Modeling to support decision making on vaccination programs

AIB 2024, Helsinki

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4.12.2024   Finnish Institute for Health and Welfare, THL

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Function: Modeling to support decision-making
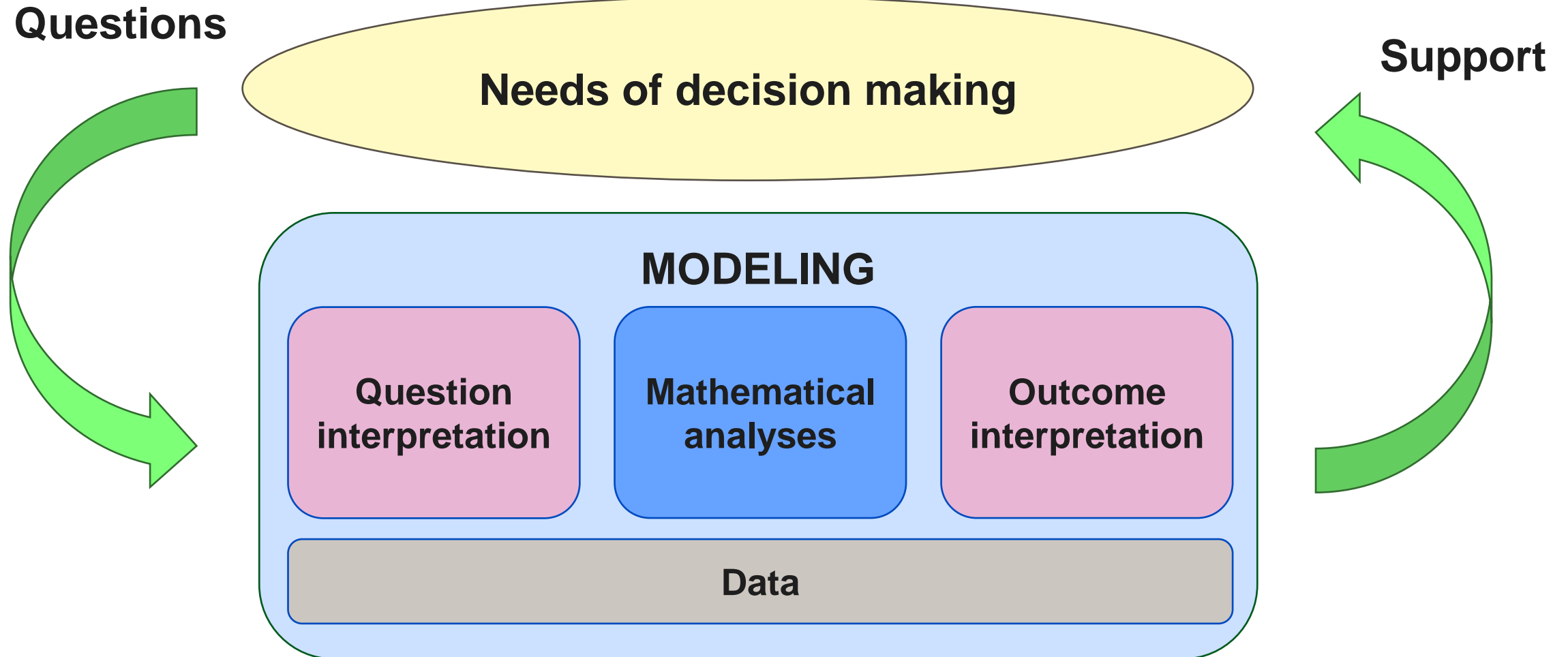
Main expertise (1-2 lines):

- **Mathematical modelling**

Disclosure of potential conflicts of interest

The Finnish Institute for Health and Welfare (THL) has received research funding from several pharmaceutical vaccine manufacturing companies until March 2022.

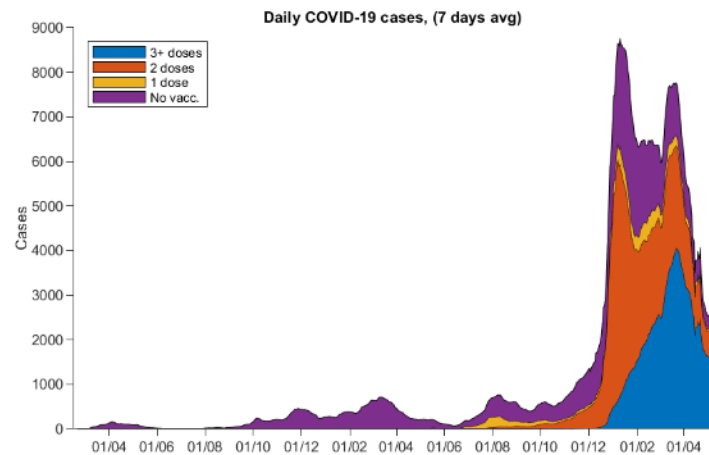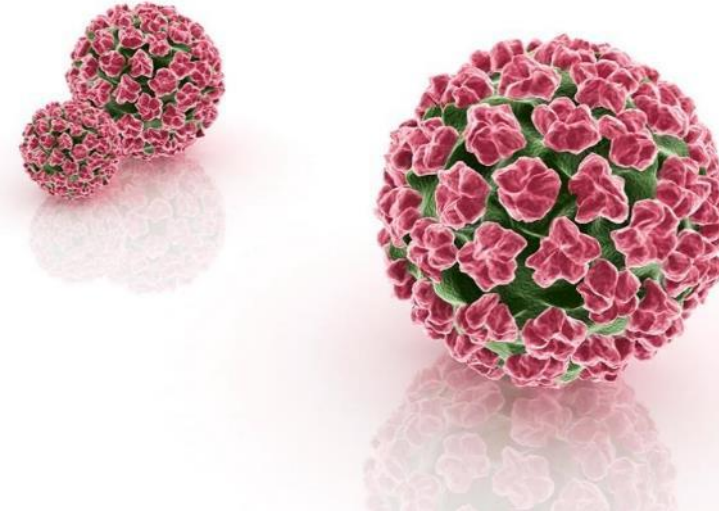The author declares no personal competing interests.
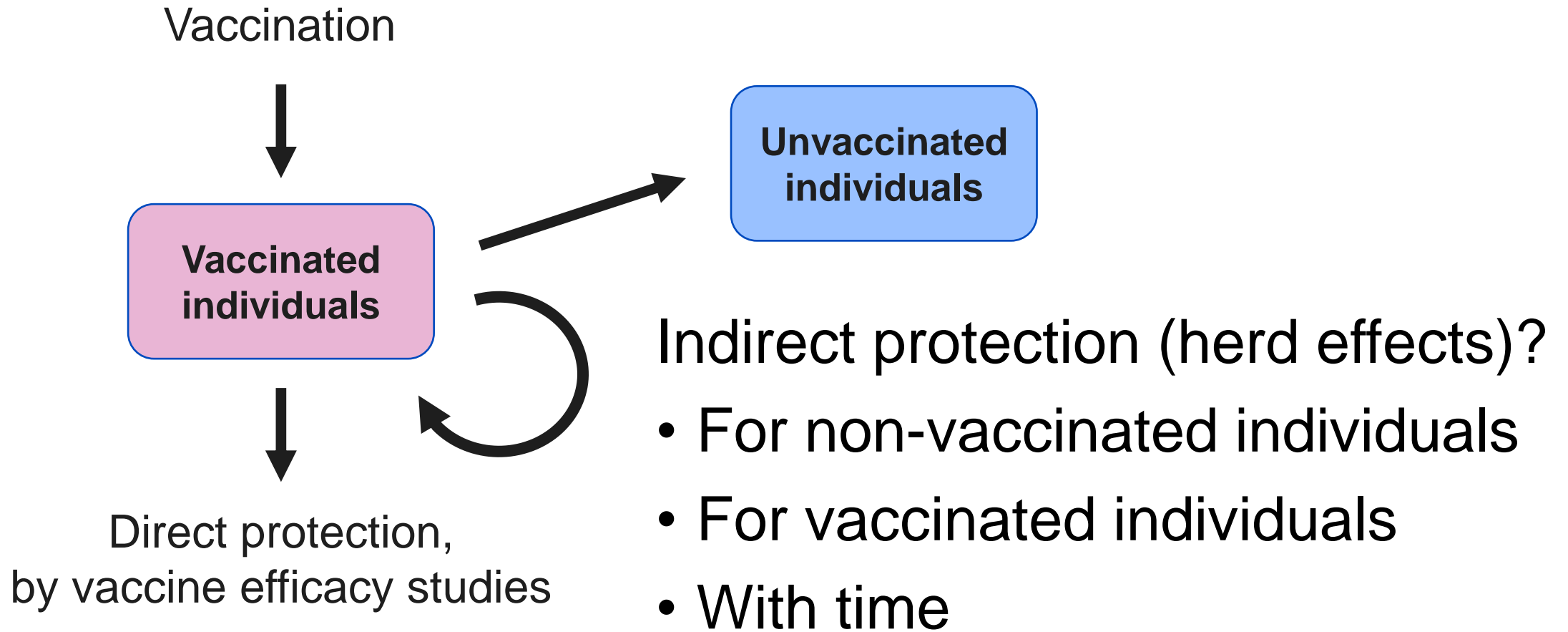
Modeling to support decision making

Questions

Support

Needs of decision making

MODELING

| Question interpretation | Mathematical analyses | Outcome interpretation |

Data

Typical situations to use modeling, examples

- New vaccine and/or new target groups

Daily COVID-19 cases, (7 days avg)

New vaccine and/or new target groups

Vaccination

Vaccinated individuals

Unvaccinated individuals

Direct protection,
by vaccine efficacy studies

Indirect protection (herd effects)?

- For non-vaccinated individuals
- For vaccinated individuals
- With time

Typical situations to use modeling, examples

- New vaccine and/or new target groups

- Complicated structure, different interactions
  - An example: HPV vaccination for girls/girls&boys
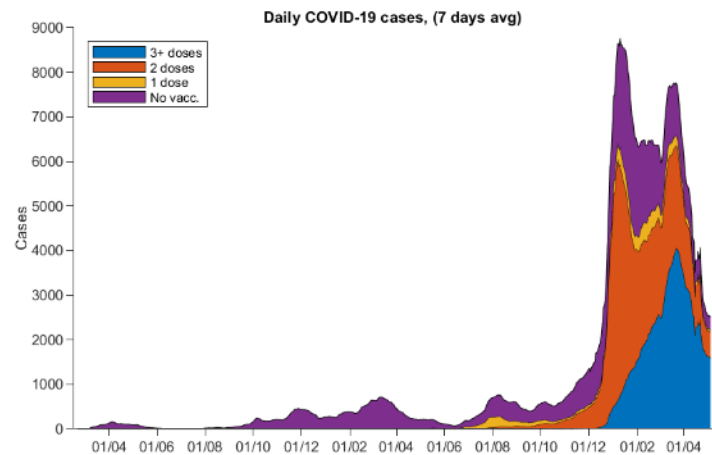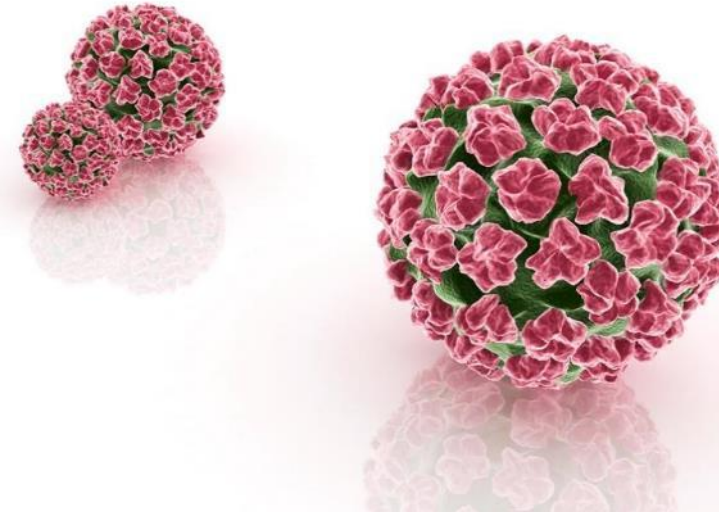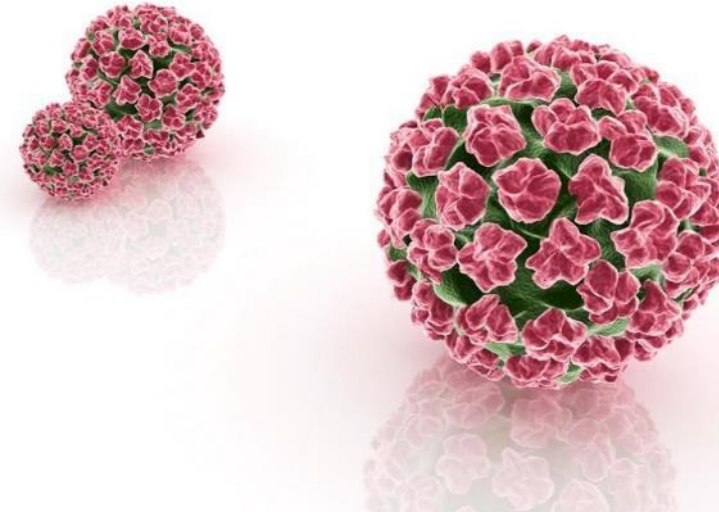
HPV model components/cervical cancer

Sexual contact structure

Different vaccines

INFECTION

INTERVENTIONS

Girls-only or Girls&Boys vaccination

PRIMARY INFECTION

TRANSMISSION MODEL

VACCINATION

High number of different HPV types

HPV INCIDENCE

Coverage

CANCER DEVELOPMENT

NATURAL HISTORY MODEL

SCREENING TREATMENT

Screening attendance

With a model, one can evaluate changes in different components one-by-one, or together

Genital warts, other cancers

Screening tests and algorithms

Expert group report, 2011
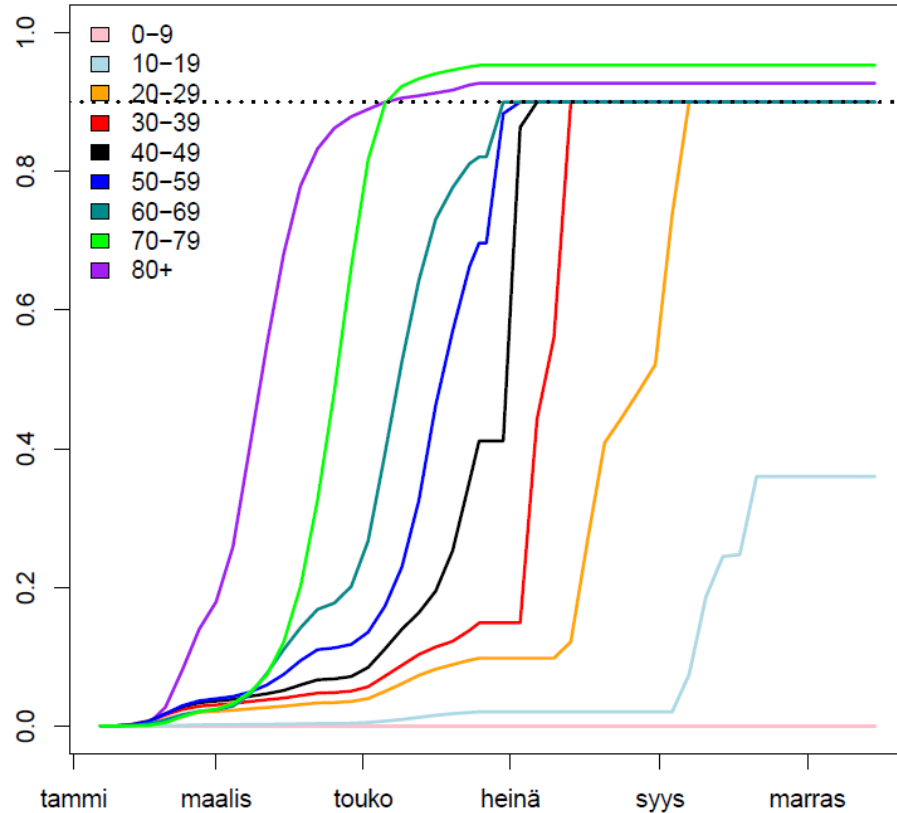
https://urn.fi/URN:NBN:fi-fe201205085434

Typical situations to use modeling, examples

- New vaccine and/or new target groups
- Complicated structure, different interactions
- Vaccine procurements

Daily COVID-19 cases, (7 days avg)
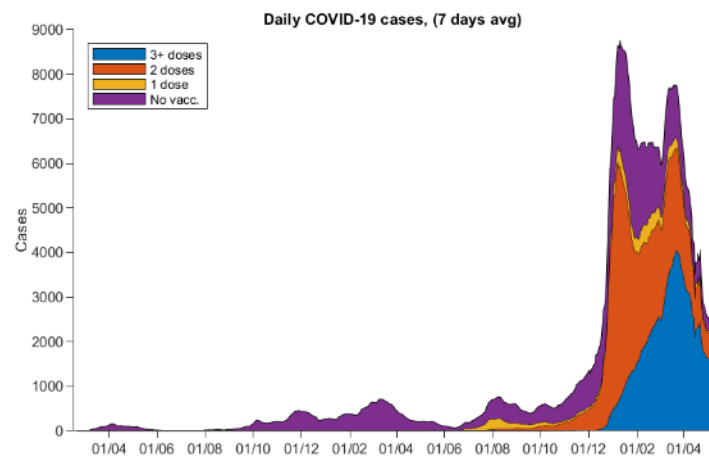
Typical situations to use modeling, examples

- New vaccine and/or new target groups

- Complicated structure, different interactions

- Vaccine procurements

- Different options/scenarios and uncertainties
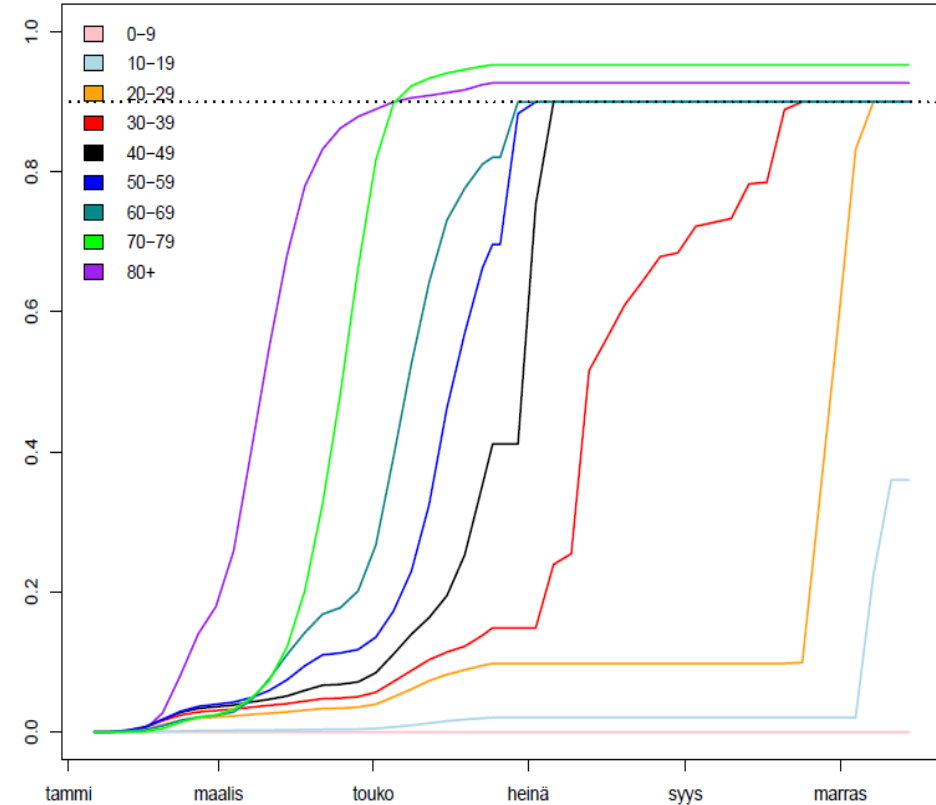   - Example: Shortage of COVID-19 vaccines

Daily COVID-19 cases, (7 days avg)
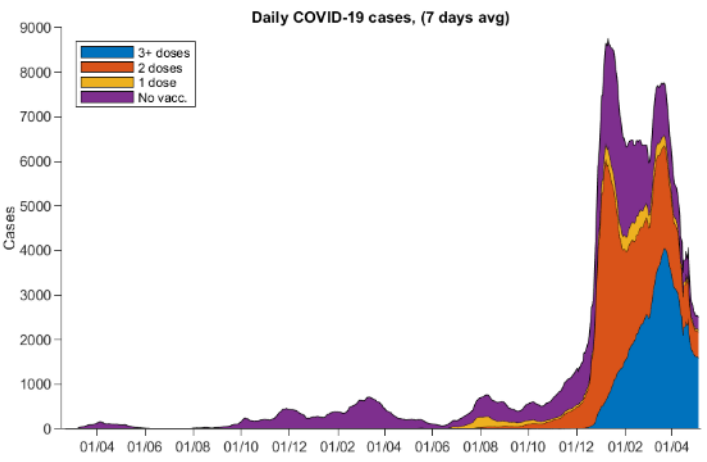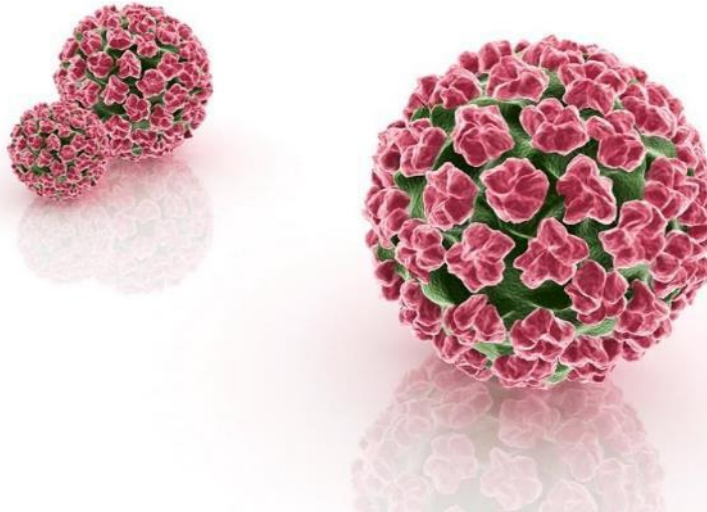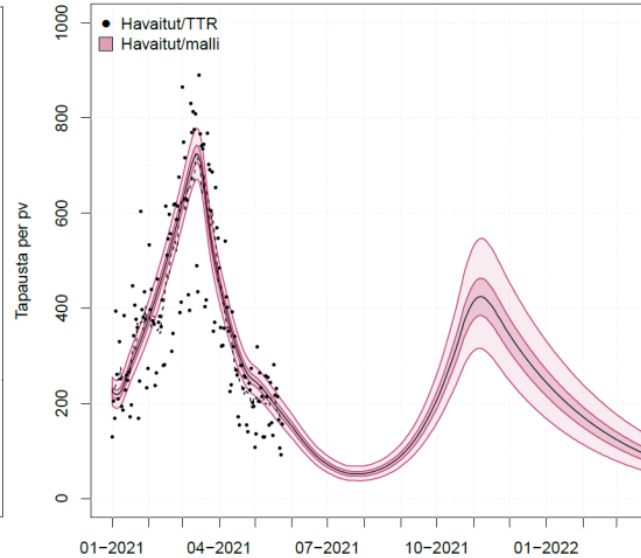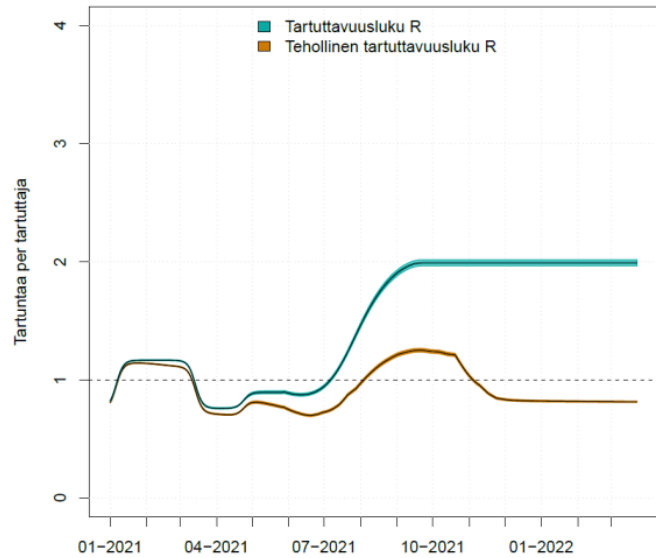
Scenarios for imported doses, vaccine coverage

Expected import

Slow import

Scenario for R=2 in September 2021

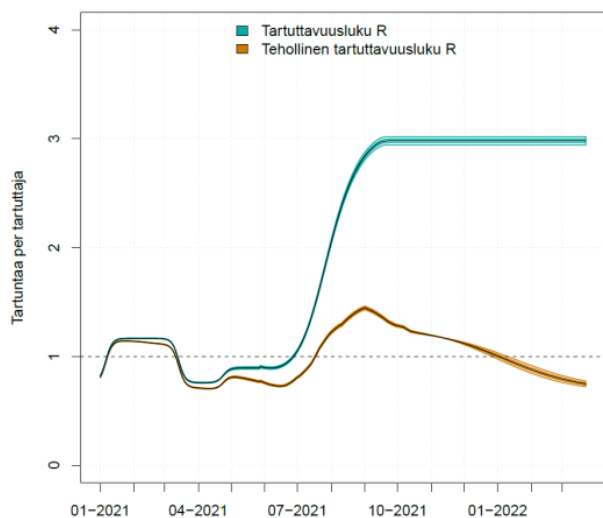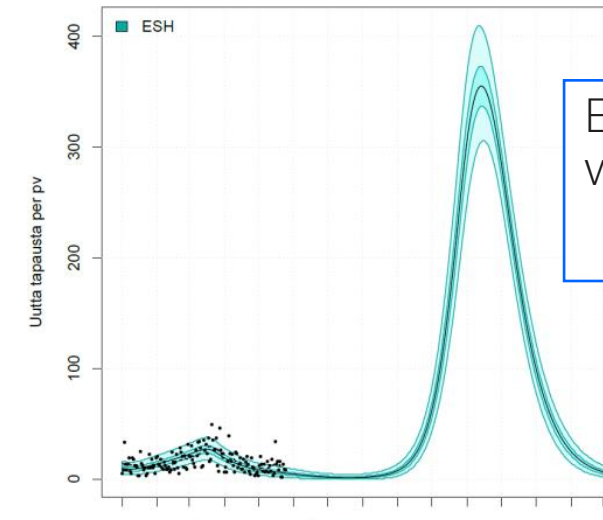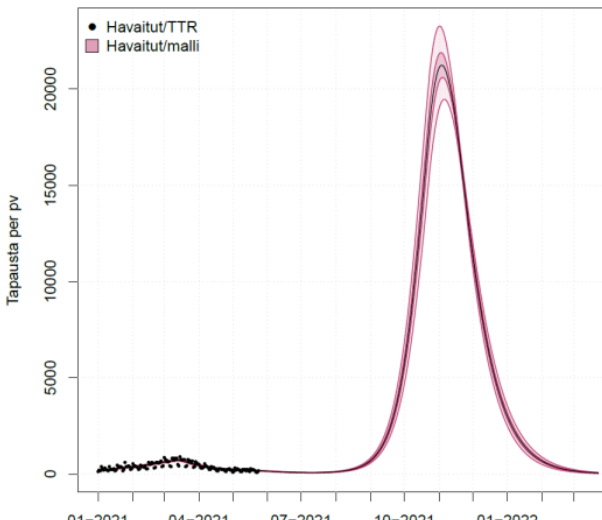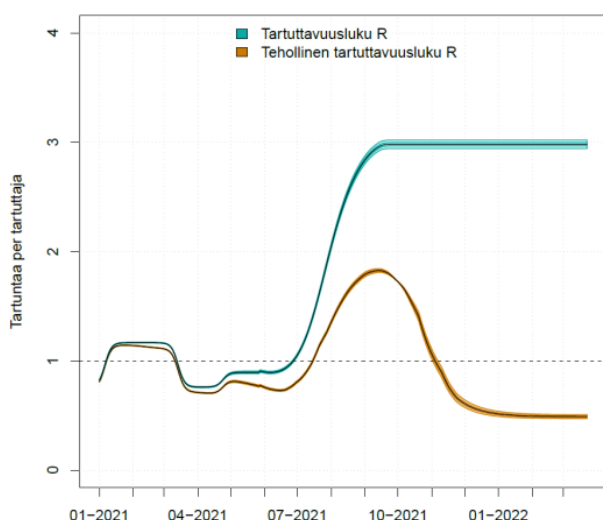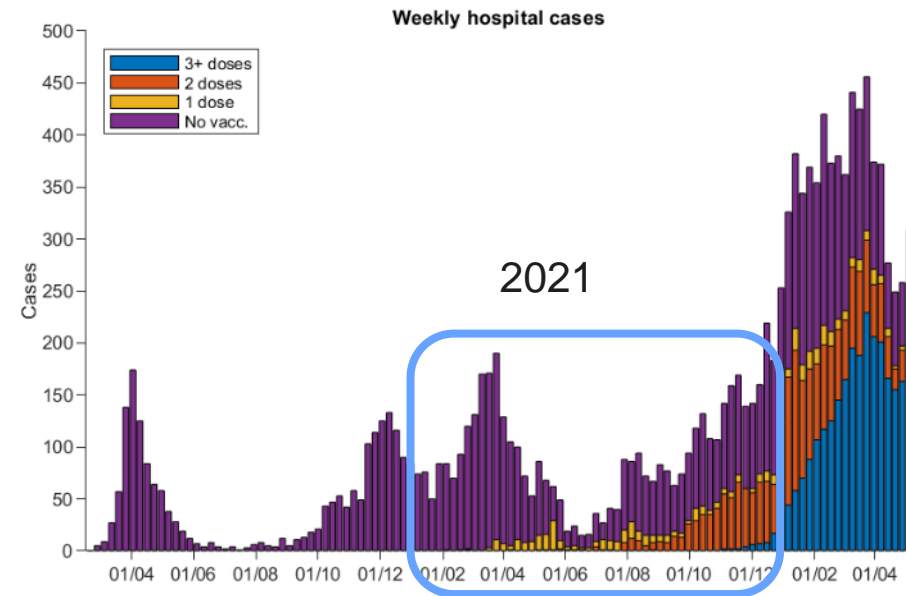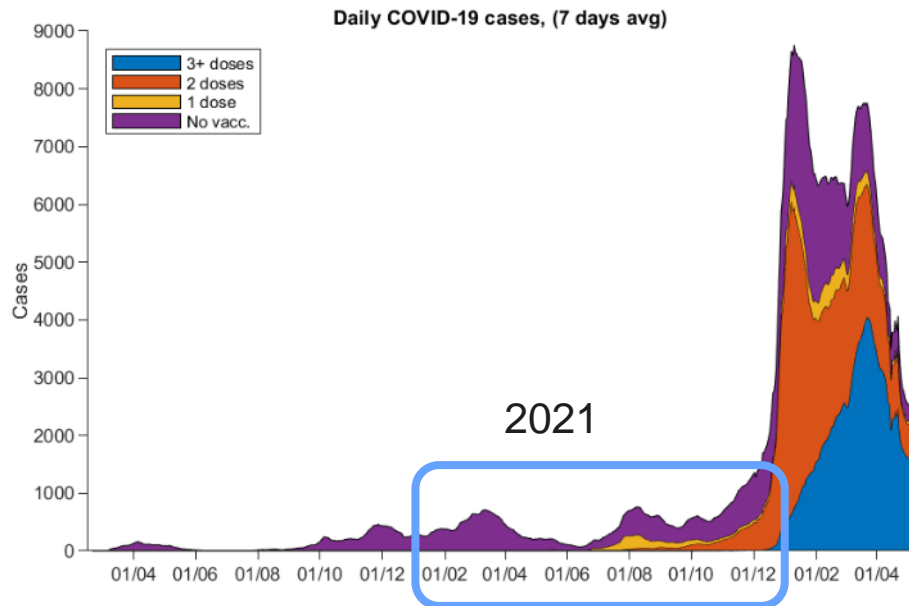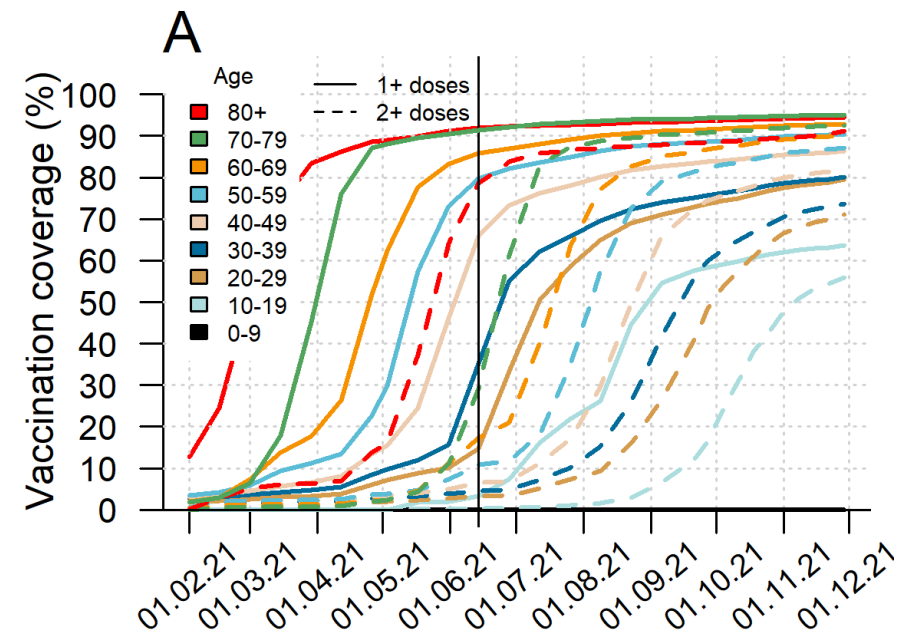# Scenario for R=3 in September 2021

Expected
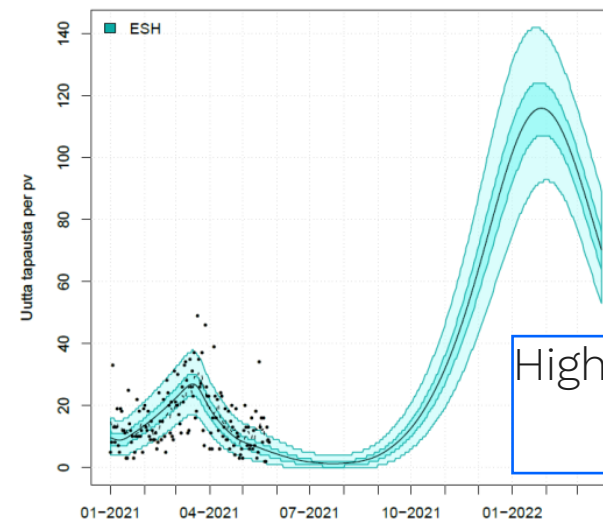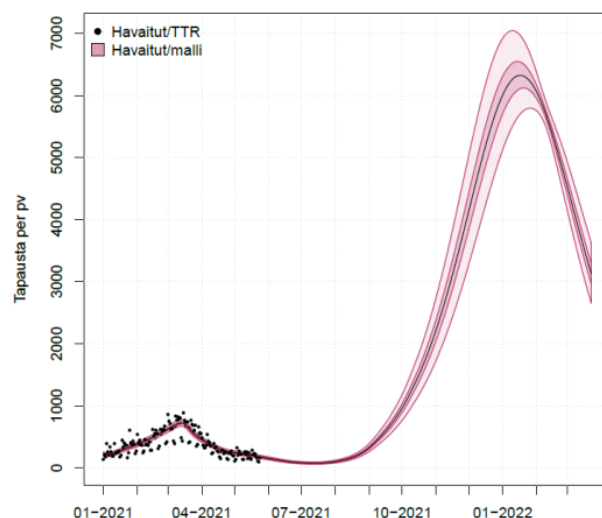
Slow

High wave in October

Even higher wave

How did it go?

- R0 increased to ~2 already in July by Delta variant
- Vaccination progressed even faster than expected

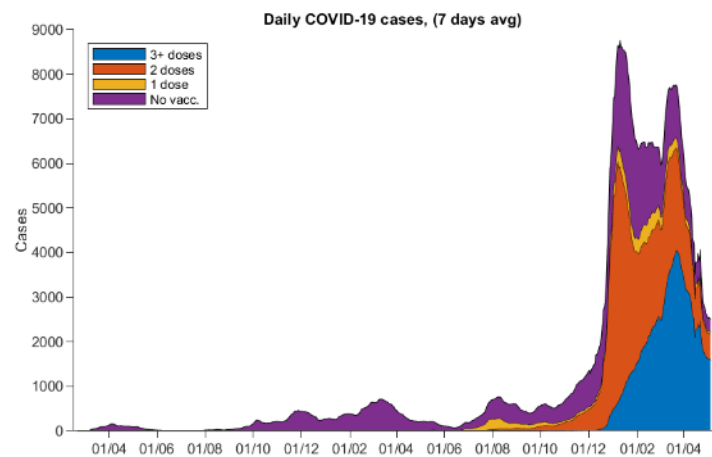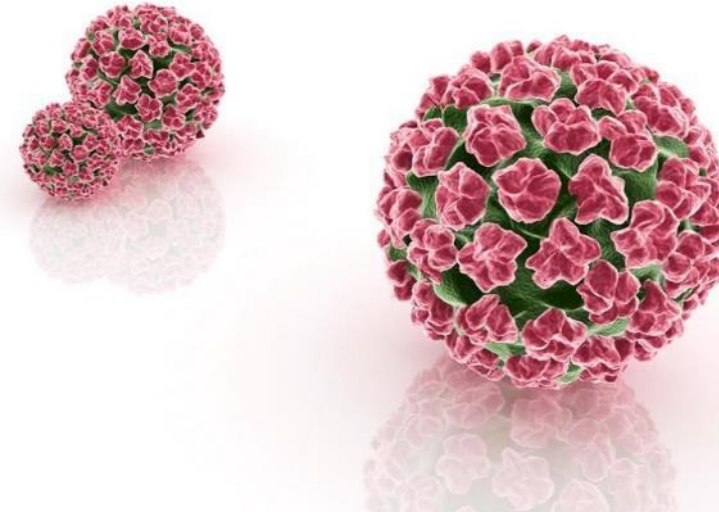# Typical situations to use modeling, examples

- New vaccine and/or new target groups

- Complicated structure, different interactions

- Vaccine procurements

- Different options/scenarios and uncertainties

- Realized total/overall vaccine effectiveness
  - Example: COVID-19, era of Delta variant


Daily COVID-19 cases, (7 days avg)

Components of vaccine effectiveness

To estimate total/overall effectiveness

- Data from the Intervention population

- Model needed to reconstruct the Control population
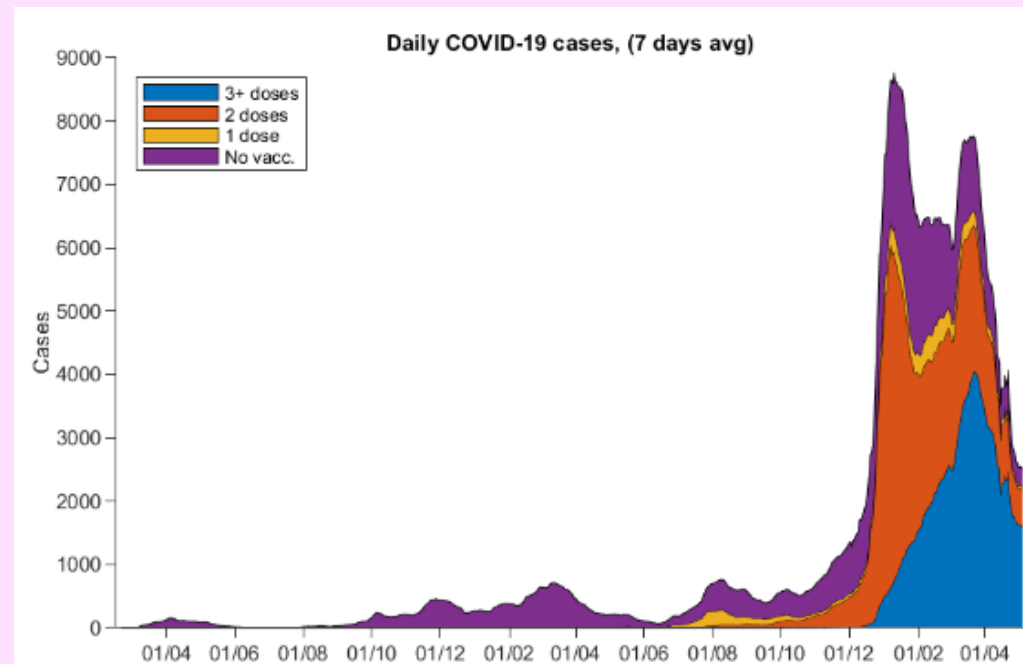
Partly vaccinated intervention population

Control population

Total

Direct

Indirect

| Vaccinated individuals | Unvaccinated individuals | Unvaccinated individuals |

Overall
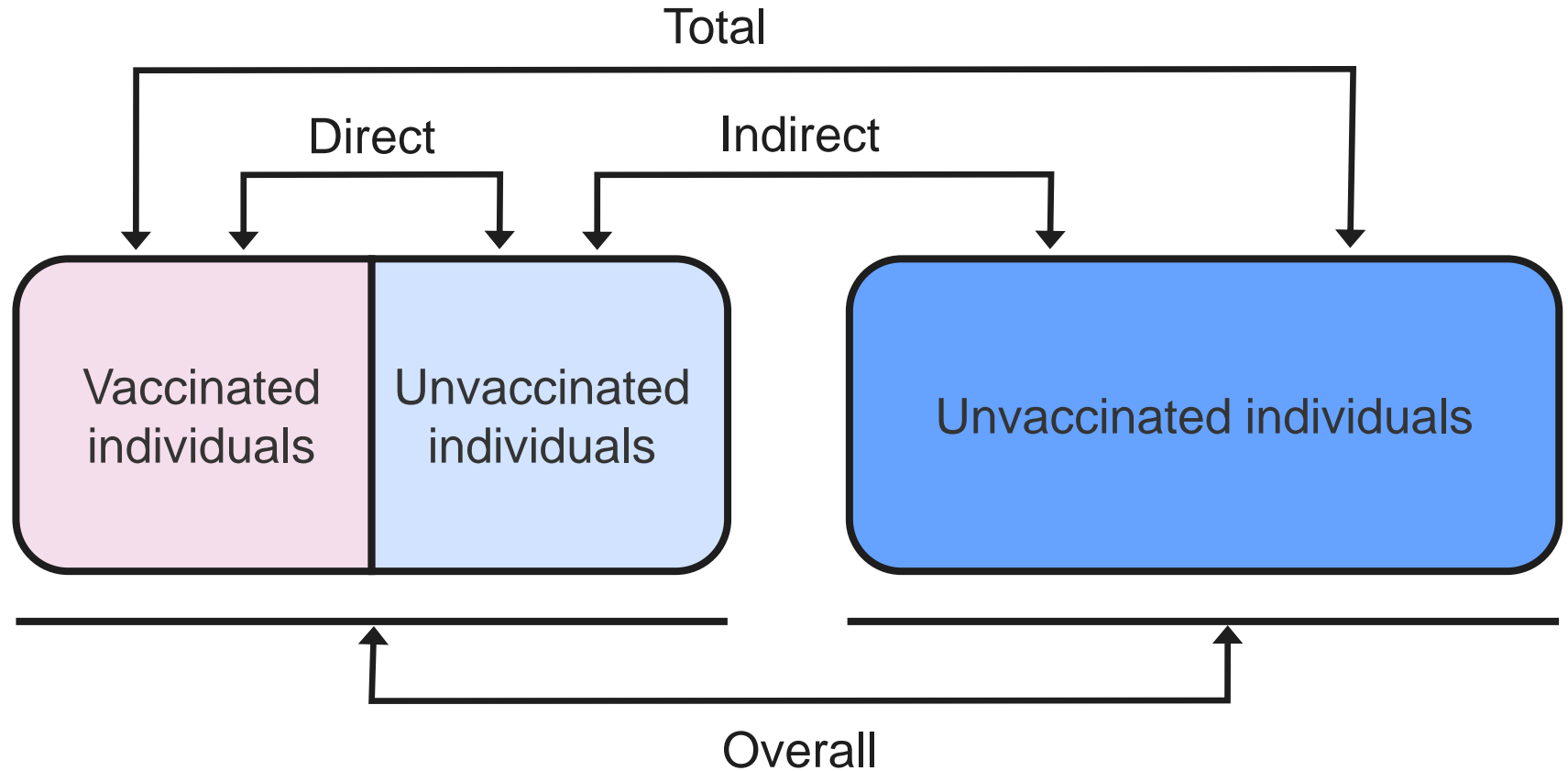
Terminology from: Wilder-Smith *et al. BMC Medicine* (2017) 15:138

Summary

- Modeling can contribute to different questions of vaccination programmes

- Interpretation of results needed – reliability

Daily COVID-19 cases, (7 days avg)