SARS-CoV-2 Reinfection Trends in South Africa: Monthly Report

For public release

2022-10-04

Overview

This report provides an analysis of recent reinfection trends, in order to improve situational awareness and inform resource planning by the Government of South Africa. The report is intended for public release.

Summary

- Since January 2021, we have conducted regular monitoring of reinfections in routine surveillance data to detect potential changes in reinfection risk, as may occur with the emergence of new variants
- We found no evidence that reinfection risk was higher as a result of the emergence of the Beta or Delta variants
- Reinfection risk increased substantially during the period of emergence of the Omicron BA.1 variant and plateaued at a level higher than associated with previous variants.
- Emergence of the BA.4 / BA.5 lineages was associated with a gradual increase in reinfections but trends remain consistent with what was observed for Omicron BA.1.
- This report includes analysis of data through 2022-09-28. The most recent data indicate that reinfections remain consistent with the level expected based on prior experience with the Omicron variant.

Authors: *SACEMA:* Juliet R.C. Pulliam, Cari van Schalkwyk, Belinda Lombard, Jonathan Dushoff; *NICD/NHLS:* Nevashan Govender, Anne von Gottberg, Cheryl Cohen, Michelle J. Groome, Koleka Mlisana, Siobhan Johnstone, Harry Moultrie.

Contents

Results

Time series of primary infections and suspected reinfections

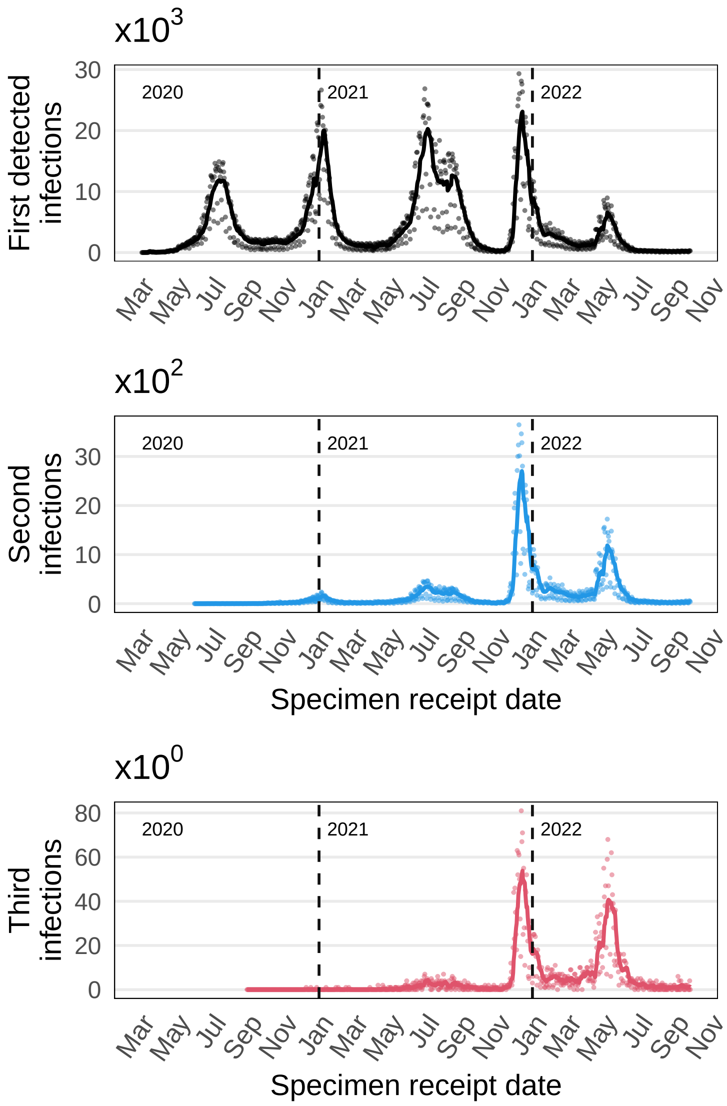

Figure 1: Daily numbers of detected primary infections and suspected reinfections in South Africa. (Top) Time series of first detected (primary) infections. (Middle) Time series of suspected second infections. (Bottom) Time series of suspected third infections. Lines indicate 7-day moving average; points are daily values.

Comparison of data to projections from a null model

Second infections

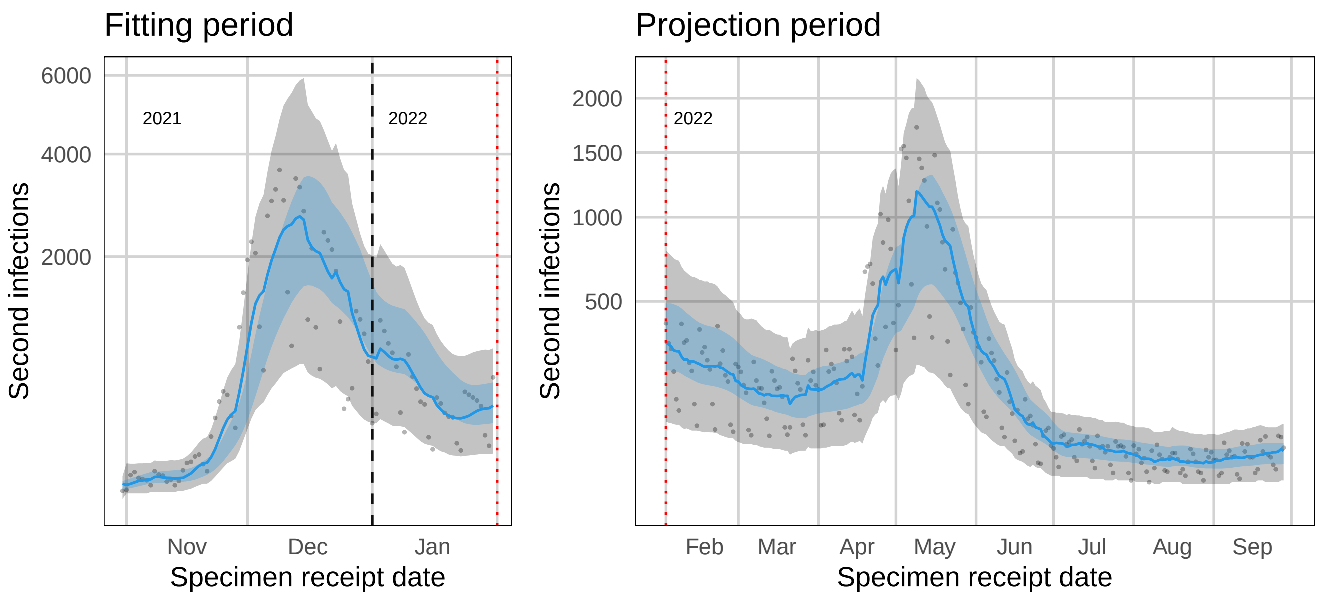

Figure 2: Observed and expected temporal trends in numbers of second infections. Blue lines (grey points) represent the 7-day moving average (daily values) of suspected reinfections. Gray bands represent the 95% projection interval on the daily number of second infections from the null model. Blue bands represent the 95% projection interval on the 7-day moving average of second infections from the null model. (Left) Null model fit to the data on suspected reinfections through 31 January 2022. (Right) Comparison of data with projections from the null model over the projection period.

Interpretation: We compare observed data to projections from a null model that assumes a constant reinfection hazard coefficient over the period 1 November 2021 to 31 January 2022. The figure should be interpreted by comparing the blue line to the shaded blue region and the grey points to the shaded grey region. When the line / points fall within the respective shaded region, this indicates that the number of reinfections is consistent with what was seen during the period of Omicron BA.1 / BA.2 dominance (fitting period).

Third infections

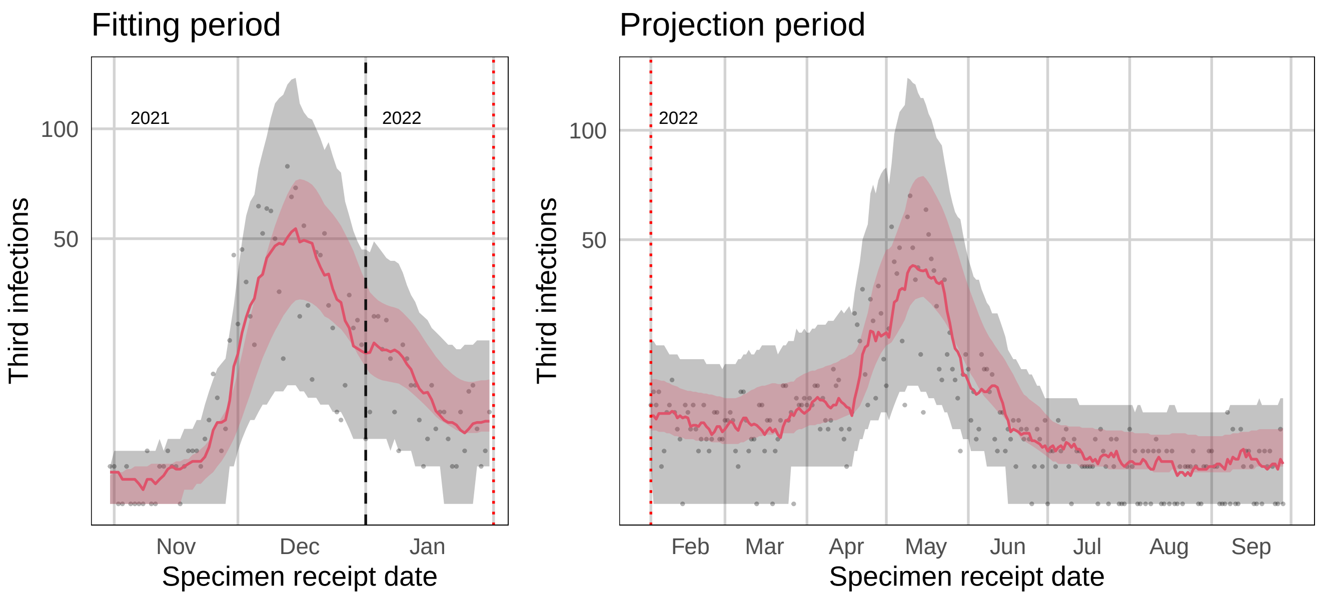

Figure 3: Observed and expected temporal trends in numbers of third infections. Red lines (grey points) represent the 7-day moving average (daily values) of suspected third infections. Grey bands represent the 95% projection interval on the daily number of third infections from the null model. Red bands represent the 95% projection interval on the 7-day moving average of third infections from the null model. (Left) Null model fit to the data on suspected reinfections through 31 January 2022. (Right) Comparison of data with projections from the null model over the projection period.

Interpretation: We compare observed data to projections from a null model that assumes a constant reinfection hazard coefficient over the period 1 November 2021 to 31 January 2022. The figure should be interpreted by comparing the red line to the shaded red region and the grey points to the shaded grey region. When the line / points fall within the respective shaded region, this indicates that the number of reinfections is consistent with what was seen during the period of Omicron BA.1 / BA.2 dominance (fitting period).

Population eligible for reinfection

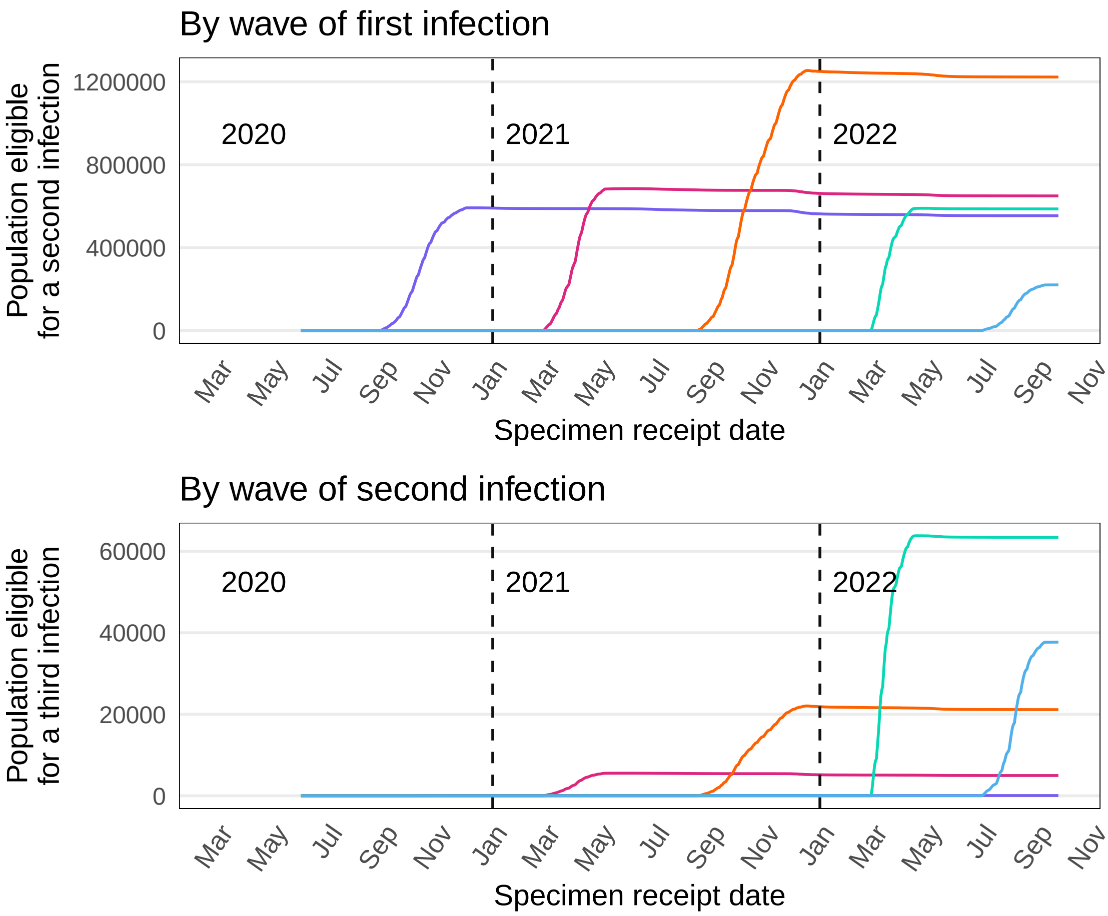

Figure 4: Population eligible for reinfection, by wave of previous detected infection (purple indicates wave 1; pink, wave 2; orange, wave 3; turquoise, wave 4; and blue, wave 5). (Top) Population eligible for a second infection, by wave of first detected infection. (Bottom) Population eligible for a third infection, by wave of second detected infection.

Methods

For detailed methods, please see: Pulliam *et al*. (2022) Increased risk of SARS-CoV-2 reinfection associated with emergence of Omicron in South Africa. *Science* 376 (6593): abn4947. https://www.science.org/doi/10.1126/science.abn4947

Data

Incidence of infections and suspected reinfections is calculated from the line list of positive tests. We identify repeated case IDs in the line list and calculate the time between consecutive positive tests. If the time between sequential positive tests is at least 90 days, the more recent positive test is considered to indicate a suspected reinfection. The total incidence is calculated as the sum of first infections and reinfections. All incidence time series are calculated by specimen receipt date; some dates are adjusted to account for inaccuracies in specimen receipt date for late-arriving test results (mainly associated with delayed reporting of antigen tests). This report is based on data through 2022-09-28.

The data for the current version of the report is available at https://doi.org/10.5281/zenodo.5745338.

Analysis of reinfection trends

We compare observed data to projections from a null model that assumes a constant reinfection hazard coefficient (Pulliam *et al* 2022). The model assumes that the reinfection hazard is proportional to the 7-day moving average of the total number of diagnosed infections (primary infections and reinfections). The current model formulation is updated from the published version to fit one hazard coefficient (λ) prior to the period of Omicron emergence, and a second hazard coefficient (λ_2) for dates between 2021-11-01 and 2022-01-31. Projections are made assuming a hazard coefficient of λ_2. Thus, we compare new data to the expectation under the assumption that reinfection risk is the same as for the average over the period of the fourth wave.

Population eligible for reinfection

We define the population eligible for a second infection as the number of individuals whose first identified infection occurred at least 90 days ago and who have not yet had an identified second infection. Similarly, the population eligible for a third infection is the number of individuals whose second identified infection occurred at least 90 days ago and who have not yet had an identified third infection. We note that these “eligible” populations are different from the true underlying populations at risk for second and third infections, due to the fact that not all infections are observed.

Limitations

- Reinfections are not confirmed by sequencing
- Wave / timing is used as a proxy of variant
- Changes in testing practice and health-seeking behavior are not explicitly accounted for

References

Pulliam *et al*. (2022) Increased risk of SARS-CoV-2 reinfection associated with emergence of Omicron in South Africa. *Science* 376 (6593): abn4947. https://www.science.org/doi/10.1126/science.abn4947

Hall *et al*. (2021) SARS-CoV-2 infection rates of antibody-positive compared with antibody-negative health-care workers in England: a large, multicentre, prospective cohort study (SIREN). *The Lancet*. 397: 1459–1469. https://linkinghub.elsevier.com/retrieve/pii/S0140-6736(21)00675-9

About SACEMA

The South African Centre for Epidemiological Modelling and Analysis (SACEMA) is a national DSI-NRF Centre of Excellence hosted at Stellenbosch University. SACEMA aims to improve health in South Africa, and across the continent, through modelling and analysis.

Funding

The development of analyses presented in this report was funded by the Wellcome Trust (grant number 221003/Z/20/Z) in collaboration with the Foreign, Commonwealth and Development Office, United Kingdom. SACEMA is supported by the South African Department of Science and Innovation and the National Research Foundation. Any opinion, finding, and conclusion or recommendation expressed in this material is that of the authors, and the NRF does not accept any liability in this regard.