

Test-Trace strategy for disease control and management:

South Africa's control measures to contain the spread of COVID-19

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Contact tracing, in conjunction with robust screening, testing and surveillance systems, is central to disrupting the COVID-19 disease transmission chain and controlling infectious disease outbreaks in the population.

This chapter provides a critical examination of South Africa's COVID-19 testing and contact tracing response, including emerging successes and weaknesses.

Lessons emerging from South Africa's COVID-19 testing and contact tracing strategy highlight the importance of rapid roll-out of community screening and testing across the country, robust implementation of public health measures, and leveraging existing healthcare services such as the deployment of existing Community Health Workers.

The absence of a standardised national information system to support contact tracing efforts, long turnaround times and backlogs in testing, and low uptake of digital solutions such as the COVIDConnect and COVID Alert Apps, were noted as some of the challenges of the process.

New considerations to take into account in planning for any future outbreaks include ways to enhance intersectoral approaches and integrate with other community surveillance systems, how to rationalise health workforce redistribution during surge periods by prioritising cases, and the use of technology solutions to manage data.

Introduction

Coronavirus disease 2019 (COVID-19), caused by the SARS-CoV-2 virus, was first identified as an emerging infectious disease in December 2019 in Wuhan China, then rapidly spread globally within weeks and resulted in an uncontrolled infectious pandemic.¹⁻³ COVID-19 is transmitted through respiratory droplets and exposure occurs in three principal ways: inhalation of very fine respiratory droplets and aerosol particles; deposition of respiratory droplets and particles on exposed mucous membranes in the mouth, nose, or eye by direct splashes and sprays; and touching mucous membranes with hands that have been soiled either directly by virus-containing respiratory fluids or indirectly by touching surfaces with virus on them.^{4,5} Public health interventions (PHI) to decrease transmission were implemented, aimed at reducing the mode and rate of viral transmission. These PHIs included mask-wearing, maintaining physical distance, and frequent hand-washing or use of hand-sanitiser. Persons under investigation and those who tested positive were advised to isolate or self-quarantine to prevent further transmission.

South Africa's first confirmed case was identified on 5 March 2020 from a traveller who had returned from Italy.⁶ However, transmission rapidly took place among people with no travel history, and clusters of cases were reported, rapidly followed by community transmission. The first case of community transmission in South Africa prompted government to take decisive early actions. President Cyril Ramaphosa announced a National State of Disaster, in terms of Section 27(5)(c) of the Disaster Management Act (57 of 2002) on 15 March 2020, and a series of risk-adjusted strategies and restrictions, along with a nationwide lockdown.⁶

Like other countries, South Africa followed guidance from the World Health Organization (WHO) by swiftly implementing a 'test, trace and isolate strategy' as a method to control the COVID-19 outbreak.⁷⁻¹⁰ The core elements of contact tracing entail the process of identifying, assessing and managing people who have been exposed to a disease to prevent onward transmission. Contact tracing is not unique to the COVID-19 pandemic. It has been used extensively in previous infectious diseases outbreaks and epidemics such as Ebola and tuberculosis.¹¹

This chapter provides an analysis of South Africa's contact tracing strategy as a key mechanism for interrupting chains of transmission of SARS-CoV-2 and reducing COVID-19-associated mortality.

For this study, the core building blocks for strengthening health systems were used to articulate the contact tracing strategies and operations used. The rapid review was guided by the question: what have we learnt from South Africa's initial test and trace strategy for reducing COVID-19 transmission in the general population?

Methodology

A case study methodology which investigates a real-life phenomenon was applied. The phenomenon investigated is the implementation of test-trace strategies for the control of COVID-19 in South Africa.

To complete the case study, the contact tracing structure and its implementation in South Africa are investigated. The data used to complete the case study include a review of published COVID-19 case-investigation and contact-tracing models was conducted. Research articles and reviews on the use of contact tracing, testing, self-isolation and quarantine (TTI) for COVID-19 management published in English within one year (January 2020 to 28 May 2021) were eligible for review. Academic and grey literature to describe the testing and contact tracing approaches to reduce COVID-19 that were implemented in South Africa were reviewed. This involved targeted and interactive searches of existing COVID-19 repositories, bibliographic database/search engines such as MEDLINE and Google Scholar, and websites of key organisations, including South African Ministry of Health, its agencies such as the NICD and NHLS, and the World Health Organization.

The limitation of this review is that interviews with local experts were not conducted to provide further insights into some of the contextual factors and stakeholder perspectives. Furthermore, given the dynamic and ever-changing nature of the COVID-19 pandemic, there is a possibility that information may have changed since the time of writing.

The proposed benefit of the study is to provide an analysis of good practice for strengthening of health systems, rather than an exhaustive review.

Key findings

Structure of the contact-tracing approach in South Africa

South Africa used a combination of a centralised and decentralised approach by implementing contact tracing at provincial, district and community levels (Figure 1). In this context, government mobilised dedicated staff members who were placed in each of the country's 52 health districts and assigned responsibility for tracking and tracing of contacts by calling all the close contacts of those known to be infected with COVID-19 and collecting information on signs and symptoms.

South Africa's contact-tracing approach consists of manual contact tracing – mobile phones, bulk short-messaging-system (SMS) and household visits – and digital tools such as the COVIDConnect and COVID Alert Apps. However, one of the main challenges inherent in manual contact tracing is that it relies on human memory, and most people are not able to identify those with whom they have been in contact beyond their close contacts in their household or workplace.

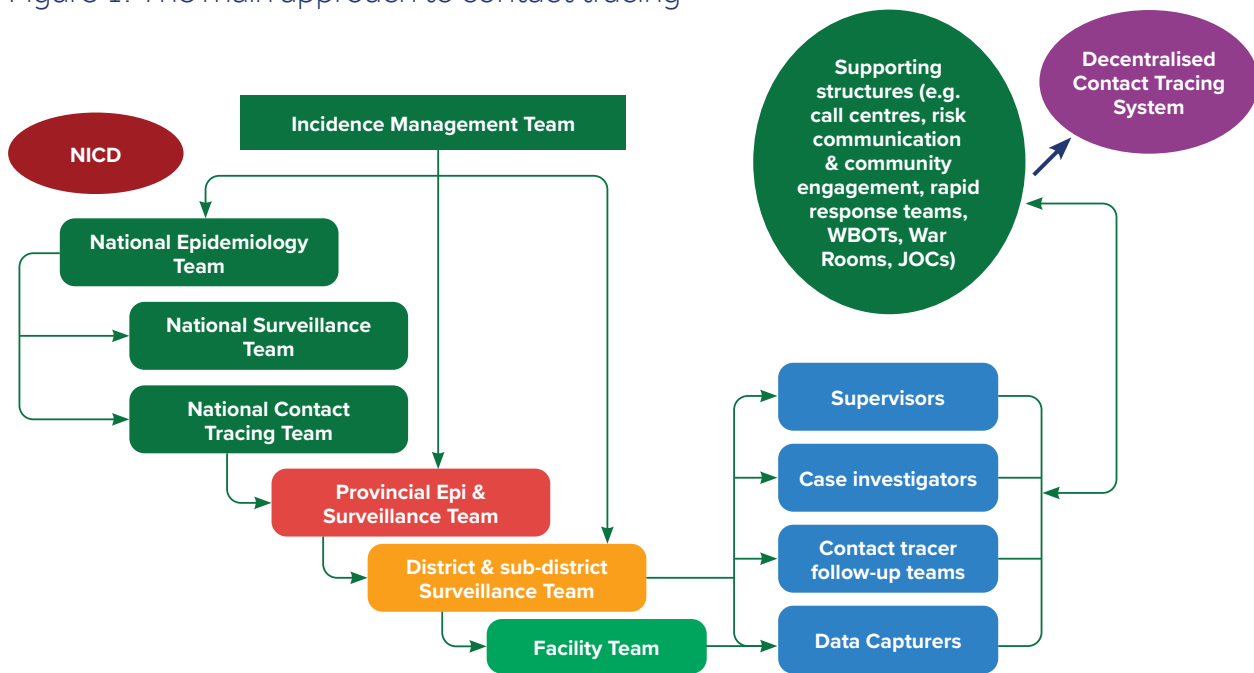
Manual contact tracing is also time-consuming and requires a large number of human resources to carry out daily interviews and follow up on contacts. Various studies have demonstrated that manual contact tracing alone is not sufficient to contain the spread of COVID-19.^{12,13} In order to enhance the manual contact-tracing efforts, the South African government implemented innovative technological solutions such the COVIDConnect platform built by the Praekelt Foundation that operates through WhatsApp, SMS and Unstructured Supplementary Service Data (USSD) to provide patients with COVID-19 test results and a set of questions to assess their symptoms daily.^{14,15} COVIDConnect thus augments manual contact-tracing efforts.

In addition, on 2 September 2020, the National Department of Health deployed a Google Apple Exposure Notification (GAEN)-based system called COVID Alert App.^{14,16} The App detects when a person has been in contact with somebody else for more than 15 minutes and sends notifications to warn users that they could have been exposed to the virus. App users are

guided as to what to do next to optimise their wellbeing and prevent the spread of the COVID-19 virus to others. At no stage does the App reveal the users' identities; confidentiality and anonymity are central to the App's contact-tracing process.

Notwithstanding its importance, digital contact tracing has been subjected to several ethical and technical challenges globally and in South Africa. These relate to the accuracy of the approach, the very poor uptake thereof, and the opt-in feature undermining its effectiveness through lack of critical mass (albeit that a mandatory mode would sacrifice the user's autonomy). Furthermore, evidence on end-users' perceptions of and adoption behaviour regarding digital contact-tracing Apps is only starting to emerge^{17,18}, and there is currently no reliable evidence on its effectiveness in South Africa. Moreover, as a result of existing geographical disparity in public health capacity and service provision, the ways in which contact tracing was implemented varied across and within provinces (see Figure 3 and Figure 4).

Figure 1: The main approach to contact tracing



Source: National Department of Health, 2020.¹⁹

On 30 March 2020, President Ramaphosa called for implementation of intensive case-finding in communities to curb the spread of the COVID-19 virus in communities. This announcement was followed by the deployment of more than 28 000 Community Health Workers (CHWs) to high-risk communities to support active door-to-door case-finding.⁶ South Africa's community contact-tracing teams – already established for TB control and management – were re-directed to support contact tracing and compliance monitoring of persons under investigation. This community-based response resulted in the screening of 11 114 600 people (almost 20% of the population) for COVID-19 between 4 April and 24 May 2020.⁶ People with COVID-19 symptoms were

referred to mobile testing stations or nearby health facilities. After testing, people were advised to quarantine until results become available; if self-quarantine was not possible, accommodation was offered in hotels and other facilities. By the end of the third week of community screening and testing (CST), the programme in Cape Town had screened 70 251 people and performed 6 127 tests, of which 208 were found to be positive (3.4%), although a backlog of test results implied a higher number of positive cases.²⁰

With the number of infections rising, testing and contact-tracing teams were anchored at district and facility levels, which relied substantially on South Africa's existing Primary

Health Care (PHC) infrastructure. Community-orientated primary care (COPC) was a natural home for these efforts, given that PHC forms the core of South Africa's district health access and service, and has deep roots in community engagement.²¹ However, strong PHC systems depend on multi-sectoral and people-centred approaches for clinical interventions, governance, planning and service delivery, making various elements of PHC systems well positioned to help in the implementation of active case investigation, treatment and contact tracing for COVID-19.^{22,23}

Service delivery: COVID-19 testing and contact tracing

At the beginning of the pandemic, only nucleic acid amplification tests (NAATs) were available for COVID-19 diagnostic testing. In South Africa, the gold standard test for SARS-CoV-2 infection is through the detection of viral Ribonucleic Acid (RNA) in a sample collected from the respiratory tract by reverse transcriptase-polymerase chain reaction (RT-PCR).²⁴ Despite having state-of-the-art laboratory facilities equipped with the latest technology, South Africa experienced constrained testing capacity at the start of the pandemic.

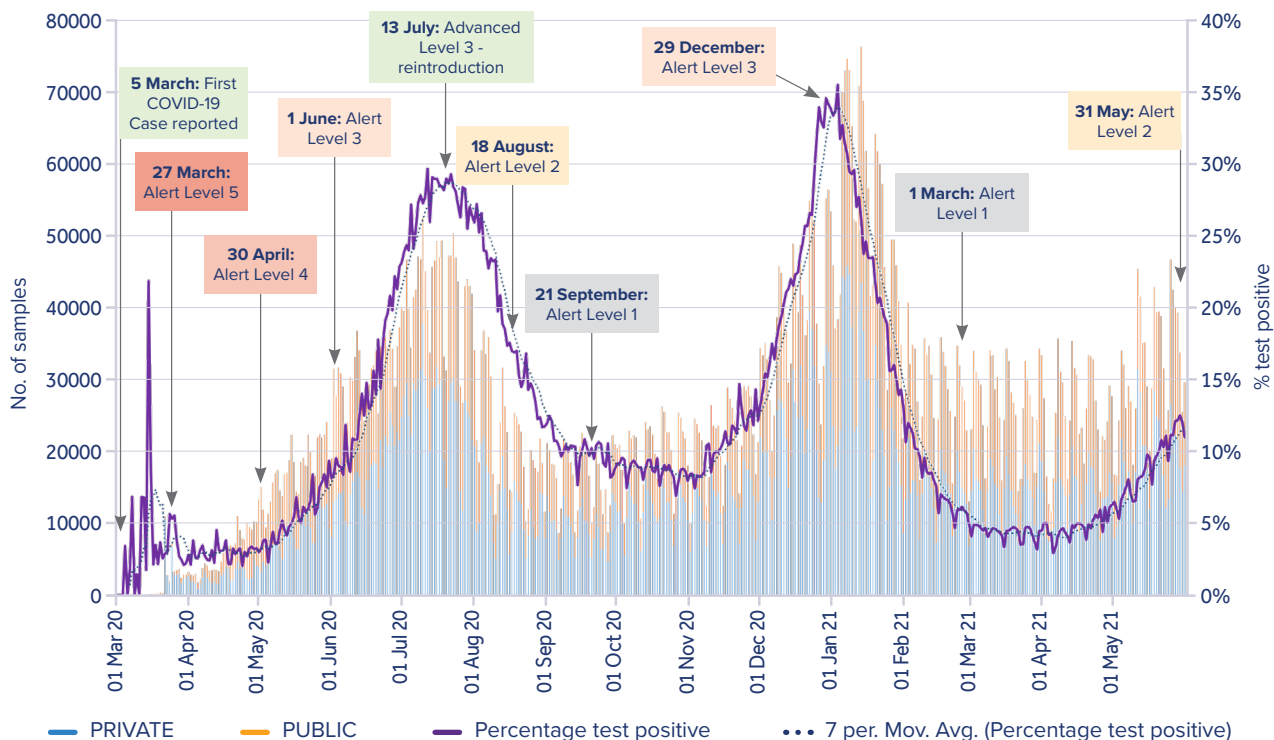
South Africa's agile approach to community testing relied on case-identification of infected persons, isolation, contact tracing, and quarantine.^{6,15} In March 2020, early reports from the National Health Laboratory Service (NHLS) indicated that testing capacity was between 10 000 and 15 000 tests

per day, with an estimated test capacity at 36 000 per day projected for the end of April 2020.²⁵ Although possibly achievable in the initial phase of the epidemic, this projected capacity became unrealistic as it would entail identification of at least 400 new cases each day.²⁶ As can be seen in Table 1, reasons for this failure include factors related to internal processes within the NHLS such as capacity planning, long turnaround time, testing backlogs, global supply chain constraints, and restricted cargo mobilisation due to global lockdown restrictions on movement.

In July 2020, a targeted testing strategy was developed to address South Africa's COVID-19 testing response.²⁷ This strategy was developed to accommodate the country's constrained testing capacity, to deal with the testing backlog, and to ensure that those categories of patients with an urgent clinical need were prioritised for testing. In cognisance of the challenges that constrained testing, South Africa changed its mass-testing strategy to a targeted testing approach to enable utilisation of its limited COVID-19 testing resources to support COVID-19 response priorities. The revised testing strategy prioritised hospitalised patients, any person presenting with symptoms deemed by a clinician to be caused by COVID-19 infection, all close contacts, and post-mortem testing.²⁷

Figure 2 shows that as at 30 May 2021, 11 606 570 cumulative tests had been conducted in both public and private health sectors, with an 11.9% positivity rate since the start of testing.

Figure 2: Daily number of tests and percentage tests COVID-19 positive in South Africa, 30 May 2021



Source: National Institute for Communicable Diseases, 2020.^a

a <https://www.nicd.ac.za/media/alerts/>

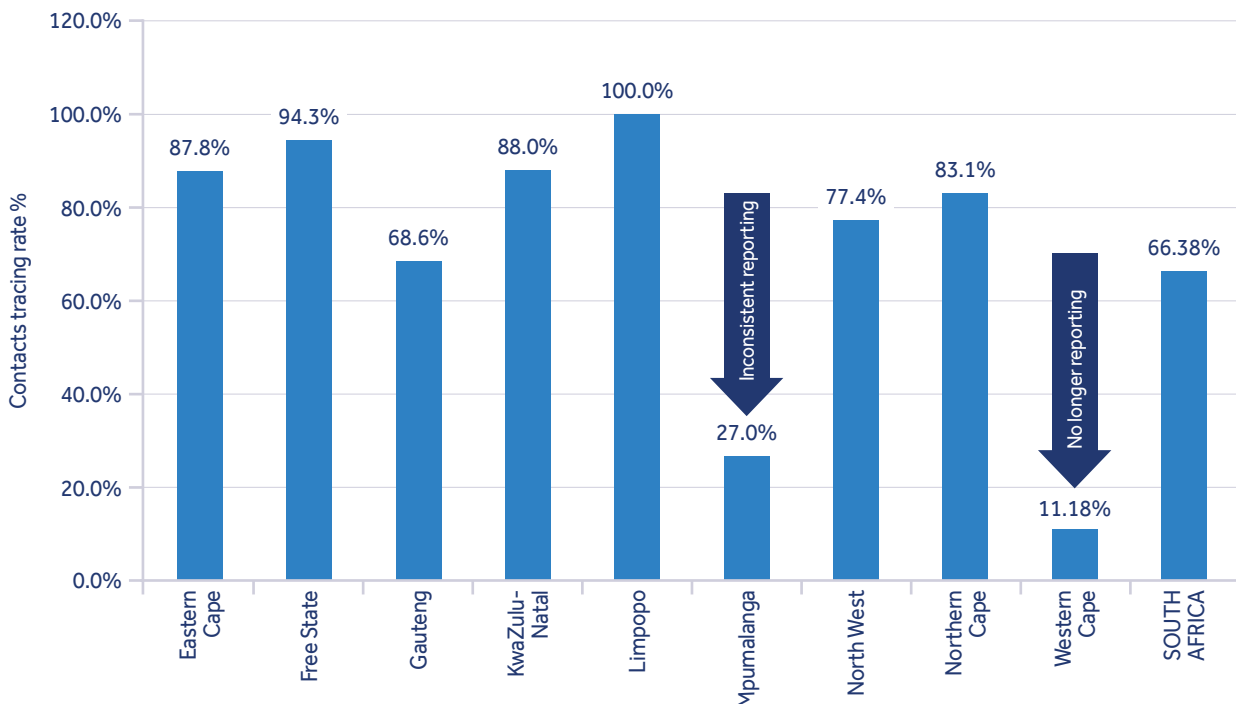
Given the testing capacity challenges, the availability of antigen rapid diagnostic tests (Ag-RDTs) for rapid and/or point-of-care identification of patients with SARS-CoV-2 infection was a helpful addition to the real-time reverse transcription-polymerase chain reaction (rRT-PCR) assays, due to their ease of use and rapid turnaround time.²⁸ South Africa has approved the use of antigen testing in specific contexts to reduce the transmission of COVID-19.²⁹ Rapid antigen tests can contribute to overall COVID-19 testing capacity, offering shorter turnaround times and reduced costs, especially in situations in which RT-PCR testing capacity is limited.³⁰

The extent to which advantages of rapid antigen testing compared with RT-PCR testing outweigh the lower sensitivity compared with RT-PCR testing is currently unknown. With the increasing use of rapid antigen tests instead of RT-PCR testing, we expect the number of missed infections to increase. Whether this limitation is offset by the prompt availability of test results remains unclear. This underscores

the importance of immediate self-quarantine of close contacts and repeat testing when symptoms develop after a negative result from a rapid antigen or an RT-PCR test. Furthermore, given the potential for false positivity of rapid antigen test results, there is a need for positive results with rapid antigen tests to be confirmed by RT-PCR.³¹ Given the current Delta and Omicron variants circulating in South Africa, capturing of information on secondary case detection rates should continue, and particularly in situations where a missed infection might have severe consequences (e.g. among immunocompromised individuals), RT-PCR tests remain preferable. It is therefore important to optimise the timing of testing according to the number of days since a person's last exposure in order to avoid false-negative results, as this may lead to artificially lower secondary infection rates.³¹

Figures 3 and 4 show the COVID-19 index-tracking and contact-tracing rates in South Africa as at 31 May 2021. Table 1 describes the testing and contact challenges and possible solutions.

Figure 3: COVID-19 index case tracking rate by province in South Africa, 31 May 2021^{b,c}



Five out of nine provinces exceeded the national target of 80% for the index case tracing rate – Northern Cape (83.1), Limpopo (100%), KwaZulu-Natal (88%), Free State (94.3%) and Eastern Cape (87%). Notwithstanding this performance, a number of challenges related to case investigation were experienced, including the time to testing; the time

to receive test results; turnaround times to start case investigation; and contact elicitation.

Furthermore, tracers failed to reach one in eight people who tested positive for COVID-19; those who were reached did not provide details of their close contacts, and more

b <https://knowledgehub.org.za/elibrary/national.guidelines-contact-tracing-covid-19>

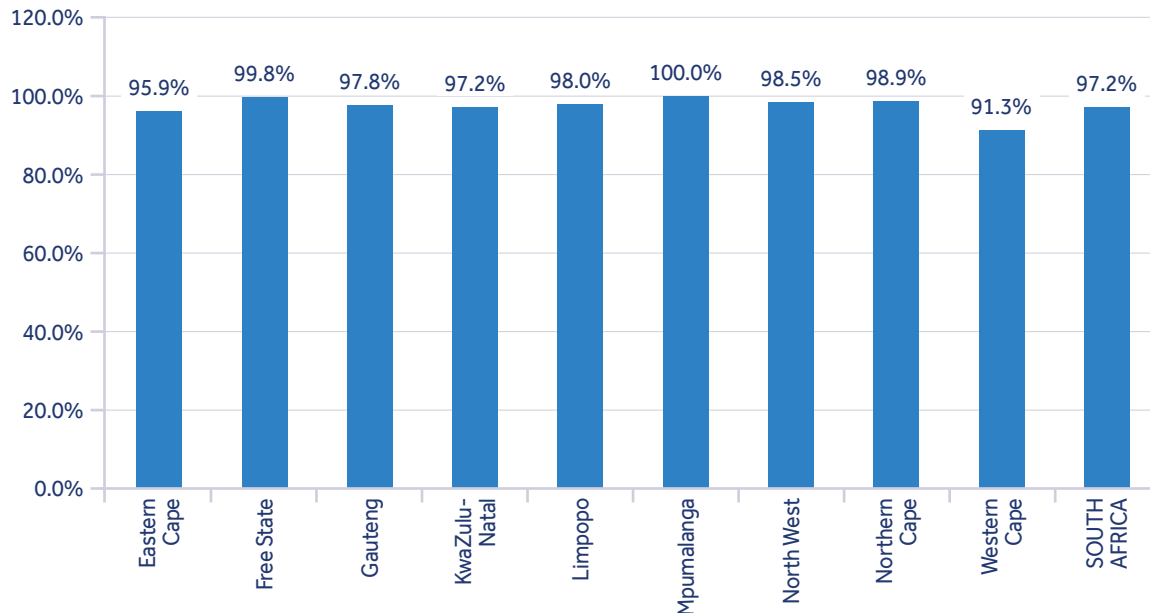
c The COVID-19 index case tracking rate is the number of confirmed COVID-19 cases tracked to obtain a list of their contacts (numerator) divided by the number of confirmed COVID-19 cases. Figure 3 does not compare performance, as various provinces used different processes to conduct COVID-19 index case tracking operations.

people who tested positive provided no details of contacts when asked. Inconsistencies in reporting were noted for Mpumalanga and Western Cape, resulting in a reduced national case index-tracking rate of 66%.

As seen in Figure 4, all the provinces performed above the national target of 90% for the number of close contacts

traced. Nevertheless, all provinces have observed various challenges with daily tracking of close contacts, including contact-tracing intervals; the contact elicitation success rate; contact quarantine percentages; and daily monitoring of close contacts.

Figure 4: COVID-19 contact tracing rate by province South Africa, by 31 May 2021^{c,d}



However, data from Mpumalanga and Western Cape should be read with caution, due to inconsistencies in reporting. Lack of official standardisation for reporting of contact-tracing statistics across provinces makes national comparisons difficult.

Workforce

Ramping up COVID-19 testing and contact tracing in South Africa entailed altering the roles of the existing healthcare workforce through task-shifting, re-assignment, and changes to workforce rostering.¹² In some provinces, the existing health workforce was augmented by hiring additional health workers to support COVID-19 testing and contact-tracing efforts. Provincial and district contact-tracing teams were trained on proper testing procedures, case investigation and contact-tracing protocols. The national contact-tracing workstream led contact-tracing activities, including the development of guidelines, standard operating procedures (SOPs), data management, guidance for activities and reporting, and support for the oversight of processes.^{14,16} The National Institute for Communicable Diseases (NICD) assigned provincial epidemiologists to support testing and contact-tracing activities, working with local public health experts who conducted data collection and tracing activities. Community-

based testing and contact tracing benefitted from the existing structure of Ward-Based Outreach Teams (WBOTs) which maximised the diverse capacities of the PHC workforce to provide co-ordinated and efficient health services.^{12,13} Efforts were made to ensure that any new workforce members hired to support COVID-19 activities were integrated into teams to optimise co-ordination and continuity of care.

However, with community transmission of COVID-19 increasing, monitoring of all reported contacts became practically impossible. This became evident when it emerged that there was a delay of five to 14 days in turnaround time for delivery and communication of test results. Additionally, some challenges included health workers being infected with COVID-19, shortage of staff for essential health services because of redeployment to the COVID-19 response, and an overwhelmed health workforce. This has resulted in the disruption of other essential health services, such as routine immunisation services.

Leadership and governance

Leadership and governance entails “ensuring strategic policy frameworks that exist and is combined with effective oversight, coalition-building, regulation, attention to system-

^d The contact tracing rate is the number of contacts traced (numerator) divided by number of contacts identified for tracing (denominator). Figure 4 does not compare performance, as various provinces used different processes to conduct COVID-19 contact tracking operations.

design, and accountability”.³² On 30 January 2020, in response to an anticipated importation and local spread of COVID-19, South Africa established its Incidence Management Team (IMT) structures at the National and Provincial Departments of Health, modelled on the WHO Framework for a Public Health Emergency Operations Centre.¹⁴ The purpose of the IMT was to establish a structured approach for managing a public health emergency, by integrating existing healthcare functions into an emergency management system. Furthermore, a National COVID-19 Command and Control Council (NCCC) was established by the Cabinet on 15 March 2020 for intergovernmental co-ordination and government-wide decision-making.¹⁴ However, there was a lack of close collaboration between various sectors at all levels of management (national, provincial, district, sub-district and facility) to identify and agree on the priority essential services for continuity during an emergency period.

Rapid, system-wide decision-making is essential for implementation of urgent COVID-19 surveillance and response measures for immediate case detection, containment and mitigation.³³ In March 2020, South Africa further established the COVID-19 Modelling Consortium (SACMC) to project the spread of the disease in support of policy and planning.^{14,34} Several sets of projections and guidance documents were provided over the first two waves of the epidemic, which facilitated effective COVID-19 testing and contact-tracing efforts.³⁵

The top-down decision-making was accompanied by social accountability measures at the PHC level to promote community engagement and monitoring to improve system performance, effectiveness, and responsiveness to the health needs of the public.³⁶ South Africa was able to use science-based approaches to increase government’s credibility and effectiveness in its COVID-19 response. Testing and contact-tracing strategies were embedded within a quality-management landscape to ascertain the accuracy of the data being generated at the community level, and to ensure the safety of patients and healthcare providers. Launching the quality-management infrastructure required actions such as adopting local statutes for testing procedures for those admitted to hospital and outpatients with COVID-19 symptoms, establishing standards for setting up facility infrastructure and referral systems, and instituting policies to ensure that patient privacy is protected.

During the early stages of the pandemic, South Africa was able to mobilise and adapt existing human and logistical resources to confront challenges brought about by the COVID-19 pandemic.^{13,14} By ensuring the involvement of the country’s health experts and scientists – especially public health medicine specialists and registrars – South Africa was able to decelerate the spread of COVID-19.^{14,21} However, the challenge was the absence of standardised information systems and a functional information system to ensure that granular data were compiled and shared for timely action by the outbreak response teams. In addition, leadership

capacity for other essential services was depleted, as officials were redeployed to COVID-19 activities.

Health information systems

The COVID-19 screening and testing information system was designed with the aim of informing both national and local risk assessment and decision-making for pandemic preparedness, response and recovery. This requires strategic health information systems used for data generation, compilation and trend analysis. Integrating technology-based contact-tracing mobile applications to break COVID-19 transmission chains can yield improved results, including closed feedback loops for effective surveillance and referrals.³⁷

South Africa has leveraged existing PHC disease surveillance data systems which allow for a rapid and cost-effective transition towards integrated COVID-19 surveillance.¹⁴ Such community and PHC-based information systems – for example, the Global Influenza Surveillance and Response System – have been utilised to identify populations for active case-finding and contact tracing, and to facilitate the referral of patients to care.³⁷ Among the challenges experienced with these contact-tracing approaches was a lack of standardised, synchronised systems for surveillance and reporting, which was subsequently remedied by integrating COVID-19 data collection into the existing influenza and pneumonia surveillance systems.¹⁴

Furthermore, SACMC developed the National COVID-19 Epi Model (NCEM), which resulted in the development of visual displays such as heat-maps, line plots and maps, and downloadable reports, with the SACMC Epidemic Explorer fast becoming an invaluable resource for monitoring the trajectory of the epidemic throughout the country.³⁸

Finances and procurement

Effective implementation of testing and contact tracing for COVID-19 entailed harnessing public health financing resources for purchasing test-kits, setting up testing centres, procurement of good-quality personal protective equipment (PPE) for healthcare workers, and recruitment of additional tracer teams. The South African Government diverted some available funds in contingency or from budgets of various departments, such as tourism, to create an extra budget for the COVID-19 response. This supported health system strengthening, facility readiness planning and co-ordination of essential resources such as the procurement of essential medicines and medical supplies (PPE and COVID-19 vaccines). However, this shift in spending priorities has led to PHC resources being redirected to COVID-19 efforts.

Establishing strong private–public partnerships ensured that the public health system taps into resources available in the private sector. Bilateral and multilateral donors, development banks, philanthropic organisations, and the private sector all played a role in contributing money, equipment and expertise to the COVID-19 response in South Africa.

South Africa initiated and promoted COVID-19 fundraising activities through the establishment of the Solidarity Fund which is responsible for co-ordinating, managing and dispersing donations received from both individuals and private-sector organisations. The Solidarity Fund is a platform for all South Africans in all sectors to unite in the COVID-19 response. For example, the Telkom team has been working with the NICD and the Council for Scientific and Industrial Research to develop COVIDConnect,³⁹ following which the second platform, COVID Alert, was launched.

As mentioned, reports have indicated a very low uptake of the COVIDConnect and COVID Alert Apps,^{39,40} due to factors such as non-availability of communication campaigns promoting contact-tracing platforms; slight delays in the delivery of related communication materials in the facilities; and marketing and cost of data being an obstacle to use of the COVID Alert App, including limited access to Smartphone ownership and the Internet.^{40,41}

Conclusions

Testing and contact tracing are an important public health strategy for disease control. To ensure sustained value of community-level contact tracing and case-identification, South Africa must continuously assess the status of the pandemic and adjust the strategies as the need arises. Leveraging existing healthcare infrastructure, past experiences with public health campaigns, a science-based approach and digital technologies will sustain contact tracing and population-level intervention efforts for the COVID-19 response. Further data and research are needed to understand the effectiveness and role of contact tracing in community transmission dynamics in South Africa.

During the mitigation phase of a pandemic, contact tracing resources should be prioritised to high-risk settings such as congregate settings.

Recommendations

Testing and contact tracing has been identified as a key element in reducing the spread of infectious diseases such as COVID-19. Recommendations for delivering sustainable change in testing and contact tracing in South Africa include the following.

- Enhance the intersectoral approach and ensure integration COVID-19 surveillance with other community surveillance systems.
- Rationalise health workforce redistribution during surge periods by prioritising cases for investigation and contacts for tracing.

- Shorten the time to testing and encourage individual actions to improve isolation and quarantine of COVID-19 cases and their contacts.
- Reduce delays caused by data deficiencies by using technology solutions to accelerate the data pipeline.
- Integrate risk communication, health promotion, case investigation and contact tracing.

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