

# The Centre for Tuberculosis: from reference laboratory to public health institution

## Background

Tuberculosis (TB) continues to be one of the biggest public health challenges of our time, and as epidemiology of the disease evolves in an era of high HIV prevalence in South Africa, so must the response. With exciting developments in diagnostics, treatment options and vaccine candidates at various stages of development, South Africa needs a centre that can synthesise all these options and advise government on preventing TB transmission and caring for those infected. The new Centre for Tuberculosis (CTB) of the National Institute for Communicable Diseases (NICD) is well placed to provide this service for the South African government and people.

To provide some historical context, with the reorganisation of diagnostic laboratory services for the public sector, the running of these services by the now defunct South African Institute for Medical Research (SAIMR) was rationalised in the late 1990s, and resulted in the creation of the National Health Laboratory Service (NHLS). The NICD, founded in the early 2000s, incorporated the NHLS reference laboratories as well as the surveillance activities of these laboratories which were expanded to become increasingly technology-development and intervention driven. A major deficiency at the time was the lack in South Africa of a TB reference laboratory and, after careful planning, the newly established National Tuberculosis Reference Laboratory (NTBRL) started its activities in 2006 and moved into an iconic new building in Sandringham in 2010.

## The National Tuberculosis Reference Laboratory

A major function of the NTBRL was to support the National TB Control Programme (NTBCP) of the National Department of Health (NDoH), by expanding TB diagnostic and treatment monitoring services within the NHLS. These activities included microscopy for acid-fast bacilli, TB culture and drug susceptibility testing, as well as new technologies for rapid TB diagnosis. Related functions of the NTBRL were to serve as a resource in the field of TB laboratory diagnostics and develop a monitoring facility to ensure a high standard of diagnostic services country wide. High priorities were to evaluate state-of-the-art technology, to assess the performance of newly introduced molecular-based line probe assays (LPAs) for the rapid diagnosis of TB and early detection of drug resistance, and to establish training programmes covering new technologies for staff.

## The Centre for Tuberculosis

Earlier this year, the NICD was restructured into seven centres and two divisions. The CTB is one of these, and aims at expanding reference laboratory functions and espousing a broader public health agenda. The CTB will serve the needs of the NHLS, the NDoH and, ultimately, the general public of South Africa and, in addition, will provide technical support for the neighbouring SADC countries. The expanded support functions of the CTB relate to policy guidelines and knowledge management, outbreak response and education and training. The core functions are the establishment of an expanded TB reference facility, conducting public health surveillance and population-based research, and fostering innovative thinking leading to the introduction of novel approaches to TB diagnostics and management.

## Reference laboratory

Reference laboratory activities of the CTB include providing specialist diagnostic services on TB patient management, including the evaluation of novel methods and, in special cases, their introduction into the NTBCP. The CTB will also make available real-time laboratory information of epidemiological importance to the NDoH and World Health Organization (WHO). Such information will include data on circulating strains, providing insights into TB transmission dynamics and drug-resistant TB. Linked to these activities is the establishment of routine genotyping and MIC testing, and the development of a specimen bank and a repository of well-characterised TB strains from geographical locations in South Africa, as well as international reference strains. The CTB is well placed to assist with policy development and standardisation of diagnostic methods. In this regard, the CTB is playing an important supporting role in the implementation of new diagnostic methods into TB management in South Africa. Together with the NTBRL, the CTB was instrumental in the integration of reverse hybridisation-based LPAs and, more recently, the national roll-out of GeneXpert technology for rapid TB diagnosis and drug resistance detection. An important function of the CTB is to support the quality assurance of TB diagnostics and training activities nationally, and to provide technical support to SADC countries.

## Public health surveillance

The new CTB will have a major public health emphasis,

and will collect clinical and demographic data in addition to traditional microbiological data. TB public health surveillance is an important component of CTB activities, and is being conducted at four levels:

- Ad hoc population-based surveys, such as the nationwide Drug Resistance Survey (DRS) presently conducted by the CTB and the NDoH as part of the Global Project on Anti-Tuberculosis Drug Resistance Surveillance of WHO and International Union Against Tuberculosis and Lung Disease. It is the second survey to be conducted in South Africa, the previous one taking place in 2000-2001. An estimated 170 000 TB suspects will be enrolled into the present survey in 349 clusters of one to four healthcare facilities each, randomly selected to be representative of South Africa and its provinces. Recruitment of patients will take place over a period of one year in each province, and will be linked to service delivery to minimise disruption of the patients' clinical management. Data from the survey will enable the NTBCP to evaluate the quality of TB control, and provide information for planning and budgeting.
- The utilisation of two ongoing surveillance networks of the NICD. The first, the Group for Enteric, Respiratory and Meningeal Disease Surveillance in South Africa (GERMS-SA), will conduct enhanced surveillance of rifampicin-resistant TB in South Africa. The other, the Severe Acute Respiratory Infections (SARI) surveillance network, will assess the contribution of TB to episodes of severe respiratory illness in the country.
- The generation of surveillance information by the NHLS Corporate Data Warehouse (CDW) and the NDoH electronic TB registers for TB prevalence and drug-resistant TB, generated by facilities around the country.
- Laboratory-based surveillance, including information on strain characterisation and molecular epidemiology showing clustering on DNA fingerprinting.

## Population research

Population research priorities of the CTB include utilisation of surveillance and microbiological data, e.g. on the distribution and frequency of drug-resistant strains from TB laboratories in order to design and implement research relevant to TB in South Africa. It is envisaged that the CTB will collate, summarise and disseminate published research on TB to stakeholders in South Africa. Valuable information on laboratory-confirmed TB cases and their drug-resistance status is available through the CDW and, following deduplication of cases, is employed to determine emerging trends in TB strain distribution, particularly those with multidrug-resistant (MDR) and extremely drug-resistant (XDR) status. The CTB will collaborate with academic centres and international institutions on nationally relevant research involving CDW-generated information.

The use of DNA fingerprinting techniques, including spoligotyping, mycobacterial interspersed repetitive unit-variable-number tandem repeat analysis (MIRU-VNTR) and IS6110-based restriction fragment length polymorphism

(RFLP) typing in ongoing surveillance and cluster analysis, provides information on circulating strains including those with MDR and XDR status, and enables detection of TB outbreaks. These activities identify the CTB as a national resource for its role in outbreak response, including management of contacts and the formulation of prevention strategies.

## Innovation and development

Innovation is essential for the containment of an epidemic that has plagued humankind for thousands of years. Great strides have been made, both in the diagnostic and drug-development fields and the CTB will focus on new technologies and novel strategies, and assess their best utility in the South African context. This focus will draw on the strengths within the academic institutions, to ensure that the research conducted is translated into addressing programmatic needs of the country. Linked to innovation is the human capital that is the driver of this process. The CTB is playing an increasingly important role in supporting NDoH training programmes, including the development of training materials on diagnostic technologies and participation in skills transfer and capacity building. The Centre also collaborates with the CDC-initiated African Centre for Integrated Learning (ACILT) and the Field Epidemiology and Laboratory Training Program (FELTP) hosted at the NICD. The CTB is also involved in the training of registrars and postgraduate and undergraduate medical and science students in South Africa and, in addition, accommodates projects for master's degree and PhD students supervised by staff with academic affiliations to medical schools.

## Conclusion

The shift in the way the CTB functions, to become increasingly public health oriented, is in progress and is already well advanced. It is anticipated that the new centre will grow to provide the evidence needed to guide South Africa's response to the TB epidemic and evaluate the impact of its control measures.

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