of data and visualisation, particularly with regard to decision-making beyond the pandemic, SANSA has developed a digital support tool that is available at http://products.sansa.org.za/mapApp/index.html. Visualisation allows users to understand what is happening in the environment, the state of the environment in term of water quality and pollution, and human activity, without relying on desktop data. Dashboards to support visualisation relating to human settlements, access to services and more, were also created, and allow users to zoom not any area of interest and assess a situation in terms of numbers and locations to help identify areas that require intervention.

Some of the lessons learnt during the COVID-19 pandemic include the need for more stakeholder engagements outside of pandemics to help government and other users of Earth Observation Technologies to understand and appreciate some of the data sets made available by SANSA, and to demonstrate how the data can be used to support decision-making. This needs to go hand-in hand with awareness and capacity building to ensure that the users are proficient in using the data. Health Analysis Ready Data needs to be developed in order to allow users to access the information they require in a user-friendly manner, without the need for data interpretation. The use of Earth Observation data needs to be encouraged in preparing for pandemics as well as post pandemics.

QUESTION AND ANSWER SESSION

Debbie Schultz: With regard to the lessons from influenza, it is not clear what the difference is between influenza and COVID-19.

Response, Prof. Jeffrey Mphahlele: The most important thing is that the causes are different. Both are caused by viruses (influenza virus and SARS-CoV-2), but there is a lot of overlap when it comes to clinical presentations and this can easily be confusing. In influenza season it will be difficult to tell whether the symptoms are influenza of COVID-10 related. Symptoms will more likely be for COVID-19 given that this virus is currently circulating. The definitive answer would be the laboratory diagnosis.

Debbie Schultz: Is a cold considered a coronavirus?

Response, Prof. Jeffrey Mphahlele: Yes. There are a lot of coronaviruses that are the cause of the common cold. With Influenza there is a rapid onset of ever, but a fever does not necessarily happen with a common cold. Coronavirus symptoms generally (not SARS-CoV-2) have mild symptoms. Influenza can be complicated in some patients when there is lower respiratory tract infection, while Coronaviruses can cause upper respiratory tract infections. This is from the perspective of a virologist. That of a clinician might differ slightly.

Zoom Q&A: Is there correlation between COVID-19 and premature deaths of babies?

Response, Prof. Jeffrey Mphahlele: SARS-CoV-2 affects the older age group and is less common in children and babies, although there have been one or two cases where premature babies were found to be positive with SARS-CoV-2. This does not mean that a correlation can be made between premature babies and COVID-19.

Debbie Schultz: Prof. Anelich explained that the death rate was low because of the high number of infections. The death rate is important because people believe it is not high enough to justify the stringent lockdown regulations. How does the death rate to the number of infections work and why is so important?

Response, Prof. Lucia Anelich: The figure I presented were simply the known number of infections versus the known number of deaths. I did a very simple calculation based on WHO historical data from the MERS and SARS outbreaks to get the percentage, and I did the same for the SARS-CoV-2. In the clinical space there are various other ways of determining this kind of percentage. A virologist or clinical microbiologist is better positioned to answer this. It is also about governments' responsibility to protect their citizens from such diseases. Governments' decisions can be criticised but the issue concerns the burden on the health system and dealing with so many cases at one time and preventing others from getting sick and from dying in large numbers. Governments have a responsibility to take disease outbreaks very seriously.

Response, Prof. Jeffrey Mphahlele: The low death rate is actually a blessing and is not alarming. Calculating the death rate, depends on a number of factors, such as whether there is enough detection (including the many asymptomatic infections will bring the death rate down even further). A lot of people are infected but the fatality rate is low compared to other respiratory infections. The death rate from SARS-CoV-2 is low compared to MERS.

Response, Prof. Wanda Markotter: it is not only about the death rate. It is also about the amount of active cases in the health system. The bigger picture is probably not communicated very well to the public. Future studies will unpack this issue better. The public needs to know that decisions are not only based on how many people die. Many other factors play a role.

Guy Preston: It is also what the numbers might have been had the measures not been put in place, coupled with the unaccounted-for deaths (possibly two to three times higher than the official numbers) suggesting that the death rate may be a lot higher.

Debbie Schultz: Dr Naicker spoke about creating a sector response plan based on the responses from the stakeholders. Will the progress made and timelines be visible to all stakeholders?

Response, Dr Kiruben Naicker: Government is obliged to conduct robust stakeholder engagement. This is a specialised area of work that is at the nexus of various disciplines, and would involve specialist input. The public would be consulted once the plan is developed as a draft. There are two phases in the process: collecting evidence to support the plan and adopting the plan. The latter involves broad consultation. A lot of policy issues need to be unblocked before the public can become involved in the process. This is a three year project, culminating in the publication of the plan.Various structures in government require us to be answerable to the public.

Debbie Schulz: What is Prof. Markotter's take away message to the general public?

Response, Prof. Wanda Markotter: The message would not be about what we need to do strategically. It would be to live responsibility with your environment and the planet because contact with animals that are hosts to the pathogens, agricultural intensification and destroying the ecosystem will lead to disease outbreaks. Humans are causing spillover, not the viruses.

Zoom Q&A: It was stated that SARS-COV-2 (as influenza) is a RNA virus of type A animal but the WHO investigating team of COVID-19 stated clearly that it is unlikely that it originated from bats. Can you confirm that it is a type A animal and which animal is it coming from?

Response, Prof. Jeffrey Mphahlele: My take is that SARS-CoV-2 originated from animals, but we may not know the source. However there are many genetic similarities of SARS-CoV-2 with related viruses in animals, especially bats and pangolins. Other sources are of course possible and investigations are ongoing.

Zoom Q&A: What is your view in terms of reducing risk associated with vaccination program if the vaccination manufacturing program has bypassed the pre-clinical stage of laboratory test (animal test) but going straight to human being?

Response, Prof. Jeffrey Mphahlele: It will be unethical to test a vaccine in humans before testing for safety at pre-clinical stage.

Zoom Q&A: If vaccination is the way forward in dealing with pandemic, why is it that to date there is not a vaccine against HIV? Can we also predict the failure of past HIV vaccine tests into current COVID-vaccine?

Zoom Q&A: What environmental conditions cause the SARS-CoV2 virus to break down to viral RNA strands?

Response, Prof. Lucia Anelich: Besides known disinfectants and detergents, ultraviolet (UV) light, particularly UV-C, as well as high-ish heat can be used, but atmospheric high temperatures cannot be relied upon. Sodium hypochlorite (household bleach) at 0.1% for 1 min of exposure also works well for home use.

SESSION 4: EPIDEMICS AMONG ANIMALS, A THREAT TO LIVELIHOODS

CONTROL OF ANIMAL EPIDEMICS IN LIVESTOCK (DR MPHO MAJA, DEPARTMENT OF AGRICULTURE, LAND REFORM AND RURAL DEVELOPMENT (DALRRD))

Animal disease control in the country is governed by the Animal Diseases Act and Regulations, and the legislation applicable to zoonotic diseases transmitted through meat is the Meat Safety Act and Regulations. As a member of the OIE, South Africa complies with international standards laid down by that organisation that relate to controlling animal diseases and trading animals and animal products, as well as the measures to control animal diseases and measures to ensure the commodities are safe to be consumed or traded.

The Animal Diseases Act provides a list of controlled and notifiable diseases. The controlled diseases are generally those that are very trade sensitive and require a collective effort to control. Most of them have prescribed control measures that are stipulated in Table 2 of the Regulations, which are applied when such diseases are reported. Notifiable diseases are that that are generally preventable and individual owners can take measures to prevent their introduction into their herds and flocks. Any disease that is detected in the country but has never been reported is automatically reported as a controlled diseases and the Director has to put control measures in place to contain, eradicate and manage the disease. The list of controlled and notifiable diseases is available of the DALRRD website.

DALRRD has developed contingency plans to deal in general outbreak response. Control measures are adapted to deal with specific disease outbreaks, depending on the relevant epidemiology. The DALRRD's Veterinary Procedural Notices are guidelines aimed at helping provincial authorities in managing diseases and controlling diseases. DALRRD's Standard Operating Procedures serve a similar purpose to the Veterinary Procedural Notices.

In terms of coordination of outbreak response, Veterinary Services is a provincialised function and coordination with the provincial directors is necessary, in particular the director in the province where the outbreak is reported, and with other government departments depending on the type of disease being dealt with. An example is the current outbreak of African swine fever, where DALRRD is working with DEFF concerning the disposal of carcasses in order to prevent further spread of the disease. Another example is the outbreak of Avian Influenza, a zoonotic disease, in 2016/17 when the NDoH was brought to help prevent any zoonotic implications. DALRRD also relies heavily on industry, which play a significant role when it comes to disease control and outbreak response by communicating messages from government to do with the application of and adherence to disease control measures. Government consults industry with regard to improve management and control of animal diseases.

Disease control is a collective effort. Government alone cannot be effective is animal disease control and is reliant on the expertise and experience of farmers, livestock owners and the industry in general.

QUESTION AND ANSWER SESSION

Prof. Wanda Markotter: There are good reporting and data systems for controlled and notifiable diseases. Biosurveillance (from several sources) is reporting on detection of a diversity of pathogens for example in wildlife, not linked to disease (mostly detections of viral nucleic acids only). These detections are important to take note of for future prevention of spillover. Is there a way to centralise this data also so that it is available for the relevant sectors? A lot of this data is with researchers and not publicly available in real-time.

Response, Dr Mpho Maja: It is a good observation that a lot of data is not centrally coordinated. We do try through our epidemiology section to collate the information we have and put it on the central database. We are open to further discussions. I need to raise a flag that detection of nucleic acids in research does not necessarily mean that there is an active outbreak. It could indicate that the animal was vaccinated or has an historic infection that has persisted. This needs to be linked with the clinical picture on the ground – with what the animal owner and Para Vets see being presented. Another point to be mindful of is the fact that some of the diseases are very trade sensitive. We must be careful when it comes to how the information is captured and stored and who it is made available to in order not to disadvantage the industry by putting out the information before it is verified or officially reported.

Prof. Wanda Markotter: I agree that the quality of the data is a problem. In bat research we identify a lot of viruses in the reservoir that is captured anywhere where people can find it easily. It can be a completely separate database that does not have to imply disease. But it is important that some of the data lies in research groups for years, such as sequences related to SARS-CoV-2 that were never reported anywhere (as was the case in China). It would be good to have a national database that government can use, and not in a student thesis that is filed away.

Jansie Niehaus: There was a change in legislation that classified wildlife as livestock. Is that a good thing? What is the purpose of that legislation?

Response, Dr Mpho Maja: I think the intention was to separate the responsibility between agriculture and environmental affairs when it comes to farming and food producing animals. Some wildlife has been migrated to agriculture because there is a potential to use them as a protein source. Wildlife that remains with environmental affairs is governed by conservation legislation. However, any disease is DALRRD animal health division's responsibility. It manages infections and TB in wildlife together with the nature reserves that are involved.

Jansie Niehaus: Could the petting ranches for big cats present a risk in terms of spillover?

Response, Prof. Wanda Markotter: It is very unlikely because the animals are kept in that environment for a long time, and it is as if they are in lockdown. If new animals are introduced and the biosecurity and hygiene is not good, it could present a problem. Overall, there is probably a lower risk than some of the other interfaces.

Michele Miller: How do you manage the presence of a pathogen without the presence of disease?

Response, Dr Mpho Maja: It makes disease control very difficult and I hope that this situation does not present itself frequently in the country. If it is a control disease that needs to be eradicated, we will do further investigations in the surrounding area, and if it is a notifiable disease or not a listed disease, we will just take note and keep an eye on the situation.

Zoom Q&A: When it comes to keeping pets healthy and disease free in many communities there's no access to vets. What is DALRRD's role in that?

Response, Dr Mpho Maja: In the last three to four years, DALRRD has introduced primary animal healthcare as well as compulsory community service for vet graduates. This was in attempt to address the concern about the lack of access to veterinary services. There is only one school that trains veterinarians and about 120 graduates annually. Of these around 100 do community service in South Africa and this does not suffice. A number of welfare organisations provide free or reduced rate services, mainly for pets. With respect to control diseases in pets, rabies comes to mind. Government offers free vaccinations for pets in communities that are regarded as hotspots.

ADVANCES TOWARDS DETECTING AND PREVENTING THE SPREAD OF MULTISPECIES DISEASE – BOVINE TB (DR WYNAND GOOSEN, STELLENBOSCH UNIVERSITY (SUN))

Bovine TB is a chronic disease caused by Mycobacterium bovis, which is a zoonotic infectious pathogen. The Animal TB Research Group at SUN is about improving scientific evidence and takes a multipronged approach to improving knowledge of the epidemiology, pathogenesis and immunology of bovine and other forms of animal tuberculosis. This includes investigating the role of host genetics and immunology in susceptibility to animal TB; the genetic diversity of mycobacterial pathogens and their impact on wildlife and livestock populations, the human animal interface, ecosystems, and the development of diagnostic technology for use in multiple host species, particularly South African wildlife. The work incorporates a continuum of basic to applied research both in the laboratory and field. Specific research areas include the investigation of novel biomarkers of infection and disease in wildlife, cattle and goats, application of knowledge to improve diagnostic algorithms, and understanding comparative immunopathogenesis in different species.

A response to a pandemic should not only be focussed on acute disease but also chronic. TB remains a major global public health threat with an estimated 10 million new cases reported globally in 2019. It is the leading cause of death due to infectious disease in South Africa. About 360 000 people develop the disease every year, with 270 000 of those having HIV and 89 000 deaths per year – roughly 10 people every hour.

Zoonotic TB (zTB) is a form of TB in people predominantly caused by the bacterial species, Mycobacterium bovis, which belongs to the M. tuberculosis complex. The implications of zoonotic TB go beyond human health. The organism is host-adapted to cattle where it is referred to as bovine TB and it also causes TB in other animal species including various species of wildlife. Bovine TB has an important economic impact and threatens livelihoods. zTB is an important disease worldwide with 147 000 new cases of zoonotic TB diagnosed and 12, 500 human deaths in 2016. It has been suggested that Mycobacterium bovis infections may account for as much as 30% of all TB cases in Africa, especially in African countries where unpasteurised milk is consumed and usually miss diagnosed as an infection with M. tuberculosis.

It is not possible to clinically differentiate between infections caused by M. tuberculosis and M. bovis. The most common form of TB in people caused by M. tuberculosis primarily affects the lungs, although up to one-third of cases may be extrapulmonary. zTB in people can also involve the lungs, but it often affects extrapulmonary sites, including lymph nodes and other organs. The most frequently used laboratory procedures for diagnosing TB in people cannot differentiate M. tuberculosis from M. bovis. This means that zTB is under-diagnosed. zTB also poses challenges for effective patient treatment and recovery. M. bovis is naturally resistant to pyrazinamide, one of the four essential medications used in the current standard first-line anti-TB treatment regimen. As most healthcare providers initiate treatment without drug susceptibility testing results, patients with zoonotic TB may receive inadequate treatment. This may lead to poorer treatment outcomes and the development of further resistance to other anti-TB drugs. Resistance to additional drugs has also been detected in some M. bovis isolates, including rifampicin and isoniazid. Resistance to these two essential first-line medications is defined as multidrug-resistant TB (MDR-TB), which poses a major threat to human health globally. As with other zoonotic diseases, zTB cannot be controlled by the human health sector alone. Animal health and food safety sectors must be engaged to address the role of animals in maintaining and transmitting M. bovis.

TB was present throughout Europe in Medieval times and the disease in cattle appeared to be associated with the growing dairy industry by the 15th century. As European settlers migrated to South Africa, they brought their cattle and introduced bovine TB along with the animals. The first recorded case of TB in cattle in South Africa was in 1880. With ongoing importations of livestock from Europe, Australia and South America during the 19th and early 20th centuries, there were probably multiple introductions of this alien disease into the country. The advent of TB testing for imported cattle resulted in the destruction of infected imported cattle and recognition of the significance of the disease. In 1911, South Africa declared bovine TB as one of the first notifiable livestock diseases.

It is important to note that although most cases of TB in wildlife are due to infection with M. bovis, there are a number of organisms in the M. tuberculosis complex that affect a wide range of hosts including humans. No validated tests for ante-mortem detection and differentiation exist. Culture and speciation of these novel pathogens can be difficult. The presence of these members can complicate the diagnosis of M. bovis and may also cause infection in humans. M. bovis has a widest host range, including domestic livestock and certain wild mammals.

The first South African wildlife cases of bovine TB were reported in a greater kudu and a common duiker in the Eastern Cape in 1928. Due to the concern about animal and public health, the Bovine Tuberculosis Eradication Scheme for cattle was implemented in South Africa in 1969. Although not considered a significant issue at the time, sporadic cases of bovine TB continued to be found in wildlife, with the first case in the Kruger National Park (KNP) identified in an impala in 1967. Despite the successful reduction in bovine TB in cattle in South Africa by the early 1990s, a new threat was recognised in wildlife with the report of the disease in African buffalo herds in the southern KNP in 1990.

In KNP, the introduction of Mycobacterium bovis was suspected to have occurred through transmission between infected domestic cattle living on the border of the park and buffalo. The spread of bovine TB to additional wildlife species was documented in the KNP from the early 1990s. Game Reserves in KZN recorded a similar spread of the disease to wildlife. Since the 1990s, additional TB cases in wildlife have been diagnosed on private farms and game reserves in South Africa.

The emergence of TB in wildlife has created significant concern among conservationists, private game and cattle farmers, agriculture regulatory agencies and the public health sector. There are large knowledge gaps regarding the role of different species in perpetuating or amplifying the impact of this chronic pathogen. Although the incubation period of the disease is unknown, wild animals appear to be able to harbour mycobacteria for months and years. As infection progresses, there is evidence that TB may decrease reproductive and other fitness parameters. However, it may not significantly affect population numbers unless the animals experience other stressors. This suggests that infected animals may remain in the population for extended periods confounding control measures for preventing introduction or decreasing transmission of disease, especially in complex ecosystems.

The direct effects of TB on wildlife have been documented. Since chronic infection does not result in large-scale mortality or rapid changes in population structure, the effects on resilience to disease and other stressors may not become apparent for years. TB in some species may lead to high mortality and even to localised extinction of infected groups. In addition to the direct impact on these populations in an ecosystem, these animals are important prey items for other species and their loss may influence predator populations.

The long-term consequences of wildlife TB in South Africa are unknown. A group of experts modelled the impact of bovine TB on lion populations in the KNP in 2009. The simulations covering the next 50 years showed that bovine TB was likely to cause an overall decrease in the lion population before stabilising. This scenario suggests a serious threat to the survival of the species. With diminishing habitats, there are increased wildlife-livestock-human interfaces and a growing threat of infectious disease transmission.

Recognition of zTB as a neglected disease in 2017, has led to the publication of the “Roadmap for Zoonotic TB” (WHO 2017), which states that, “The human burden of disease cannot be reduced without improving standards of food safety and controlling bovine TB in all animal reservoirs. A One Health approach recognises the interdependence of the health of people, animals and the environment, and the engagement of all relevant sectors and disciplines.” The WHO has stated that, “Breaking the chain of transmission at the animal-human interface in places like South Africa requires an interdisciplinary approach involving social and medical sciences to create an innovative strategy for rural areas at risk.
This means addressing the disease not only in communal livestock, but ALL animal hosts including wildlife.” In South Africa, despite the successful reduction in bovine TB in commercial livestock, the prevalence in communal cattle (defined as cattle not restricted to a single property) and other livestock like domestic goats are unknown. Communal livestock often share boundaries and resources with wildlife from areas known to be endemic for Bovine TB and spillover is a consequent risk of this practice. With no current surveillance and compensation program for zTB in these livestock herds, livestock owners have no perceived incentive to test or cull infected animals.

M. bovis infections in animals are considered to be a ‘spillover’ from other species. In contrast, there are species that are ‘maintenance’ hosts for TB, including M. bovis in African buffalo and possibly greater kudu and lions. Maintenance hosts are species in which the infection can persist without introduction from an external source. The presence of multiple susceptible hosts complicates the management and control of TB since the maintenance of infection will be affected by the interactions of different species, variable susceptibility, the influence of environmental factors and the ability of the pathogen to persist in the host and environment.

Research programmes are continually being developed to investigate various aspects of TB in wildlife. One of the key areas is the exploration of the different hosts' immune responses and the development of diagnostic tests, especially for wildlife species. Ongoing projects include identifying ante mortem novel biomarkers of infection and disease, routes of transmission and effects of co-infections, and developing and validating techniques for improved indirect and direct detection of mycobacterial organisms in species such as rhinoceros, African buffalo, lions, warthogs and greater kudu, among others.
Research is crucial to understanding the epidemiology, pathogenesis, risk factors associated with intra- and interspecies transmission and zoonotic potential. Some of the limitations for advancing comprehension of wildlife TB are the lack of resources to conduct studies, including lack of funding, a paucity of validated species-specific tests and logistical challenges and constraints on accessing animals to take samples. There are pitfalls when it comes to treatment and control programmes in South Africa.

With the advent of new techniques and specie-specific tools developed to detect M. bovis infection in wildlife, the understanding of wildlife bovine TB continues to evolve every year. To date, 24 species of wildlife in South Africa have been confirmed to be infected with M. bovis. Over the years, it has become clear that the clinical and pathological presentation of M. bovis varies significantly between species. These observations may also be due to the different routes of interactions between species. Currently in South Africa, control programmes are aimed at reducing transmission between human and animals, predominantly based on test and slaughter programmes of all infected animals. This approach has a negative economic and social impact on animal owners and leads to international trade restrictions and negatively impacts conservation progammes for wildlife aimed at improving biodiversity. With this in mind, TB cannot be controlled if TB testing is only implemented for some species. TB control programmes have been effective in terms of reducing disease in some countries, but this has been very costly and required political and stakeholder buy-in, as well as constant, ongoing surveillance to maintain control of the disease.

From the Animal TB Research Group's experience of Bovine TB in South Africa, improved prevention of the spread of animal diseases will require continued generation of scientific evidence, strengthening of sectoral and collaborative approaches (government should work with research groups rather than against them), continuous stakeholder engagement, increased public awareness and co-development of guidelines and policies that lead to action. Evidence-based priorities for addressing TB across all hosts tailored to the needs of specific countries are essential.

QUESTION AND ANSWER SESSION

Andries Very: Is there any faster TB test on the horizon for cattle, like in humans, because the current bovine TB test takes 3 days for a diagnosis?

Response, Dr Wynand Goosen: The main aim of our research group (based at human medical faculty) is to repurpose and develop tests based on what is available for human TB patients. A lot of my research in the last 2 years has been around improvising the human gene Xpert MTB/RIF® diagnostic to try to improve the detection of the detection of Mycobacteria TN complex members. We are battling to get those approved by the OIE and recognised by DAFF so that we can start increasing the research in that area to show efficacy and to further enhance the research. We are currently 20 to 40 years behind the human TB research in terms of diagnostics.

Gordon Branston: Is there an added threat with the COVID-19 pandemic occurring in wildlife and the ongoing TB infection nexus in animals affected with TB, and the threat of COVID-19 in wildlife animals? Has research been carried out in this area of interest and potential impact?

Response, Dr Wynand Goosen: It is still early to respond to this. There is no answer to this question yet. We have been screening bat samples with the technology we have for COVID-19 and available for humans. Tests need to be tailored for specific species.

Michelle Muller: COVID has been diagnosed in captive wildlife in a number of zoos and for instance in the mink industry in multiple countries.

Debbie Schultz: Dr Goosen mentioned that government needs to work with research groups and not against them. How can government do better in terms of working with research groups, and how has government worked against these groups?

Response, Dr Wynand Goosen: This is a sensitive topic for me as a scientist, the bottlenecks in information flow (research data) are very evident to me. As Prof. Markotter pointed out, important data that could be used to prevent the next pandemic is stuck with researchers. It is not accessible to other researchers, stakeholders and decision-makers. Crucial information is not reaching the people who need it. The situation needs to be improved.

Responses, Dr Mpho Maja:

- Unfortunately, DALRRD has had to introduce and tighten its controls around research in the last few years. This was a very painful exercise for everyone because we were still learning what to look out for. Section 20 of the Animals Diseases Act indicates that any research involving animals or animals pathogens conducted in the country needs to be done under permission of the Director. The risk that the research poses to the country is considered before permission is given. Research has sometimes failed to understand this. I apologise for the frustration this has caused. It is unfortunately very necessary for the country.
- The epidemiology unknit at DALRRD was very sympathetic with its medical counterparts when COVID-19 started because from the veterinary perspective, the disease would have been dealt with quickly by culling the infected animals.
- With regard to the frustration concerning TB diagnosis, we welcome all the research and development on alternative diagnostics. The current TB testing is very subjective. It depends on the tester and not much on the presence of absence of a disease. Misdiagnoses can happen. Dr Goosen is invited to discuss the work done by the research group with us to see what could be approved by the Director as a diagnostic tool for TB.

Responses, Dr Wynand Goosen:

- With regard to Section 20, the system definitely works and is useful. It must continue to be implemented and enforced.
- In terms of technology available, TB testing in humans started decades ago using purified protein derivatives as a skin test, waiting 72 hours to observe inflammatory response. Until today, this test is used in animals. The human industry has started bringing out different technologies (such as a blood based test using peptites specifically for M.TB and M. bovis). To get this test to a level where it can be implemented in South Africa has been a challenge. I will gladly discuss our data from the last 20 years about this test with Dr Maja in order to further its use in the country.

Debbie Schultz: It is not clear what research needs to be done in terms of creating a database. Why is there not a general database with the results of all research projects dealing with a certain area? Can such a database be developed?

Response, Dr Mpho Maja: There is no central database for all of the information. I am not sure that DALRRD has the capacity to do this. The department welcomes any suggestions in this regard. Public consultation will be necessary because some people would not want their information to be captures in a central database. It is indeed very important to know what research is being done and what the results of that research are. Certain reports and incidents need to be flagged for the record and for decision-making processes. This should be tabled to be addressed outside of this meeting.

Response, Dr Wynand Goosen: The major area where we need to work together is output management and data sharing. Human researchers at medical faculties have specific teams to do this work, to improve knowledge transfer amongst clinicians. These teams can be exploited for animal research to enhance surveillance of specific diseases in South Africa.

Zoom Q&A: With the current biosecurity associated with research laboratories, isn't the risk of research causing a disease outbreak very low? Can we use the example of other countries?

Response, Dr Mpho Maja: This cannot be done. The audits of the laboratory team's work show that 95% of research and researchers have no understanding and appreciation of biosecurity and the risk this presents to the country. However, if there are easier ways to audit and evaluate the biosecurity measures at different research laboratories, then this would help. DALRRD only has three people to do this work and it is difficult to audit all the laboratories. Any suggestions and comments can be sent to epidemiology@DALRRD.gov.za.

Zoom Q&A: How can animal owners and veterinarians send samples around the country without the same requirements as researchers?

Response, Dr Mpho Maja: One should be reminded that outbreak of foot and mouth disease in the UK around 2000 was a result of a virus escaping from the laboratory. A laboratory is a higher risk because of the activities that take place there. Many samples are handled and there is a very high viral load. There is a higher chance of a virus escaping from a laboratory.

Gordon Branston: In human populations the strategy of antibiotic resistance is high on the agenda and has become the silent pandemic of antibiotic resistance. Is the use of antibiotics in animals a similar threat in terms of preventing the spread of multispecies disease and if so what is the future strategy?

Response, Dr Mpho Maja: Anti-microbic resistance has become an important global discussion point. The use of antimicrobials in animals has also been flagged because most of the animals are used for human consumption. Global and local discussions on resistance need to be enhanced and more surveillance needs to be done to see where the problems emanate from, and how best to address them to prevent further mutations and resistance.

CLOSING

The knowledge and information that was exchanged during the forum would be widely disseminated. A media release highlighting the main issues discussed will be published and proceedings of the forum will be produced as outcomes of this discussion forum. The presentations and recordings of the two days' proceedings would be available on the NSTF website.

Ms Niehaus thanked all the presenters for their time and effort, and the valuable insights they shared, and all attendees for their participation in the forum.

ANNEXURE A: ATTENDANCE

Title	Name	Surname	Organisation Name
Mr	Evariste	Umba-Tsumbu	4IR Yako Consulting Services
Mrs	Deirdre	Lawrence	AEC - Amersham SOC LTD
Prof.	Nceba	Gqaleni	AHRI
Prof.	Lucia	Anelich	Anelich Consulting; and Central University of Technology (CUT)
Mr	Thabiso	Mudau	ARC
Ms	Tebogo	Habedi	ArcelorMittal Science Centre
Ms	Yamkela	Nomnganga	Cape Peninsula University of Technology (CPUT)
Dr	Yogan	Pillay	CHAI
Dr	Mpho	Maja	DALRRD
Mr	Mathala	Mokwele	DALRRD
Ms	Patience	Mphumbude	DALRRD
Mr	Victor	Twala	DALRRD
Mr	Andries	Vrey	DALRRD
Mrs	Jennifer	Ricketts	Deli Spices (Pty) Ltd
Mr	Marius	Vrey	Department of Agriculture
Dr	Kiruben	Naicker	DEFF
Miss	Vutivi Judith	Vukeya	DEFF
Mr	Xolani	Shange	Department of Higher Education and Training (DHET)
Mr	Ben	Durham	DSI
Ms	Glaudina	Loots	DSI
Miss	Sandra	Carminati	Ecopath
Ms	Lerina	van Zyl	Ecowize (Pty) Ltd
Prof.	Julian	Kinderlerer	European Commission
Mr	Nathan	Craig	Independent Media
Dr	Lungile	Shoba-Zikhali	Inkazimulo Yenkosi Empowerment (Pty) Ltd
Miss	Pride	Gumede	Just Flour Mills
Mr	Teddy	Mnisi	Limpopo Department Agriculture and Rural Development
Ms	Nicky	Belseck	Medical Chronicle
Dr	Wayne	Ramkrishna	NDoH
Mrs	Moyahabo	Manganyi	National Metrology Institute of South Africa (NMISA)
Mrs	Maphuti	Kutu	National Regulator for Compulsory Specifications(NRCS)
Mrs	Rebaone	Mokate	South African Nuclear Energy Corporation (Necsa)
Ms	Zahna	Steynberg	Necsa
Dr	Kerrigan	McCarthy	NICD
Mrs	Sophie	Vrard	PAAZA (Pan-African Association of Zoos and Aquaria)
Mr	Wayne	Barnes	PerkinElmer
Miss	Seshnee	Pillay	PerkinElmer
Dr	Ian	Espie	Private

Title	Name	Surname	Organisation Name
Mrs	Barbara	Jay	Private
	Nthabiseng	Madisha	Private
	Nicole	McCain	Private
	Maanda	Mudau	Private
Dr	Guy	Preston	Private
Dr	Esper	Ncube	Rand Water
Mr	Gordon	Branston	Royal Environmental Health Institute of Scotland
Miss	Jesse	Kelfkens	South African Association for Food Science and Technology (SAAFoST)
Dr	Gerda	Botha	South African Council for Natural Scientific Professions (SACNASP)
Ms	Naledzani	Mudau	SANSA
Dr	Lyn	Hanmer	SAMRC
Prof.	Jeffrey	Mphahlele	SAMRC
Prof.	Martha	Van der Walt	SAMRC
Miss	Aziza	Kharwa	Self-employed
Mrs	Karen	Beyer	Sovereignfoods
Dr	Wynand	Goosen	SUN
Dr	Tanya	Kerr	SUN
Dr	Leanie	Kleynhans	SUN
Prof.	Michele	Miller	SUN
Dr	Peter	Johnston	UCT
Dr	Sandiswa	Mbewana	UCT
Mr	Fungai	Musaigwa	UCT
Prof.	Edward	Rybicki	UCT
Dr	Sheetal	Silal	UCT
Dr	Patrick Ehi	Imoisili	University of Johannesburg (UJ)
Dr	Hafizah	Chenia	UKZN
Miss	Michelle	Adams	UP
Miss	Simone	Bence	UP
Miss	Christelle	Botma	UP
Prof.	Stephanie	Burton	UP
Dr	Low	de Vries	UP
Dr	Marike	Geldenhuys	UP
Mr	Colyn	Grobler	UP
Miss	Caitlin	MacIntyre	UP
Prof.	Wanda	Markotter	UP
Prof.	Walter	Meyer	UP
Miss	Dineo	Molewa	UP
Miss	Retshedisitswe	Mollo	UP
Dr	Marinda	Mortlock	UP

Title	Name	Surname	Organisation Name
Mr	Tauya	Muvengi	UP
Miss	Carla	Nel	UP
Mr	Tedson	Nkoana	UP
Mrs	Thrishantha	Pillay	UP
Ms	Rochelle	Rademan	UP
Prof.	Vanessa	Steenkamp	UP
Mrs	Erika	Strydom	UP
Miss	Megan	Van Der Merwe	UP
Miss	Mine	Van der Walt	UP
Mr	Sheldon Arno	Viviers	UP
Mr	Matthew	Wood	UP
Mr	Jay	Bhagwan	WRC
Dr	Mamohloding	Tlhagale	WRC
Staff and Service Providers			
Ms	Debbie	Schultz	Alphabet Soup
Ms	Jansie	Niehaus	NSTF
Ms	Wilna	Eksteen	NSTF
Miss	Gabriela	Mankune	NSTF
Mrs	Mosima	Kgwele	NSTF
Miss	Itumeleng	Ndlovu	NSTF
Ms	Jane	Mokgwatshane	NSTF
Ms	Heather	Erasmus	Write Connection CC

ANNEXURE B: LIST OF ACRONYMS

AHRI	African Health Research Institute
AIDS	Acquired Immune Deficiency Syndrome
AU	African Union
CDC	Centres for Disease Control and Prevention
CHAI	Clinton Health Access Initiative
COVID-19	Coronavirus disease of 2019
CSIR	Council for Scientific and Industrial Research
CUT	Central University of Technology
DALRRD	Department of Agriculture, Land Reform and Rural Development
DEFF	Department of Environment, Forestry and Fisheries
DSI	Department of Science and Innovation
EOC	Emergency Operations Centre
FAO	Food and Agriculture Organisation (of the United Nations)
FDA	Food and Drug Administration
GI	Gastrointestinal
GLOPID-R	Global Research Collaboration for Infectious Disease Preparedness
HIV	Human Immunodeficiency Virus
HSRC	Human Sciences Research Council
IHR	International Health Regulations
IKS	Indigenous Knowledge Systems
IMS	Incident Management System
IPBES	Intergovernmental Platform of Biodiversity and Ecosystem Services
J&J	Johnson & Johnson
JEE	Joint External Evaluation
KNP	Kruger National Park
KRISP	KZN Research Innovation and Sequencing Platform
KZN	KwaZulu-Natal
MAC	Ministerial Advisory Committee
MERS	Middle East Respiratory Syndrome
MNORT	Multi-Sectoral National Outbreak Response Team
NATJOC	National Joint Operations Committee
NCC	National Command Council
NCD	non-communicable disease
NDoH	National Department of Health
Necsa	South African Nuclear Energy Corporation
NGO	Non-governmental organisation
NGS-SA	Network for Genomic Surveillance in South Africa
NHC	National Health Council
NHLS	National Health Laboratory Service
NICD	National Institute of Communicable Diseases
NMC	Notifiable Medical Conditions
NPI	Non-pharmaceutical interventions
NSTF	National Science and Technology Forum
OIE	World Organisation for Animal Health (known as OIE in French)
PHEIC	Public Health Event of International Concern
PHEIC	Public Health Event of International Concern
PPE	Personal Protective Equipment
R&D	Research and Development
RCCE	Risk Communications and Community Engagement
RNA	Ribonucleic acid
SACMC	South African COVID-19 Modelling Consortium
SADC	Southern African Development Community
SAHPRA	South African Health Products Regulatory Authority
SAMRC	South African Medical Research Council

SANSA	South African National Space Agency
SARS	Severe Acute Respiratory Syndrome
SARS-CoV-2	Severe Acute Respiratory Syndrome Coronavirus 2
StatsSA	Statistics South Africa
SUN	Stellenbosch University
TB	Tuberculosis
THP	Traditional Health Practitioner
UCT	University of Cape Town
UKZN	University of Kwazulu-Natal
UP	University of Pretoria
UV	Ultraviolet
WBE	Wastewater-Based Epidemiology
WHO	World Health Organisation
WRC	Water Research Commission
zTB	Zoonotic TB