

Test-negative case control design to evaluate indirect effects of COVID-19 vaccination

Pre-analysis plan

Drafted by: Sophia Tan and Nathan Lo

Date: February 22, 2024

Last edited: February 26, 2024

Objective: Estimate the indirect protection of COVID-19 vaccination and prior SARS-CoV-2 infection against the Omicron variant in California state prisons.

Hypothesis: Residents in California state prisons are less likely to be infected by the Omicron SARS-CoV-2 variant if they reside with an individual with prior infection and/or vaccine-induced protection.

Study period: December 15, 2021 – December 15, 2022

Methods

In brief, we will use a test-negative case control design to quantify indirect effects of natural and vaccine-induced immunity. We will identify and match cases and controls based on testing data, vaccine status, and prior infection status. We will then leverage differences in the vaccine and prior infection profiles of their co-residents to evaluate impact of indirect effects.

Case definition

- Incarcerated throughout the entire pandemic (incarcerated before April 1, 2020)
- Has new infection (positive SARS-CoV-2 test) at least 90 days after most recent infection
- Co-resides with only 1 other resident continuously for at least 7 days leading up to their positive test

Control definition

- Incarcerated throughout the entire pandemic (incarcerated before April 1, 2020)
- Has negative SARS-CoV-2 test
- Has not had an infection in the 90 days preceding their negative test
- Co-resides with only 1 other resident continuously for at least 7 days leading up to their negative test

Matching

Exactly

- Number of vaccine doses
- Prior infection (binary)
- Security level
- Building
- Case and control cannot be in same room
- Case and control have tests within 2 days of each other

Propensity (both co-residents)

- Age, risk for severe COVID-19

Statistical model

Outcome

- SARS-CoV-2 infection (case v. control)

Main exposures

- Vaccination in co-resident (binary and by dose)
- Prior infection in co-resident (binary)

Adjustment for

- Calendar time (or variant period)
- Age, risk for severe COVID-19 for both co-residents
- Number of vaccine doses
- Prior infection (binary)
- Security level
- Institution

We will use a conditional logistic regression model and will evaluate alternative statistical formulations.

Alternative considerations

Based on sample size, we will consider restrictions on room type and cell doors to minimize the risk of transmission from outside of the room.

We will evaluate different definitions of vaccine and prior infection exposures. We will define vaccine and prior infection by time of most recent event and will consider including an interaction between vaccination and prior infection.

Sensitivity analyses

We recognize that under the main study design, residents can be eligible as cases and controls at multiple time points throughout the study period. In the main analysis, we will allow for multiple observations per resident. We will run a sensitivity analysis where we do not allow residents to be included more than once in the study. We will additionally consider testing the robustness of results to alternative variables inclusion/exclusion (e.g., relaxing require for incarceration over entire pandemic), time periods, and statistical choices.