The Present

Leveraging cohort data and expertise for emerging infections

An example from COVID-19 vaccine effectiveness research

School of Public Health
Departement Openbare Gesondheid
Isikolo Sempilo Yoluntu

UNIVERSITY OF CAPE TOWN
IYUNIVESITHI YASEKAPA • UNIVERSITEIT VAN KAAPSTAD

Reshma Kassanjee
Centre for Integrated Data and Epidemiological Research (CIDER)
Reshma.Kassanjee@uct.ac.za

Acknowledgements

Western Cape Government
FOR YOU
Health and Wellnesss

PHDC
Provincial Health Data Centre

Director: Andrew Boulle

Technical partners

- Western Cape Centre for E-Innovation
- National Department of Health & EVDS
- UCT School of Public Health, and CIDER
- Jembi Health System
- National Health Laboratory Service
- National Institute for Communicable Diseases
- Centre for Scientific and Industrial Research
- South African Medical Research Council
- ANOVA
- Sisonke

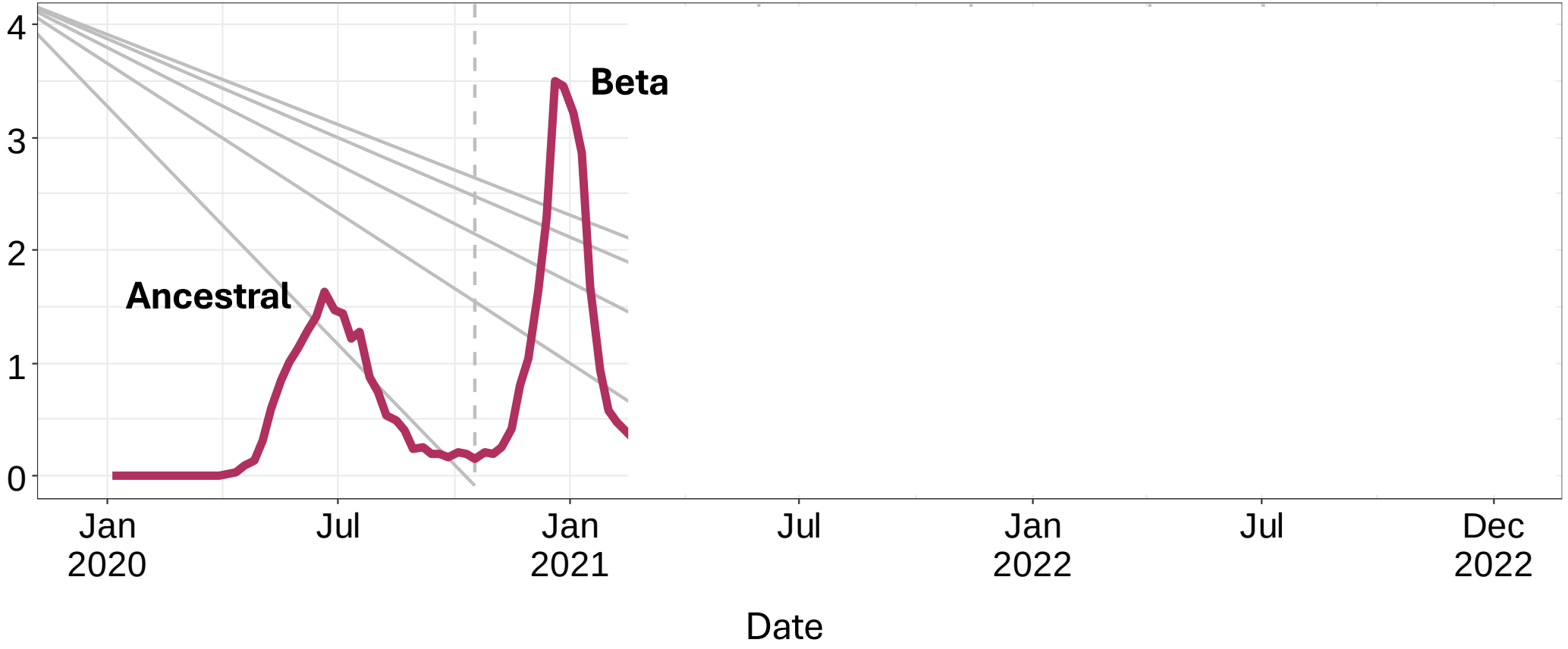
Funders

- Department of Health and Wellness, Western Cape
- National Institutes of Health
- Bill & Melinda Gates Foundation
- Wellcome Trust
- GCRF / NHRI
- CDC & USAID
- South African Medical Research Council
- Grand Challenges ICODA pilot initiative:
  delivered by Health Data Research UK, and
  funded by the Bill & Melinda Gates Foundation and the Minderoo Foundation

COVID-19 in South Africa

Weekly **rate of severe COVID-19** in the Western Cape cohort

(events / 100 person-years)



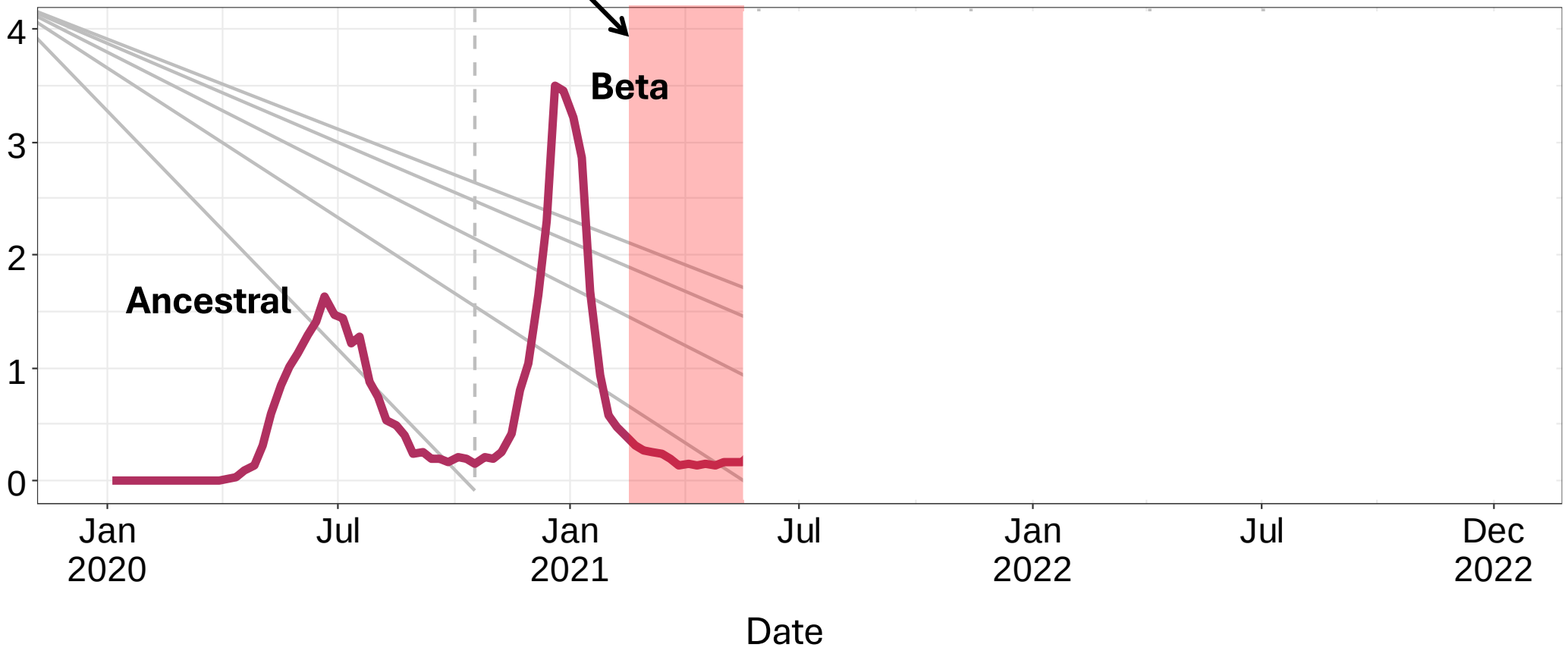
COVID-19 in South Africa

Sisonke study (17 Feb – 17 May 2021)

- Vaccination of **healthcare workers**
- Single-dose **Janssen** Ad26.CoV2.S vaccine

Weekly **rate of severe COVID-19** in the Western Cape cohort

(events / 100 person-years)



COVID-19 in South Africa

Sisonke study (17 Feb – 17 May 2021)

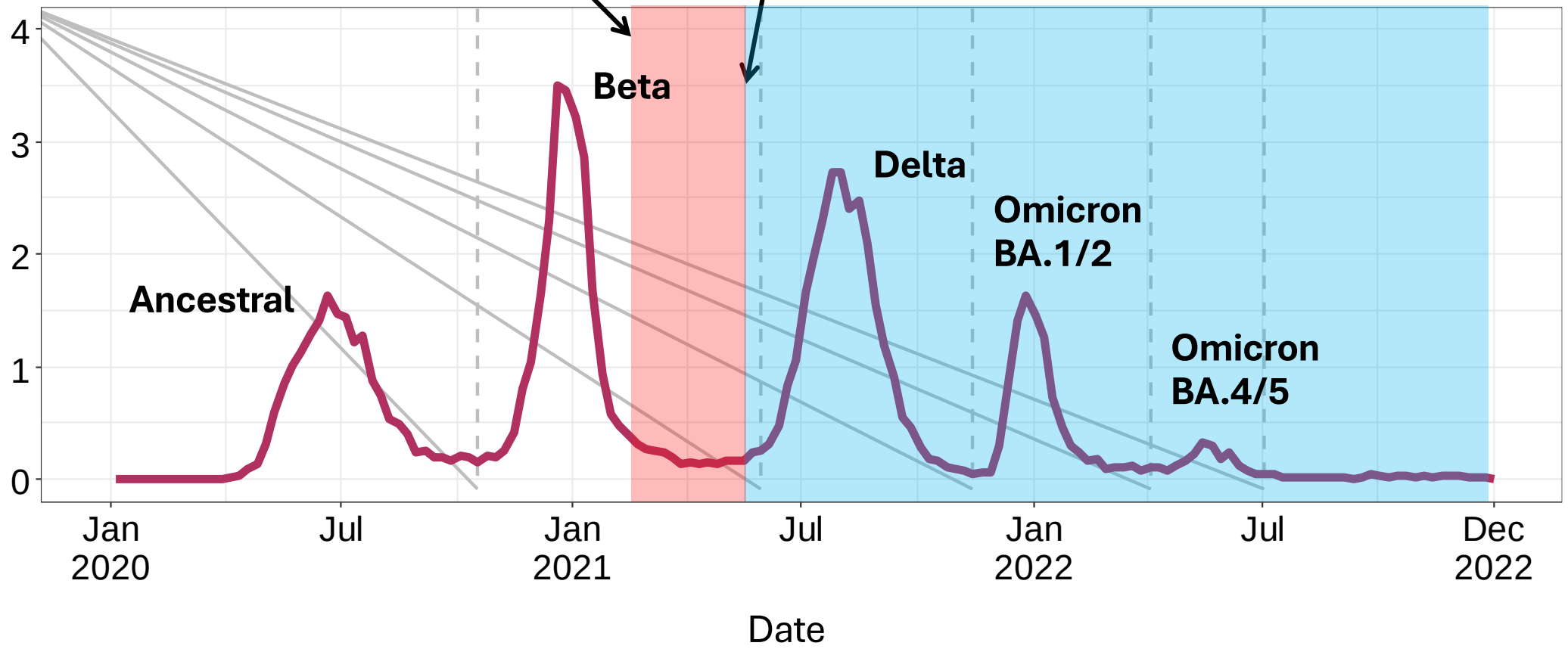
- Vaccination of **healthcare workers**
- Single-dose **Janssen** Ad26.CoV2.S vaccine

General population vaccination

- Single-dose **Janssen** Ad26.CoV2.S or two-dose **Pfizer** BNT162b2 vaccine

Weekly **rate of severe COVID-19** in the Western Cape cohort

(events / 100 person-years)



COVID-19 in South Africa

Sisonke study (17 Feb – 17 May 2021)

- Vaccination of **healthcare workers**
- Single-dose **Janssen** Ad26.CoV2.S vaccine

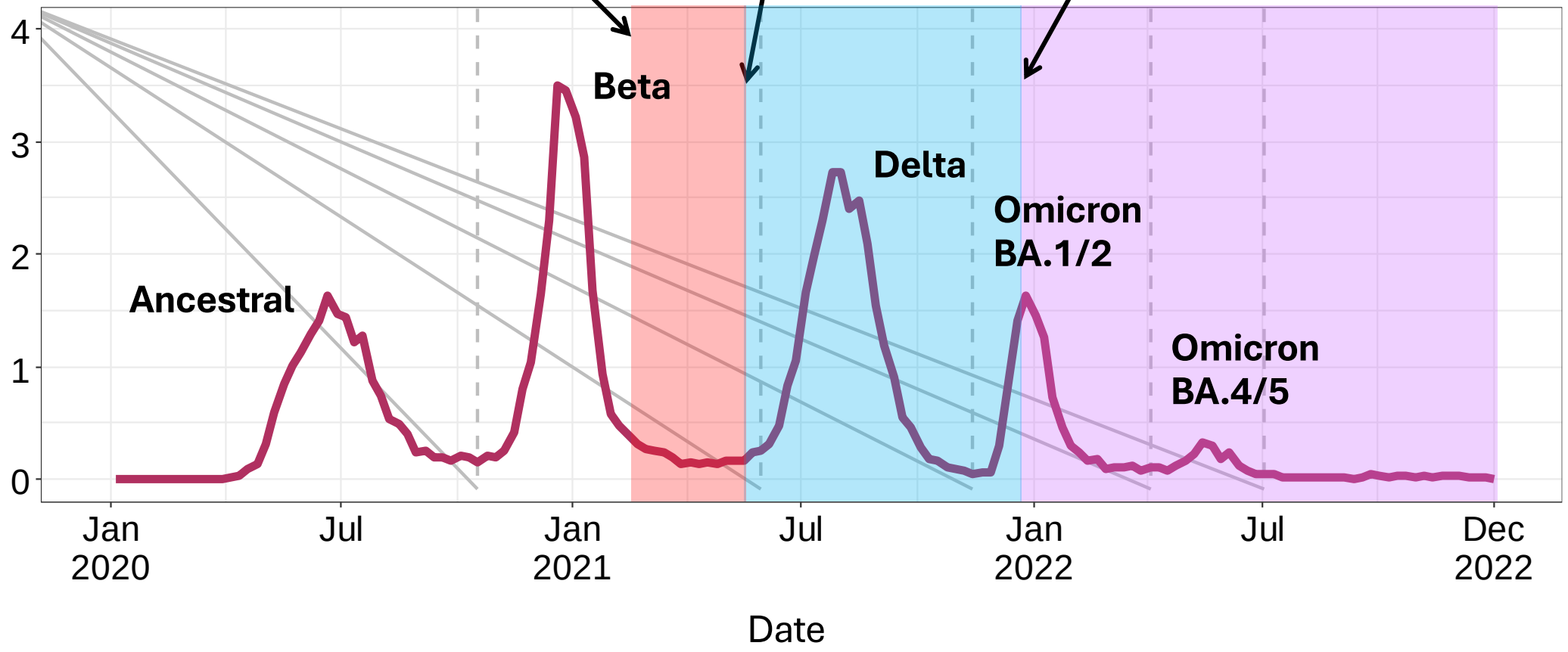
General population vaccination

- Single-dose **Janssen** Ad26.CoV2.S or two-dose **Pfizer** BNT162b2 vaccine

Booster doses

Weekly **rate of severe COVID-19** in the Western Cape cohort

(events / 100 person-years)



Objective

- Estimate the **‘effect’ of COVID-19 vaccination on severe COVID-19**, at a person level

Objective

- Estimate the **‘effect’ of COVID-19 vaccination on severe COVID-19**, at a person level

SARS-CoV-2 with related hospitalisation and/or death

Objective

- Estimate the **‘effect’ of COVID-19 vaccination on severe COVID-19**, at a person level

From available observational data

SARS-CoV-2 with related hospitalisation and/or death

Data sources

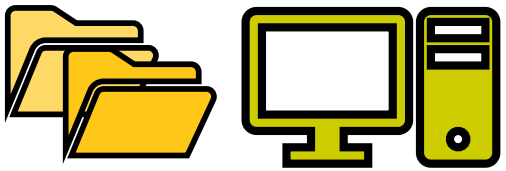
Boulle et al. IJPDS 2019
https://doi.org/10.23889/ijpds.v4i2.1143

Data sources

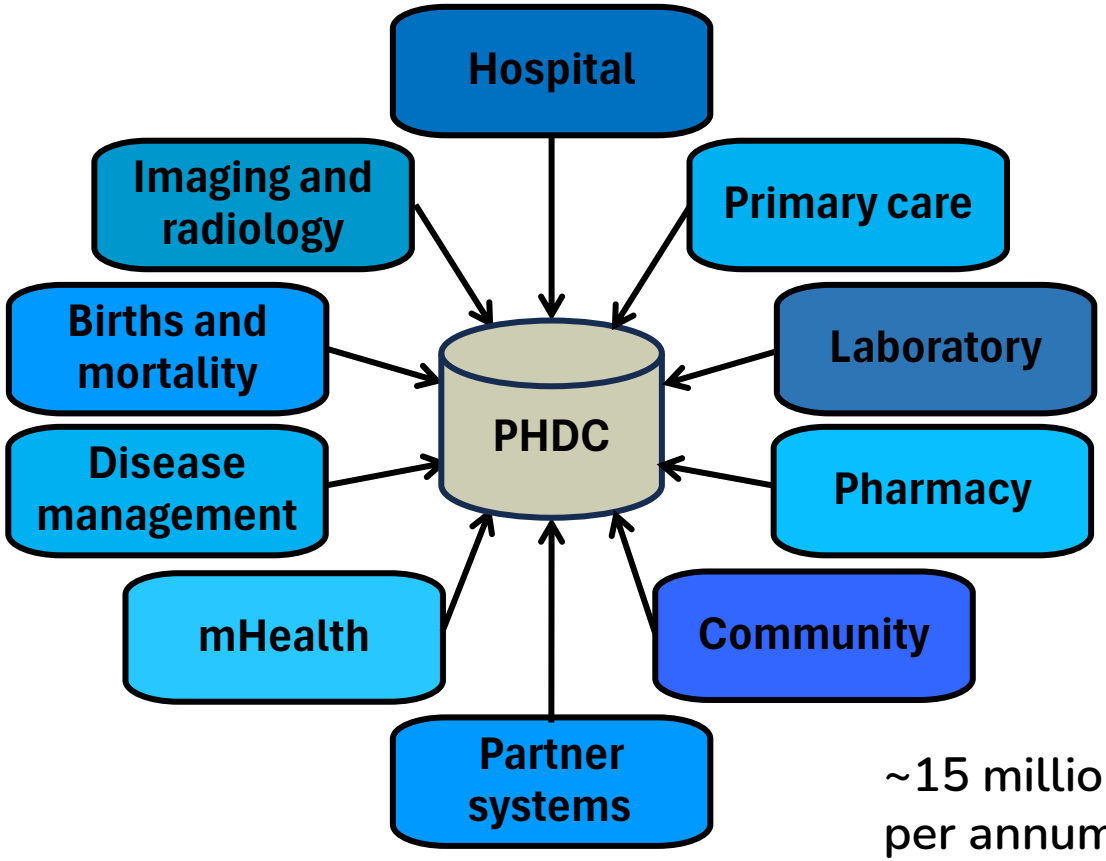
~7.5 million people
~75% use public sector health facilities

Boulle et al. IJPDS 2019
https://doi.org/10.23889/ijpds.v4i2.1143

Data curation and harmonisation



Patient presents for care
Unique patient identifier



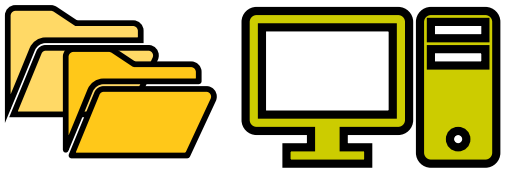
~15 million contacts per annum

Data sources

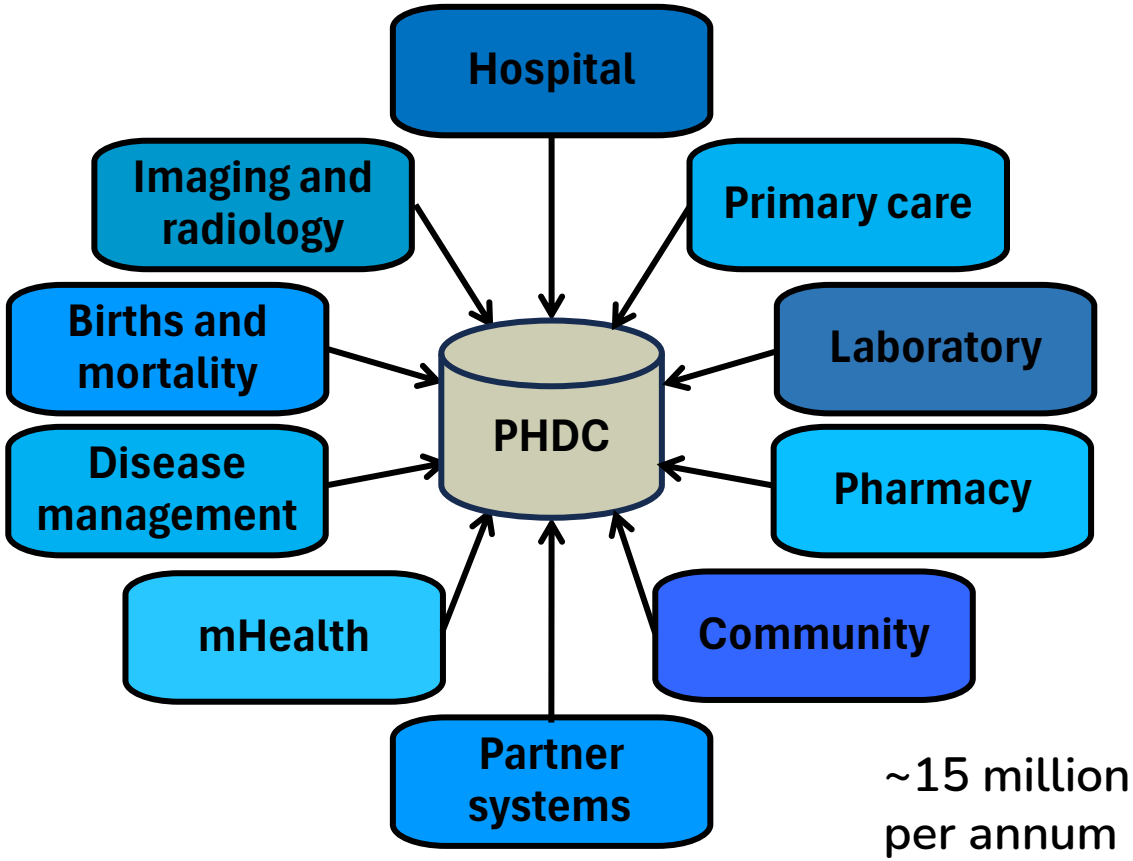
~7.5 million people
~75% use public sector health facilities

Boulle et al. IJPDS 2019
https://doi.org/10.23889/ijpds.v4i2.1143

Data curation and harmonisation

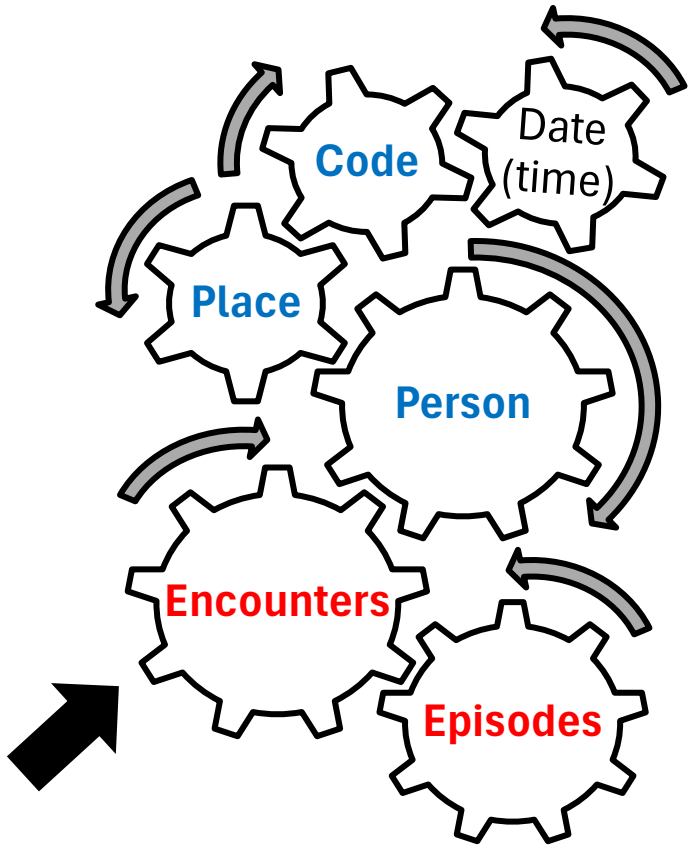


Patient presents for care
Unique patient identifier



~15 million contacts per annum

Data beneficiation

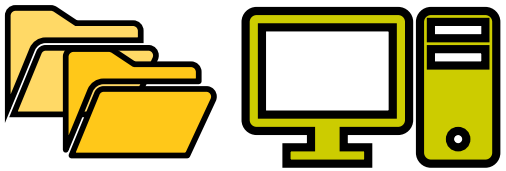


Data sources

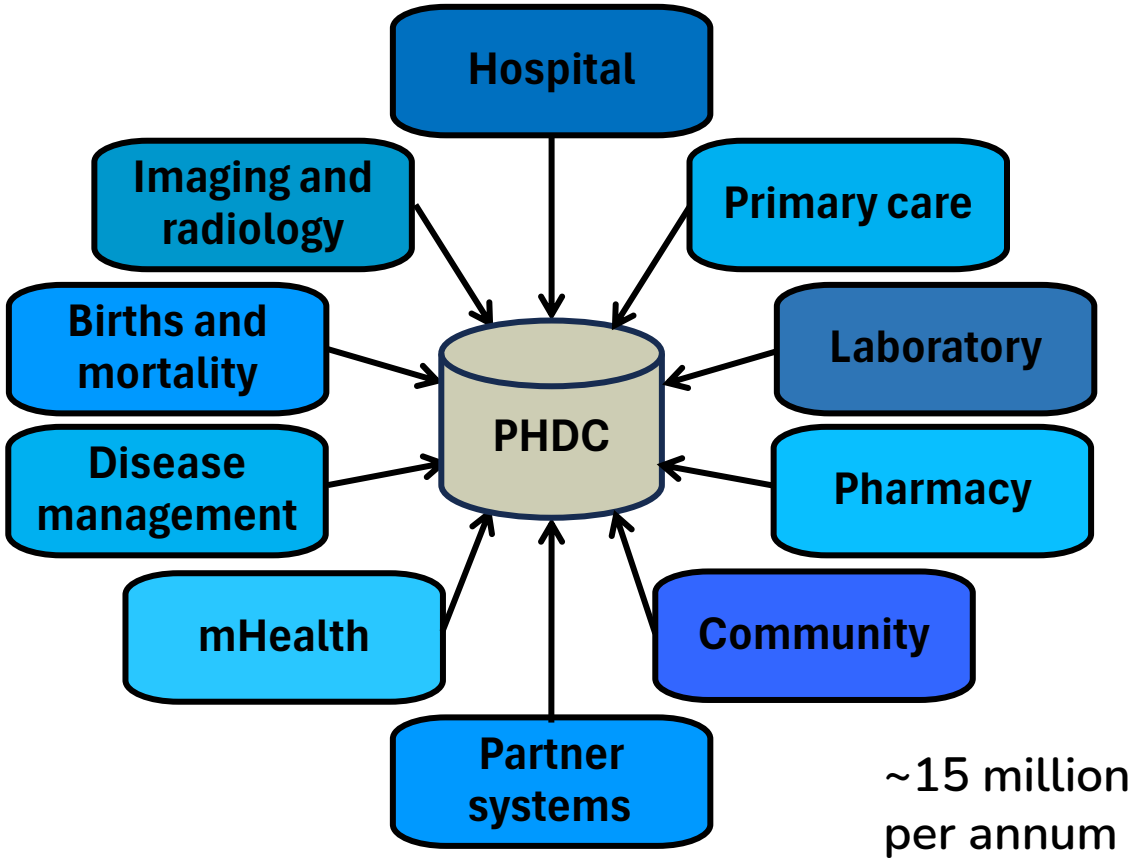
~7.5 million people
~75% use public sector health facilities

Boulle et al. IJPDS 2019
https://doi.org/10.23889/ijpds.v4i2.1143

Data curation and harmonisation

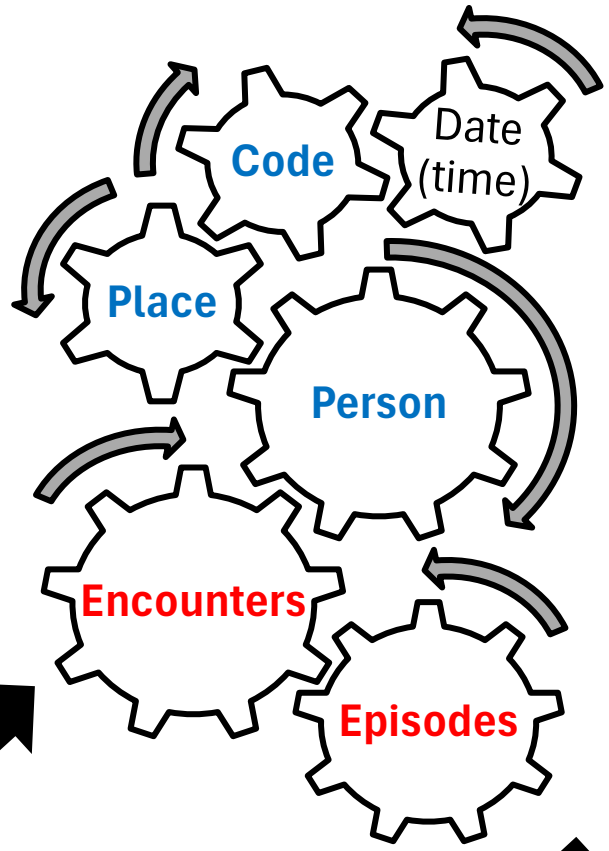


Patient presents for care
Unique patient identifier

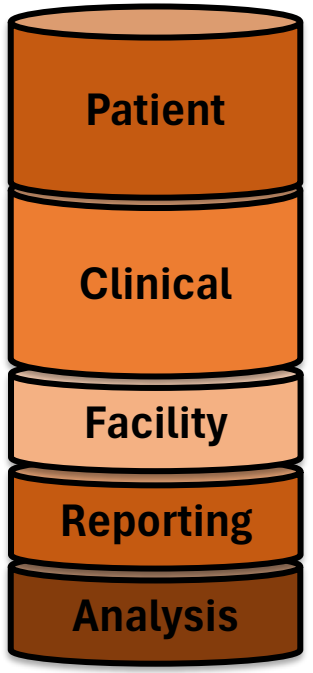


~15 million contacts per annum

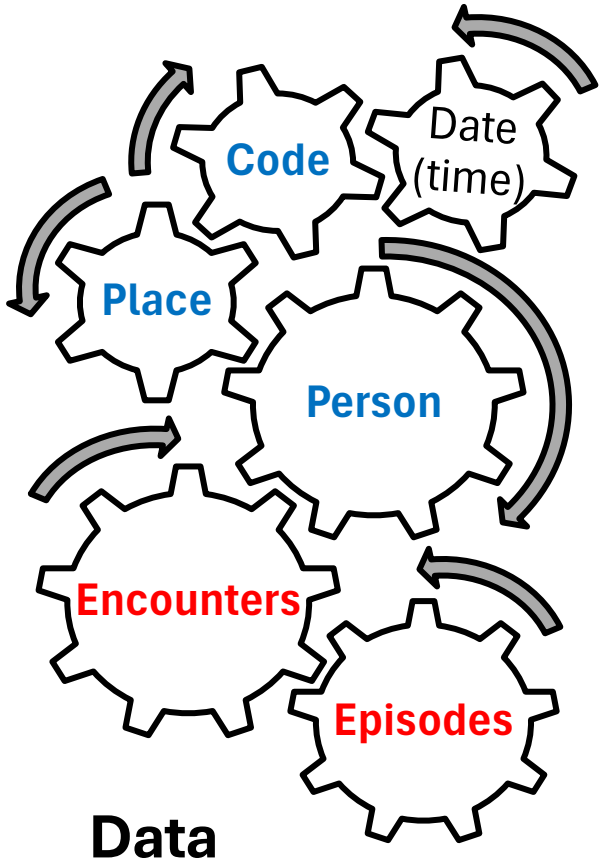
Data beneficiation



Data reporting



Data sources

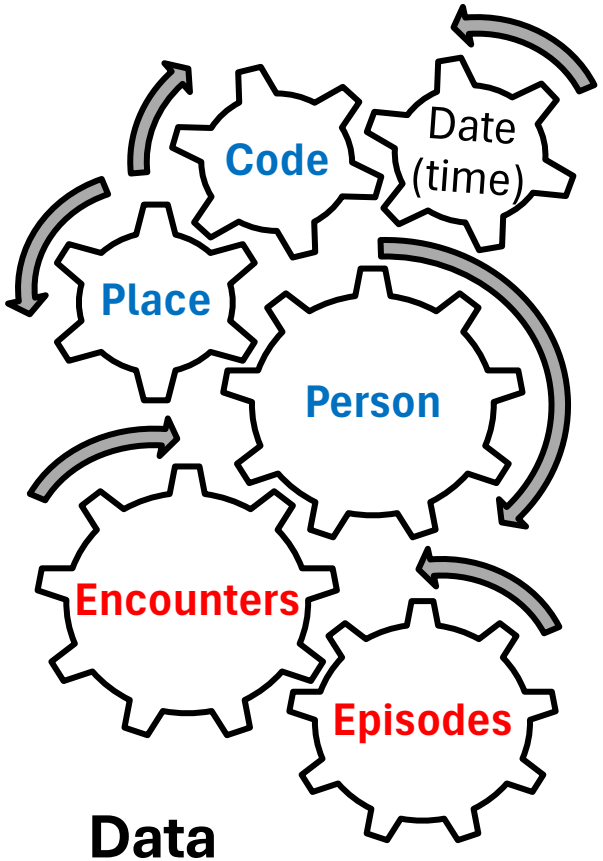


Data beneficiation

Data sources

Evidences extracted from all possible data sources

Evidence	Source	Category	Date
Positive rapid test	Labs	Weak-Moderate	2020-01-16
ICD10 code	Admission	Supporting	2020-04-03
Detectable viral load	Labs	High confidence	2020-04-05
Valid ART regimen	Drugs	High confidence	2020-04-05
Valid ART regimen	Drugs	High confidence	2020-06-01
ART treatment	Disease Register	High confidence	2020-06-01

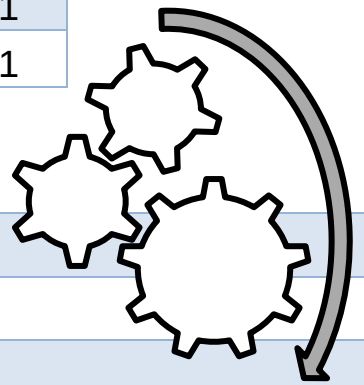


Data beneficiation

Data sources

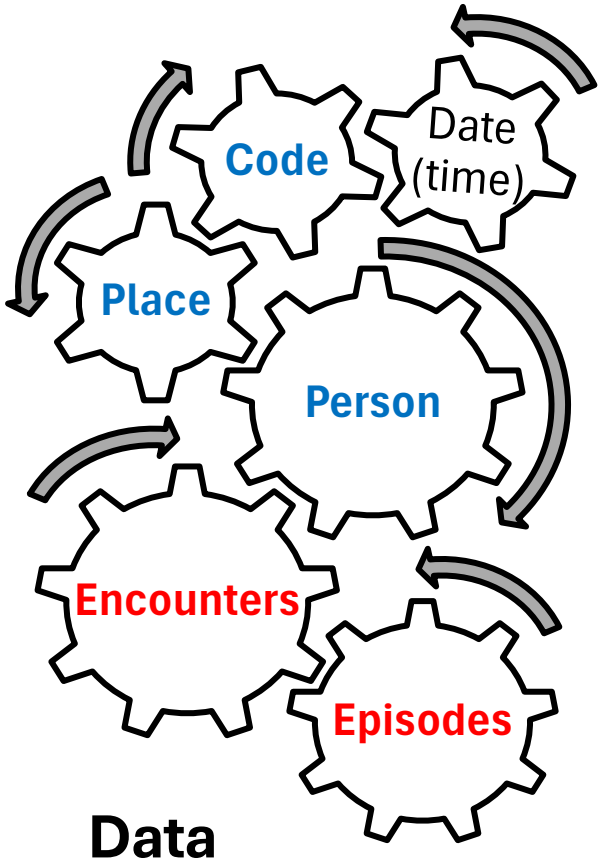
Evidences extracted from all possible data sources

Evidence	Source	Category	Date
Positive rapid test	Labs	Weak-Moderate	2020-01-16
ICD10 code	Admission	Supporting	2020-04-03
Detectable viral load	Labs	High confidence	2020-04-05
Valid ART regimen	Drugs	High confidence	2020-04-05
Valid ART regimen	Drugs	High confidence	2020-06-01
ART treatment	Disease Register	High confidence	2020-06-01



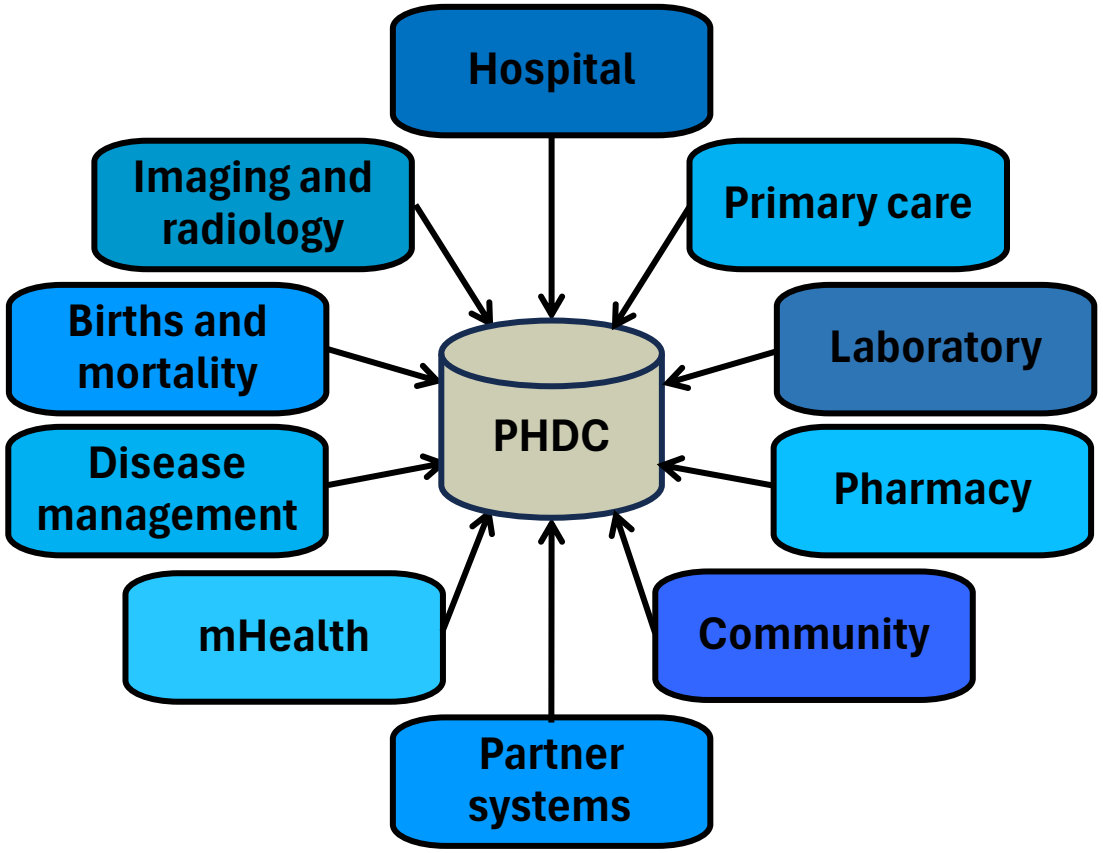
Summarised into single record per **episode**

Patient	
Episode number	1
Start date	2020-01-16
Treatment start date	2020-04-05
Last contact date	2020-06-01
Evidence list	Positive rapid test, ICD10 code, detectable viral load, ART dispensed, treatment register
Last evidence list	ART treatment register, valid ART regimen
Last evidence facility	KHC
Confidence	0.99 → High confidence

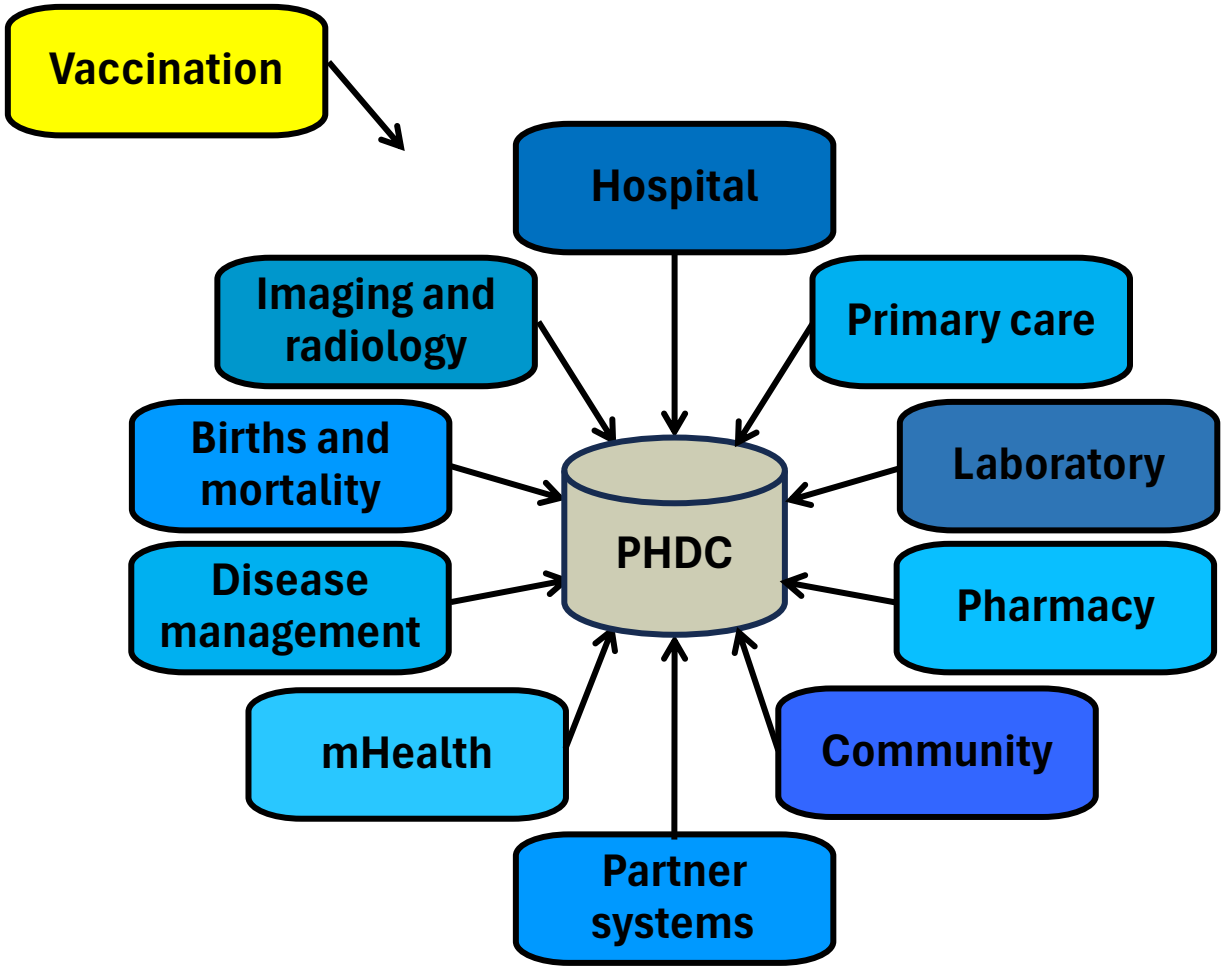


Data beneficiation

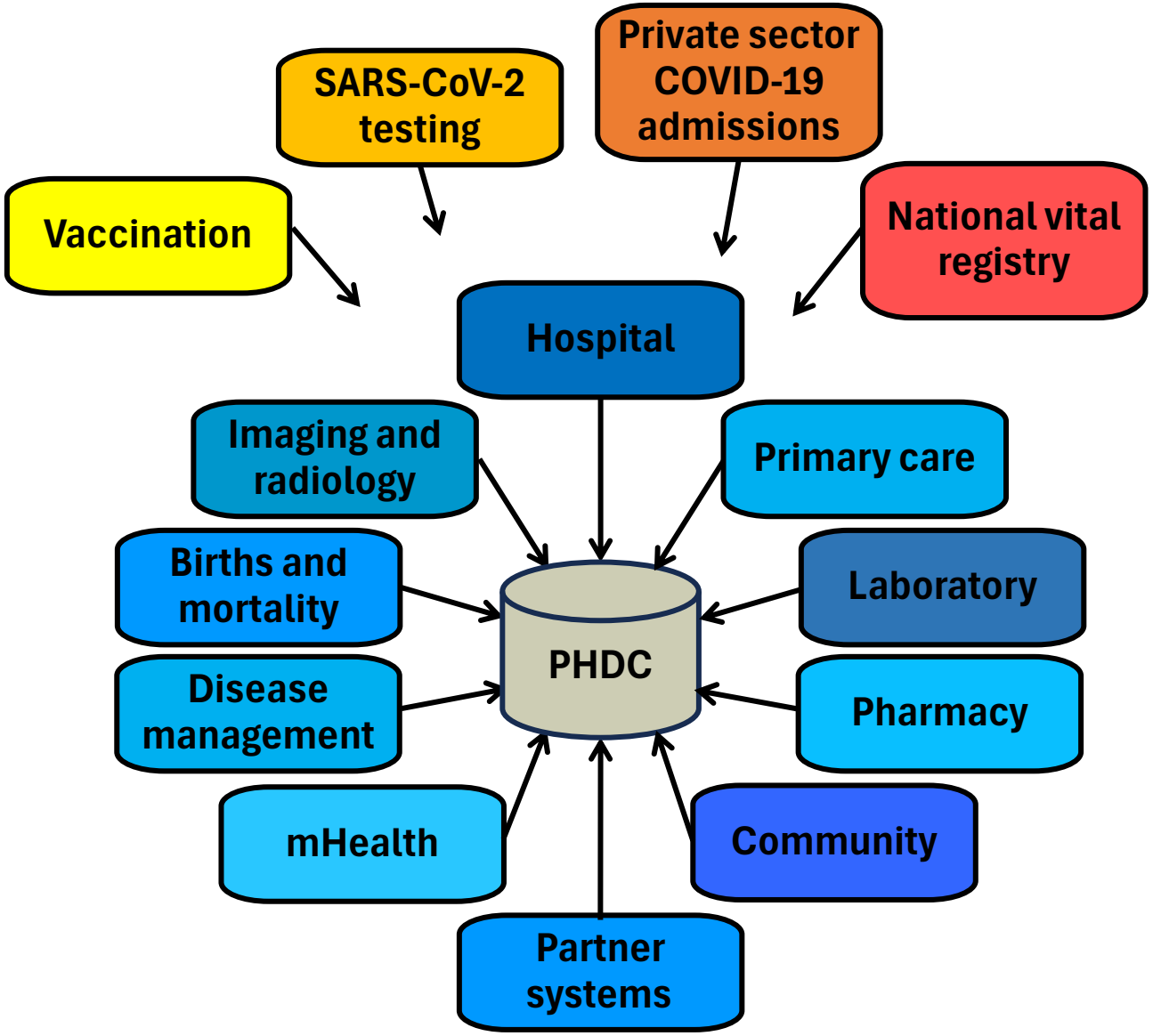
Data sources



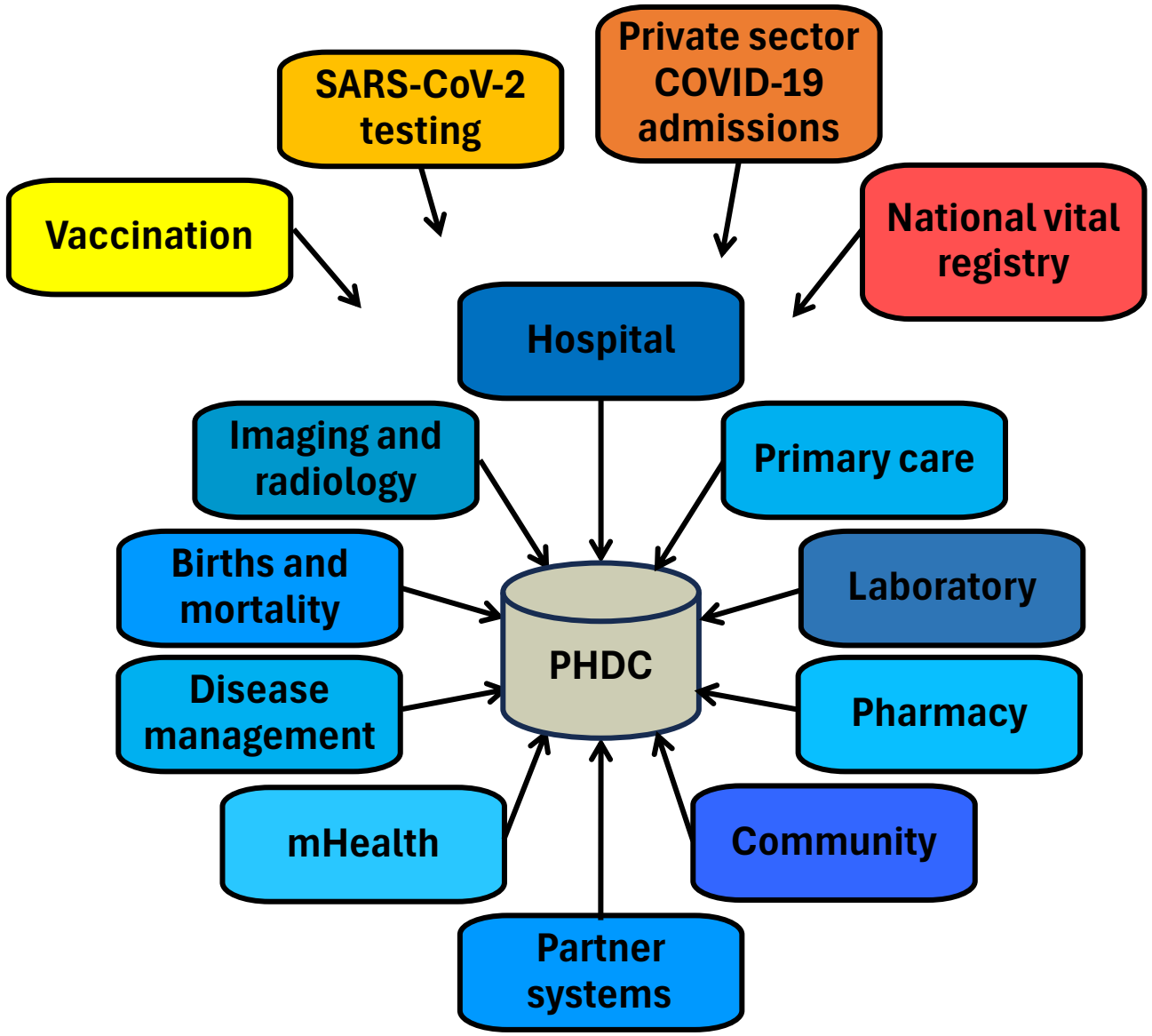
Data sources

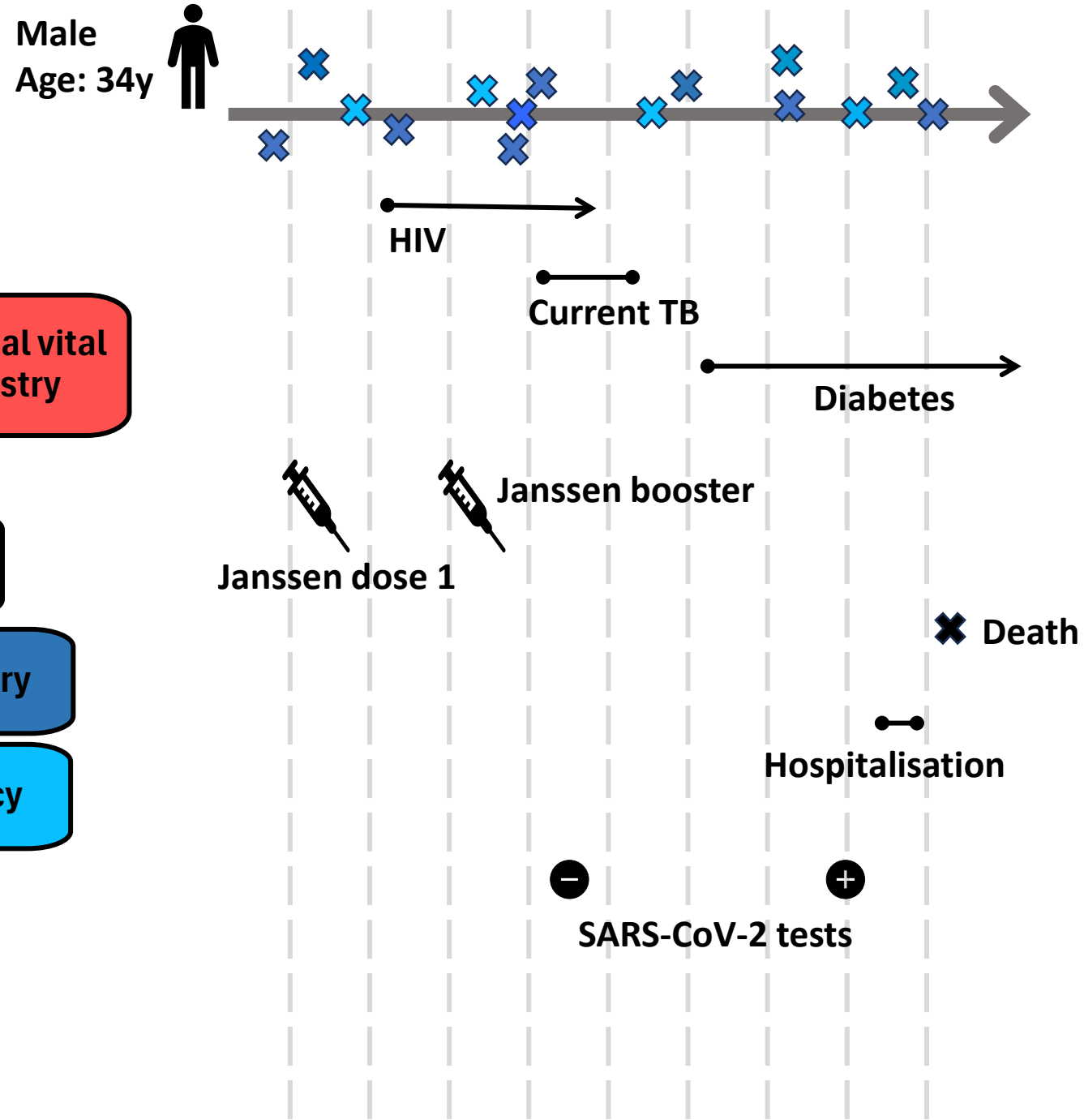


Data sources



Data sources





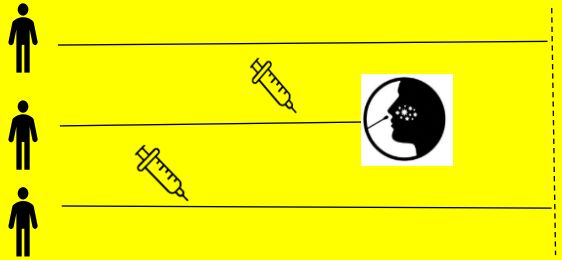
Statistical methods

Test-negative case control study

WHO, INTERIM GUIDANCE: Evaluation of COVID-19 vaccine effectiveness

Compare
vaccination status

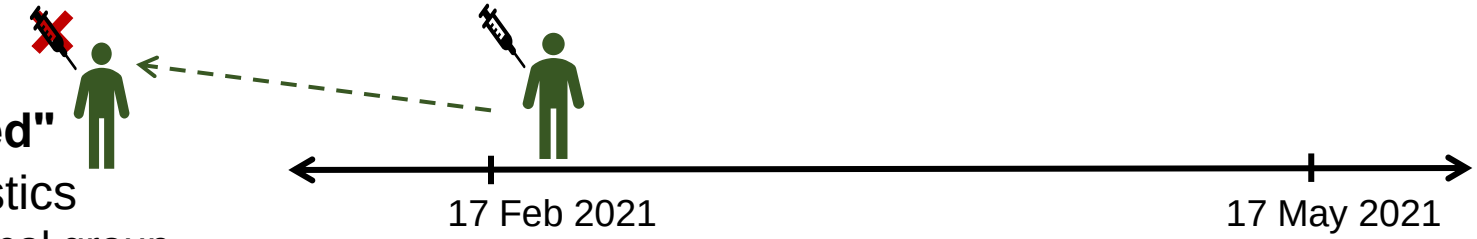
Survival analysis (adjusted)



Matched pair analysis

Matched pair analysis: Sisonke study

1



“Matched"

Similar characteristics
(age, sex, occupational group, prior documented infection, negative COVID-19 test count)

Matched pair analysis: Sisonke study

1

“Matched"

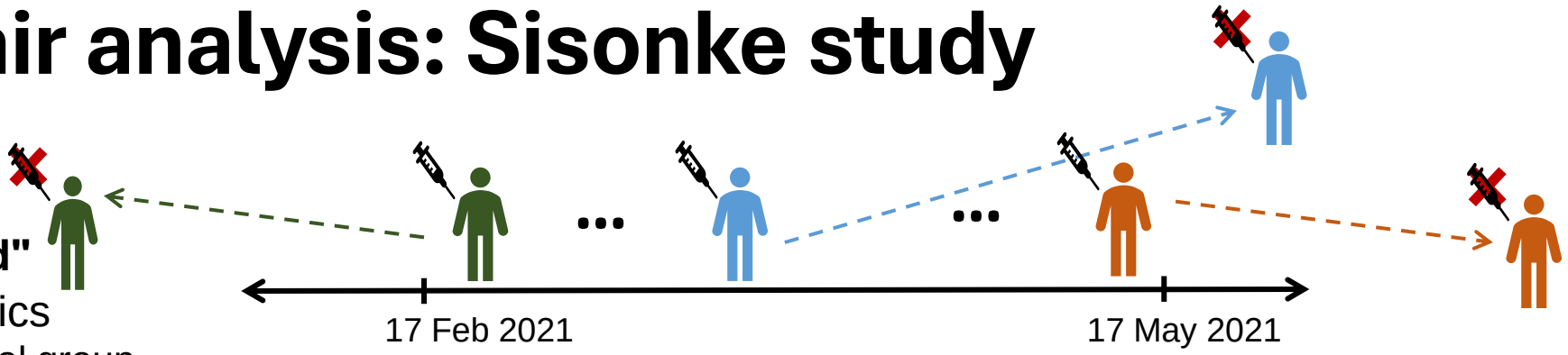
Similar characteristics
(age, sex, occupational group, prior documented infection, negative COVID-19 test count)

Matched pair analysis: Sisonke study

1

“Matched"

Similar characteristics
(age, sex, occupational group, prior documented infection, negative COVID-19 test count)

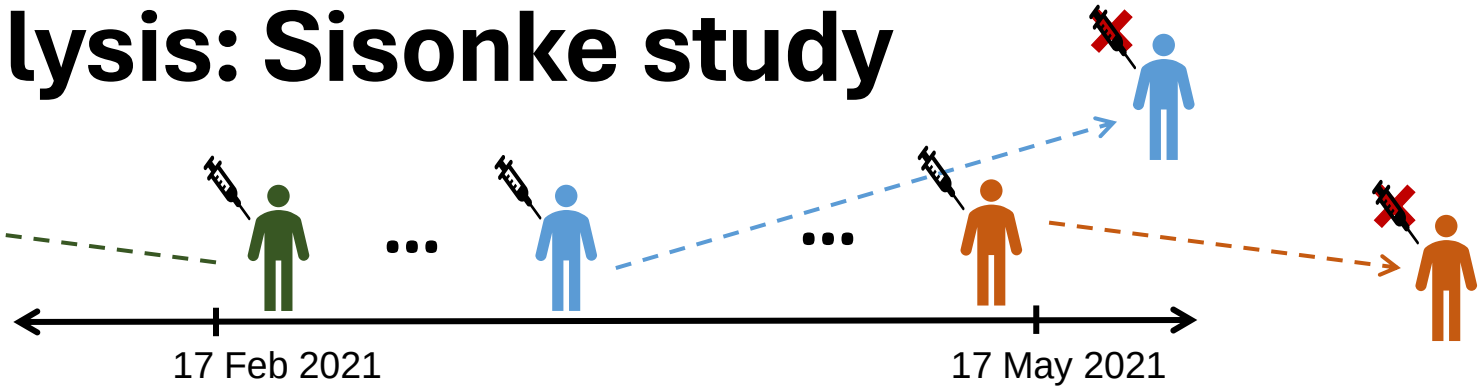


Matched pair analysis: Sisonke study

1

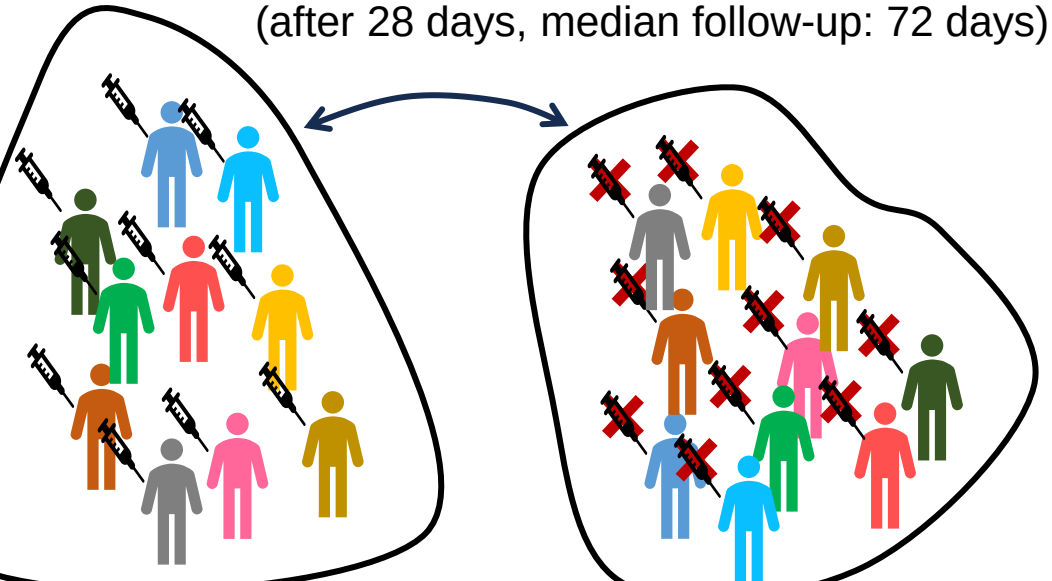
“Matched"

Similar characteristics
(age, sex, occupational group,
prior documented infection,
negative COVID-19 test count)



2

Compare rates of severe COVID-19
(after 28 days, median follow-up: 72 days)

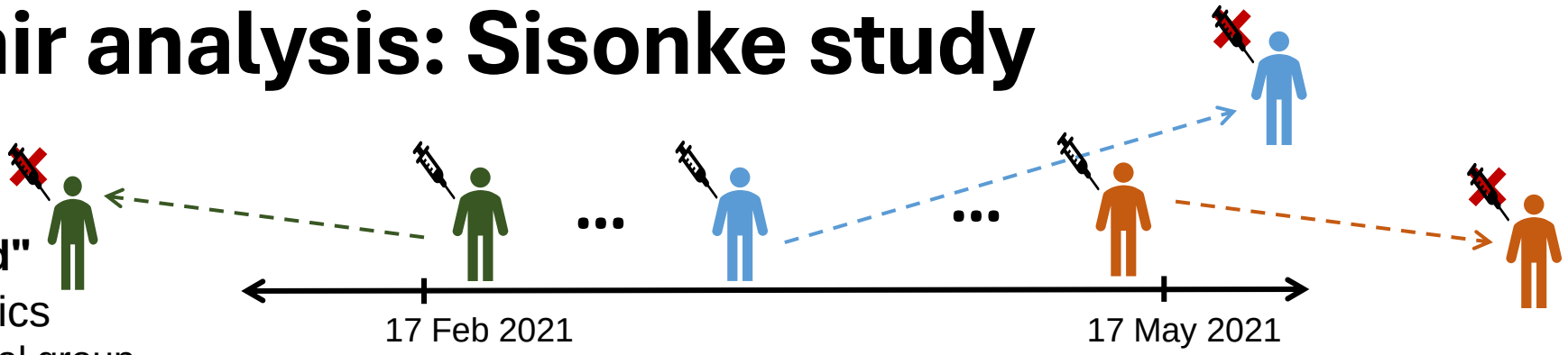


Matched pair analysis: Sisonke study

1

“Matched"

Similar characteristics
(age, sex, occupational group, prior documented infection, negative COVID-19 test count)

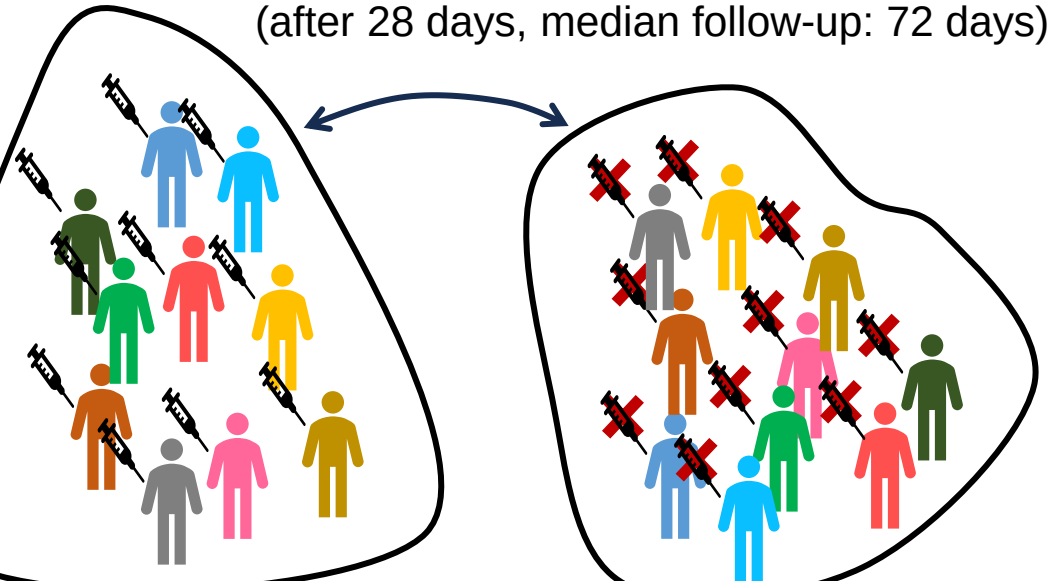


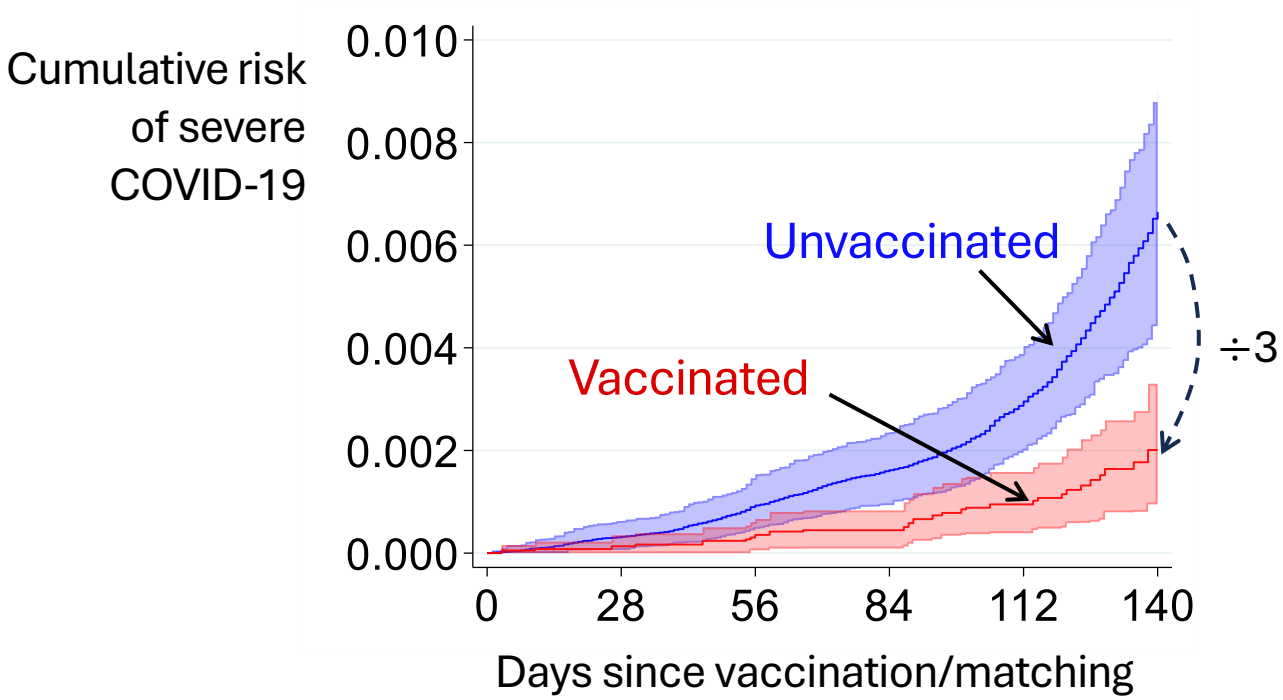
3 n = 34 399 (vaccinated: 22 305)

68% reduction (95% CI: 48,86) in the rate of severe COVID-19 (in vaccinated vs unvaccinated)

2

Compare rates of severe COVID-19
(after 28 days, median follow-up: 72 days)





Adjusted survival analysis: General population

1. Cox proportional hazards models…

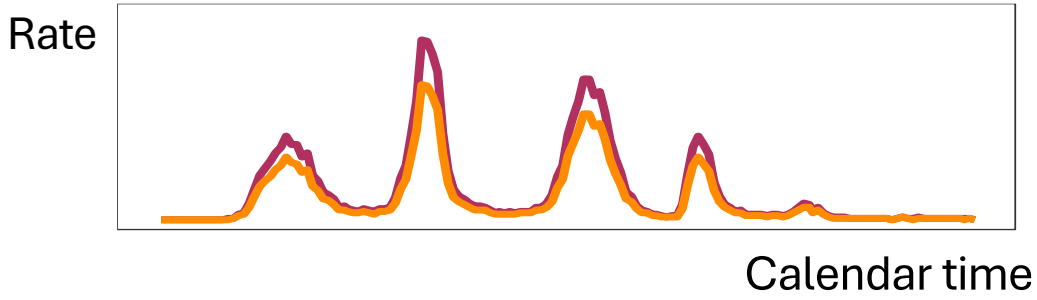
2. with time varying vaccination status…

3. and adjusted for several constant or time-varying covariates

Adjusted survival analysis: General population

1. Cox proportional hazards models…

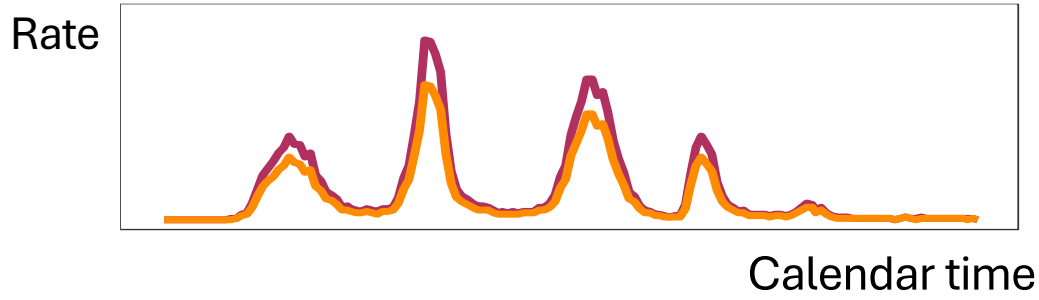
2. with time varying vaccination status…



3. and adjusted for several constant or time-varying covariates

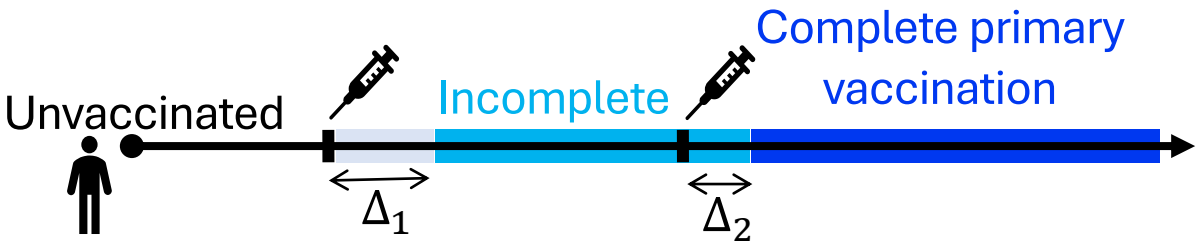
Adjusted survival analysis: General population

1. Cox proportional hazards models…



2. with time varying vaccination status…

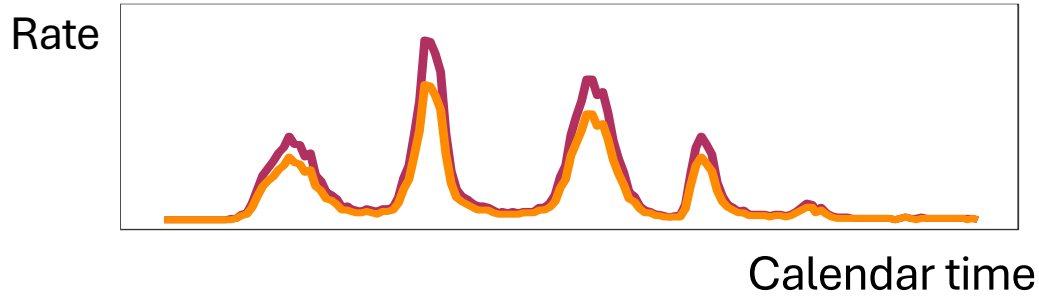
1) Vaccine state



3. and adjusted for several constant or time-varying covariates

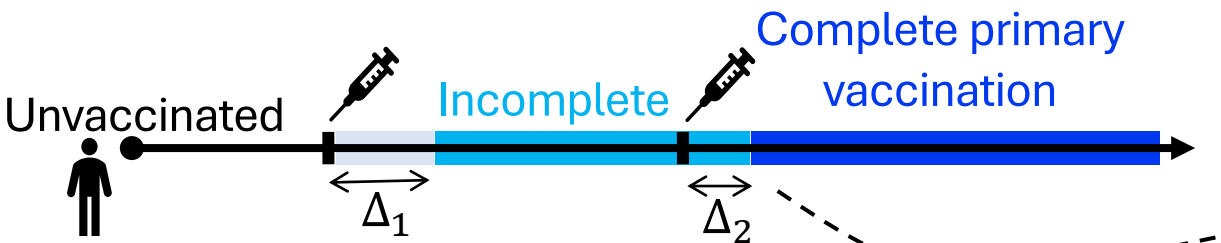
Adjusted survival analysis: General population

1. Cox proportional hazards models…



2. with time varying vaccination status…

1) Vaccine state

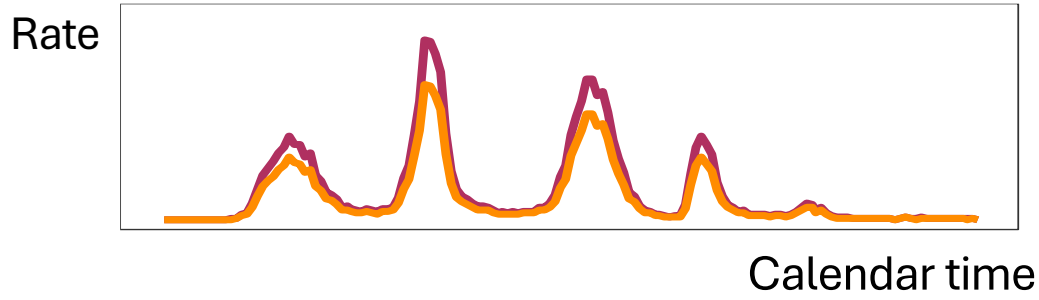


2) Time since completing vaccination

3. and adjusted for several constant or time-varying covariates

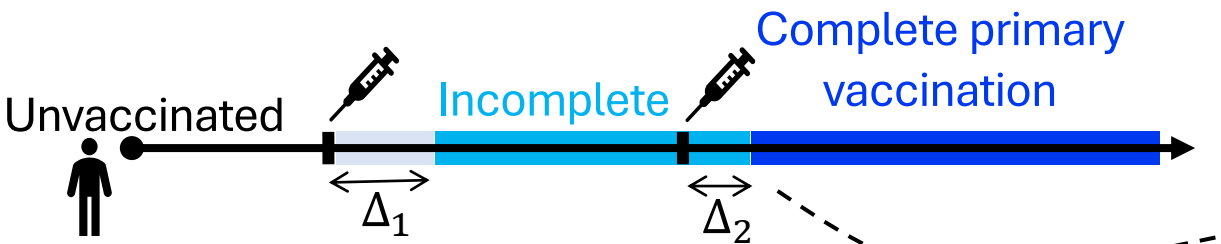
Adjusted survival analysis: General population

1. Cox proportional hazards models…

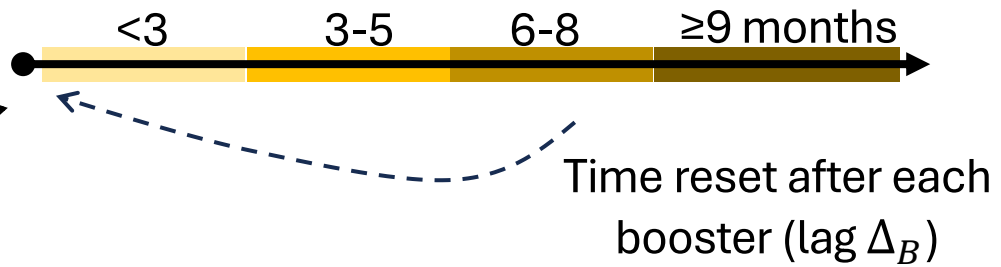


2. with time varying vaccination status…

1) Vaccine state



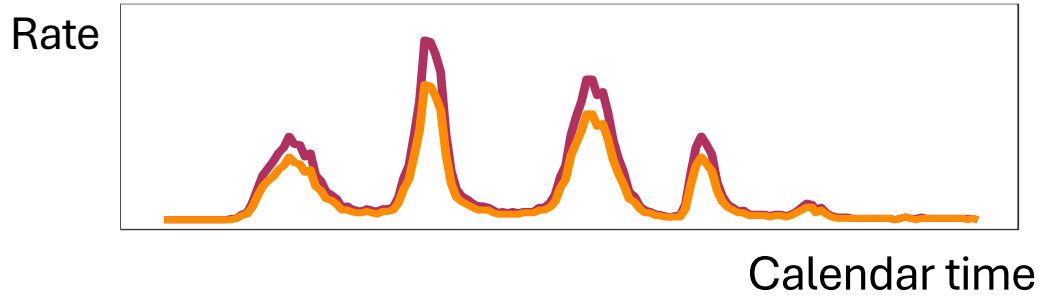
2) Time since completing vaccination / boosting



3. and adjusted for several constant or time-varying covariates

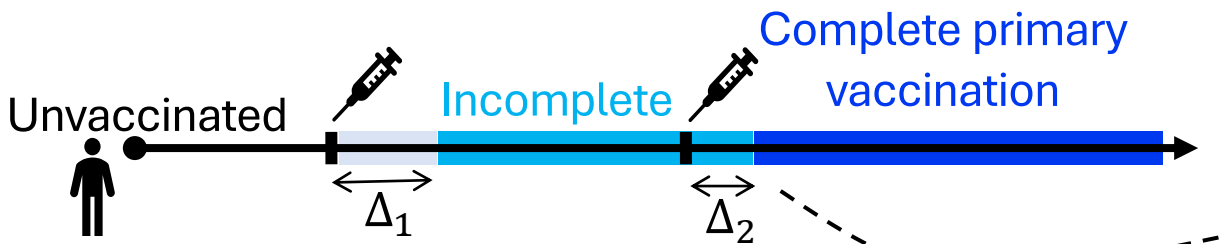
Adjusted survival analysis: General population

1. Cox proportional hazards models…

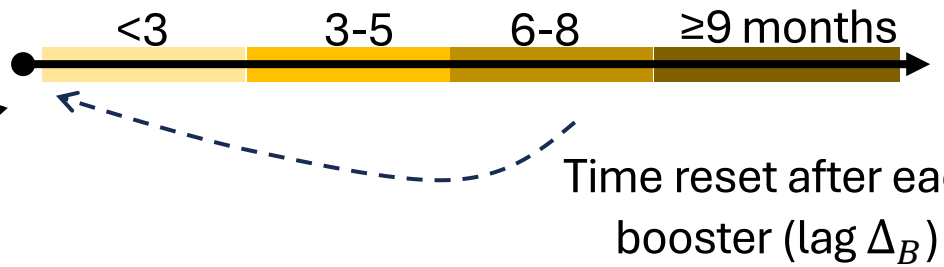


2. with time varying vaccination status…

1) Vaccine state



2) Time since completing vaccination / boosting

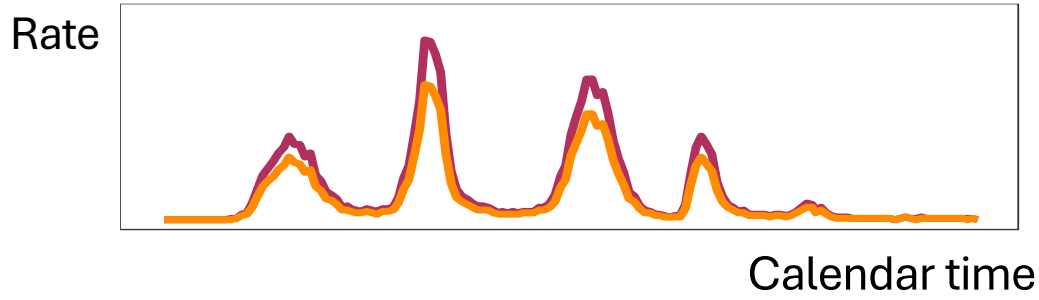


3. and adjusted for several constant or time-varying covariates

> 15 covariates (demographic characteristics, underlying health conditions, socioeconomic status proxies and healthcare utilisation)

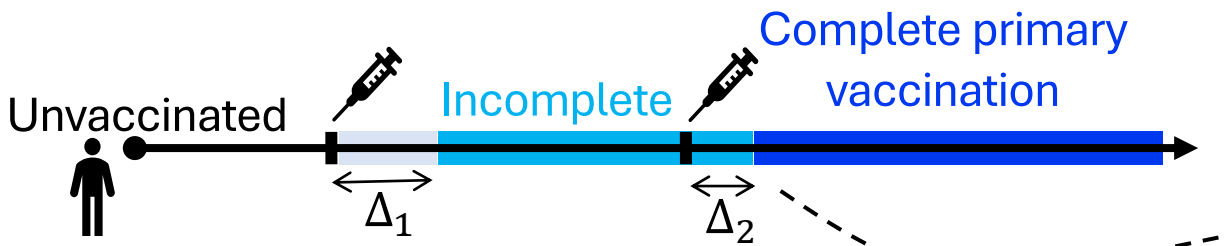
Adjusted survival analysis: General population

1. Cox proportional hazards models…

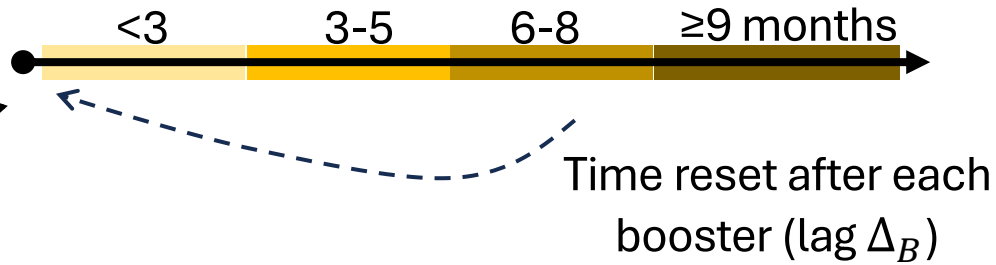


2. with time varying vaccination status…

1) Vaccine state



2) Time since completing vaccination / boosting



3. and adjusted for several constant or time-varying covariates

> 15 covariates (demographic characteristics, underlying health conditions, socioeconomic status proxies and healthcare utilisation)

4. n > 2.4 million (2021-2022)
During each wave, high VE within 3 months of completing/boosting vaccination (with rapid reductions thereafter); and no detectable differences in VE by HIV status

Wrap up

- **Rapid research** in response to an emerging infection, leveraging existing **routine health data** to create a **virtual cohort**

- Updated **results used in real-time** during the COVID-19 pandemic to inform South Africa's vaccination program

- **Largest general population observational cohort study of COVID-19 vaccine effectiveness in Africa**

References

Western Cape PHDC:
Boulle et al. International Journal of Population Data Science 2019.

Sisonke study VE:
Bekker et al. The Lancet 2022.

General population VE:
Kassanjee et al. Vaccines 2024.

Next speaker: Miguel Hernán