

CDC

Science, Technology and Innovation take on COVID-19

The first National COVID-19 Conference, which took place via the Zoom online platform on 31 July 2020, showcased the variety of ways in which science, technology and innovation are being harnessed for South Africa's response to the disease.

The conference, which lasted a little under six hours, began with an opening session of addresses by various dignitaries, including President Cyril Ramaphosa (delivered on his behalf by Dr Blade Nzimande), three government Ministers and the Director-General of the World Health Organisation (WHO), Dr Tedros Adhanom Ghebreyesus. This was followed by three panel sessions with experts and leaders presenting on health research – including innovations in therapeutics, diagnostics, testing and tracking – data modelling and analysis, and economy and social recovery.

During his opening address, Minister of Higher Education, Science and Innovation, Dr Blade Nzimande, gave an overview of the initiatives being fast-tracked by the

Department of Science and Innovation (DSI) to support the government's response to the COVID-19 crisis. These initiatives include the following.

Deploying DSI-funded infrastructure to expand testing for COVID-19

For example, the Centre for Proteomic and Genomic Research – a non-profit organisation based in Cape Town – has validated various testing protocols and undertaken risk assessments according to WHO guidelines, and will install a laboratory information management system as required by the National Health Laboratory Services (NHLS). The KwaZulu-Natal Research Innovation and Sequencing Platform (KRISP), in partnership with the Centre of AIDS Programme for Research in South Africa (CAPRISA) and the Africa Health Research Institute, have validated the quantitative polymerase chain reaction (qPCR) and sequencing protocols from two manufacturers for COVID-19 testing. In addition, the Council for Scientific



KRISP

The KwaZulu-Natal Research Innovation and Sequencing Platform (KRISP) started performing qPCR testing with CAPRISA in March as part of a sentinel population cohort to determine when SARS-CoV-2 infections were first seen in South Africa. In July it tested thousands of samples to help clear the NHLS qPCR backlog. KRISP also began whole genome sequencing of the virus in April, and by the end of August had sequenced over 1 000 genomes. These and other KRISP initiatives are detailed in a news item and video called 'How a team of scientists worked tirelessly to help the COVID-19 response in Africa' on the KRISP webpage: <https://www.krisp.org.za/covidnews.php>.

and Industrial Research (CSIR) labs were repurposed to do testing in support of government's drive for a massive roll-out of testing.

Biomanufacturing of molecular biology enzymes, reagents and testing kits

Local supplies of reagents and kits for COVID-19 testing are being developed through DSI-funded spin-out companies, centres of excellence, and various other programmes and initiatives to ensure security of supply, local manufacturing, and the creation and preservation of jobs. At the time of the conference, this work was at the South African Health Products Regulatory Authority (SAHPRA) accreditation stage, although approval had already been granted in some cases, with certain products having been ready for use in May.



Prior to lockdown, chemists at InnoVenton – Downstream Chemicals Technology Station at Nelson Mandela University had produced a first batch of 2 000 litres of sanitiser for the campus community. A further 1 500 litres were produced once more raw material was sourced. A service was subsequently offered to test the percentage alcohol content in hand sanitiser for other producers. By 20 August InnoVenton had produced almost 14 000 litres of hand sanitiser and had conducted 62 analytical tests for 21 different customers.



Prof. Ed Rybicki heads the University of Cape Town's Biopharming Research Unit (BRU), which has been awarded funding for a project to develop reagents for COVID-19 rapid test kits. The process relies on RNA made in plants using the BRU's proprietary plant virus-derived expression systems.

Developing personal protective equipment (PPE)

In the first month of lockdown, the Product Development Technology Station at the Central University of Technology (CUT) produced two prototypes of a reusable mask that forms a tight seal around the mouth and nose, making it suitable for clinicians working in the 'hot zone', such as when intubating or suctioning a COVID-19 patient. The eNtsa innovation hub at Nelson Mandela University (NMU) is using additive manufacturing (3D printing) for face shield frame design and printing modifications to enable clinicians to easily replace standard A4 transparent sheets without the need for holes and adhesives. The designs had been made available through open-source networks.

Supporting good hygiene practice

Many of the universities have been producing hand sanitiser, with some starting even before lockdown began. By 20 March, for example, the Technology Station in Chemicals at Tshwane University of Technology (TUT) had distributed the first 1 500 units of 15 ml bottles for individual use to TUT campuses. On the same day, production began at Rhodes University's Faculty of Pharmacy, which subsequently distributed thousands of litres to hospitals and other care facilities in the Eastern Cape, and also taught staff of organisations working in rural communities how to make sanitiser.

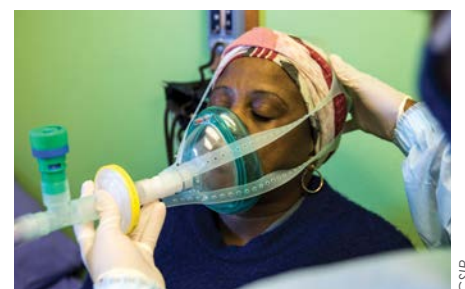
Coordinating efforts for a local COVID-19 vaccine manufacturing plant

The DSI has convened a COVID-19 Vaccine Production Task Team that includes the Technology Innovation Agency (TIA), the Department of Trade, Industry and Competition (DTIC), the South African Medical Research Council (SAMRC), academia as well as local vaccine and adjuvant manufacturers Biovac (which is 47.5% government-owned) and Afrigen (which has Industrial Development Corporation investment). The aim is to get South Africa into a state of readiness to manufacture an approved COVID-19 vaccine locally.

Providing technical support for the National Ventilator Project

The National Ventilator Project (NVP) was set up to coordinate and secure a supply of locally manufactured ventilators. The Solidarity Fund approved R250 million for the production of 20 000 non-invasive ventilators. Four potential suppliers were selected, including the CSIR, which was contracted to manufacture 10 000 non-invasive CPAP ventilators.

The CSIR-supplied ventilator is a CPAP – a Continuous Positive Airway Pressure device. It provides a mild level of oxygenated air pressure to keep the airways open, which assists with breathing.





CSIR

The CSIR LIFE (Lung Inspiratory Flow Enabler) CPAP ventilator was designed and produced by the CSIR in collaboration with a number of industry and manufacturing partners, with testing conducted at UCT's Medical Devices Laboratory to obtain approval and licensing by the South African Health Products Regulatory Authority (SAHPRA).

The National Ventilator Project

During the conference, more detail on the National Ventilator Project was provided by Minister of Trade and Industry, Ebrahim Patel. He explained that under normal circumstances hospitals have an adequate supply of imported ventilators, which are used to supply oxygen to the lungs of severely ill patients. The ventilators range from ambu-bag resuscitators and nasal cannulas to non-invasive Continuous Positive Airway Pressure devices – known as CPAPs – and invasive ventilating machines. Of course, demand for ventilators soared worldwide in the first quarter of the year, due to the COVID-19 pandemic.

“In April this year, hospitals reported that they were unable to source ventilators on global markets. Minister Nzimande and I then decided to initiate the National Ventilator Project,” he said. “We appointed one of our top agencies, the South African Radio Astronomy Organisation (SARAO), to serve as project managers, given their world-class systems integration and systems engineering capabilities. These same scientists and engineers had delivered some of the technologies for the Square Kilometre Array project in the Northern Cape – the world’s largest radio telescope project with the power to peer deep into the cosmos and to shed light on the mysteries of the universe.”

A national call was put out, inviting proposals for the development and manufacture of CPAPS, as critical-

care physicians had advised that these had the greatest potential impact on saving lives.

“The response we received was phenomenal. Nearly 100 individual proposals were received,” continued Minister Patel. “These were thoroughly evaluated by the engineers and scientists at SARAO to ensure compliance with international standards for ventilators, usability in our hospitals and medical facilities, and to fully leverage South African manufacturing expertise. We needed a machine that could be used as easily in a private hospital in Sandton as in a field hospital in the Eastern Cape.”

Prototypes of the most promising proposals were built and tested, first in the laboratory and then in a hospital, to ensure compliance with the stringent requirements of the South African Health Products Regulatory Authority (SAHPRA). Funding was obtained from the Solidarity Fund, which was created in March as a donation platform for South African citizens and businesses to assist in addressing the challenges of the COVID-19 crisis.

- On 24 August, 36 ventilators were delivered to Charlotte Maxeke Academic Hospital in Johannesburg. These were part of the first batch that would be distributed to 60 hospitals countrywide. By mid-September, some 4 000 units had been delivered, at a cost of about R12 500 each.

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