SARS-CoV-2 reinfection trends in South Africa during the emergence of Omicron

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Overview

• Background:
  • 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

• Two approaches give similar results:
  • We find no evidence that reinfection risk was higher as a result of the emergence of Beta or Delta
  • In recent weeks, reinfection risk has increased substantially

• Caveats:
  • Reinfections are not confirmed by sequencing
  • Wave is used as a proxy of variant
  • Changes in testing practice and health-seeking behavior have not been accounted for
  • This analysis does not provide information on the risk of breakthrough infection in vaccinated individuals
Data

• Incidence of first infections is calculated from the NMC-SS case line list
  • Does not include incident reinfections.

• Incidence of reinfections is calculated from the line list of positive tests
  • Repeated case IDs in the line list are identified and the time between consecutive positive tests is calculated.
  • 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)
Data

Based on data through 2021-11-27
Data

- 35,670 individuals had potential reinfections
  - 1.3% of the 2,796,982 individuals with first positive >=90 days prior to database closure on 2021-11-27
- In a 10% random sample of suspected reinfections occurring on or before 2021-01-20 (n=585):
  - Manual review of laboratory and NMC-SS records including fields not used for linkages (address, cell-phone numbers, facility and healthcare providers)
  - 562 (96%) verified as the same individual
  - 23 (4%) judged not a match or insufficient evidence

**Note:** Reinfections are defined as occurring at least 90 days after the previous positive test
Methods: Approach 1

Catalytic model assuming a constant reinfection hazard coefficient

• Assume reinfection risk is proportional to incidence of detected cases
• Estimate a constant reinfection hazard coefficient (‘null hypothesis’)
  • Fit to data from prior to March 2021
• Project the expected number of reinfections under the null hypothesis that reinfection risk has not changed
• Compare observed reinfections to projection to assess deviation from the null hypothesis

Detailed methods at: https://www.medrxiv.org/content/10.1101/2021.11.11.21266068
Approach 1 (National)

Based on data through 2021-11-27
Approach 1 (Gauteng)

Based on data through 2021-11-27
Approach 1 (KwaZulu-Natal)

Based on data through 2021-11-27
Approach 1 (Western Cape)

Based on data through 2021-11-27
Methods: Approach 2

**Empirical estimation of time-varying infection and reinfection hazards**

- Estimate time-varying empirical hazards of infection and reinfection
  - Assume risk is proportional to incidence of detected cases (for both primary infections and reinfections)
  - Account for probability of detection
- Compare the temporal trend in infection and reinfection hazards

Detailed methods at: https://www.medrxiv.org/content/10.1101/2021.11.11.21266068
Approach 2

Note: Exact estimates are sensitive to assumptions regarding the detection probabilities, but conclusions are robust.
Recent reinfections (detected since 1 Nov. 2021)

• Recent reinfections appear concentrated in individuals whose primary infection was during wave 3
• Increase in reinfections among individuals infected during waves 1 and 2 since early-to-mid November

Based on data through 2021-11-27
Individuals with multiple reinfections

- Emerging signal of increase in individuals who have already had 2 or more infections

Based on data through 2021-11-27
Key messages

• Reinfection risk has increased markedly since the beginning of October

• Reinfections are occurring in:
  • people whose primary infection occurred in all 3 prior waves
  • people who had already experienced 2 infections prior to the emergence of Omicron

• No data yet on severity of reinfection
  • NICD is working on this
Thinking about context

• South Africa likely has high seroprevalence compared to much of the world
  • Higher selective pressure for immune escape
  • Stronger signal of increased reinfection risk?

• This also means that generalization of early severity from SA may not be applicable elsewhere

Calibrated seroprevalence based on National COVID Epi Model v6.0
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