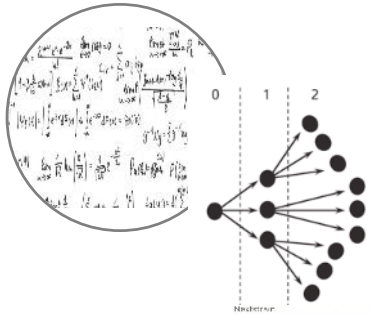
The Science Behind COVID-19: Interpreting Epidemiological Trends and Models

14th April 2021 Virtual Event Series – Session 2

PD Dr Nakul Chitnis and **Prof. Melisa Penny**
Disease Modelling Unit
Swiss Tropical and Public Health Institute
University of Basel

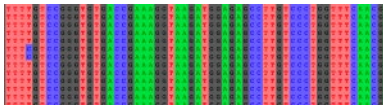
Virtual Event Series – Session 2

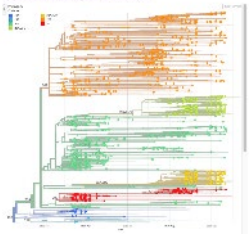


Setting the Scene and Interpreting Epidemiological Trends

Melissa Penny (Swiss TPH)

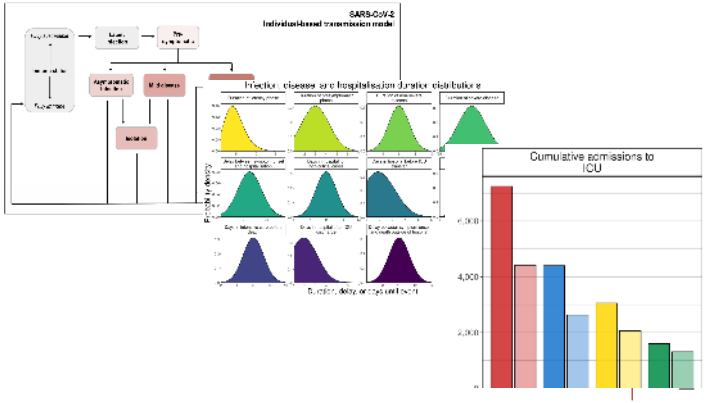
Nakul Chitnis (Swiss TPH)





Genomic surveillance of SARS-CoV-2 in Switzerland

Sarah Nadeau (ETH Zürich)



The impact of COVID-19 interventions in Switzerland: what can models tell us?

Andrew Shattock (Swiss TPH)

Ending with a Q & A

Swiss TPH

Swiss TPH

Setting the Scene

Interpreting Epidemiological Trends and disease modelling

PD Dr Nakul Chitnis and **Prof. Melisa Penny**
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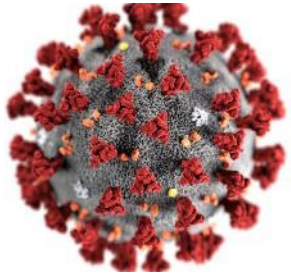
Poll question #1

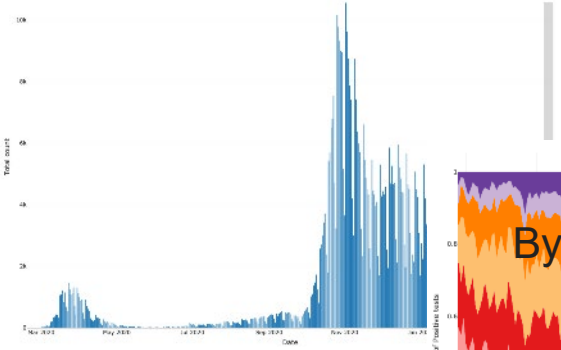
What is the value of modelling in epidemiology?

1. To forecast “short term” epidemic trends
2. To forecast “long term” epidemic trends
3. To compare potential intervention strategy scenarios
4. To improve understanding of transmission dynamics

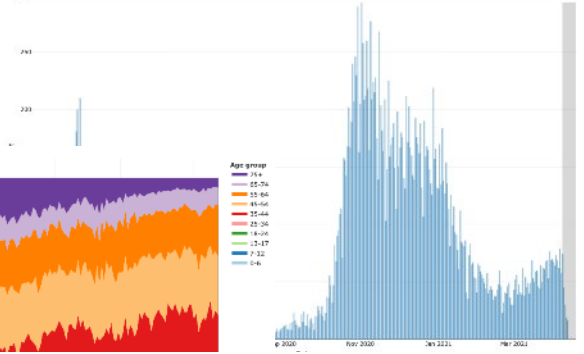
Epidemiological trends

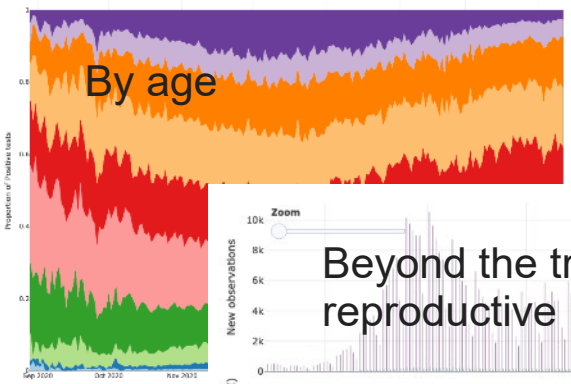


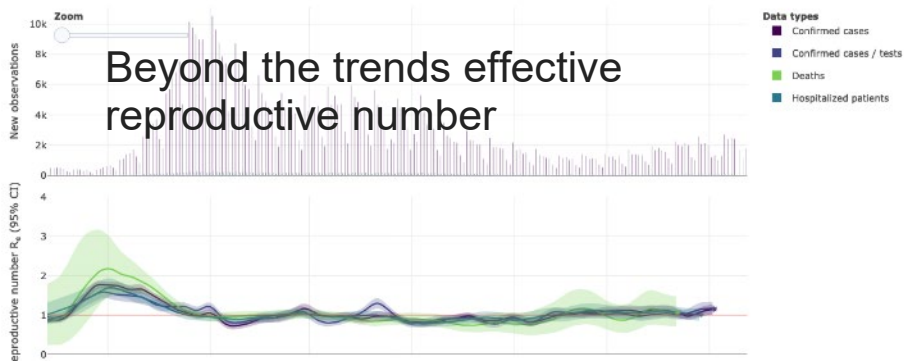
Reported cases



Hospitalised cases





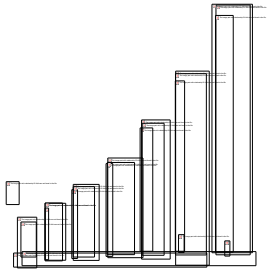


https://ibz-shiny.ethz.ch/covidDashboard/

Where are we now? Disease dynamics and interventions

Phase I : Understand disease dynamics

Outbreaks, short term forecasts on trends to understand disease dynamics



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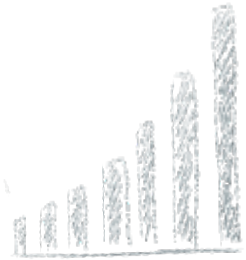
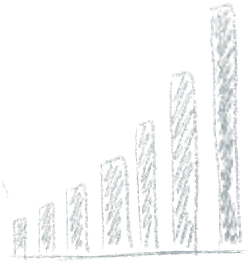


Phase II : How can we intervene

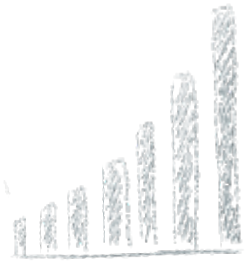
Interventions mixes via scenario analysis:
Relative comparison is often more important than “predictions”



Where are we now? Disease dynamics and interventions

Phase I : Understand disease dynamics

Outbreaks, short term forecasts on trends to understand disease epidemics



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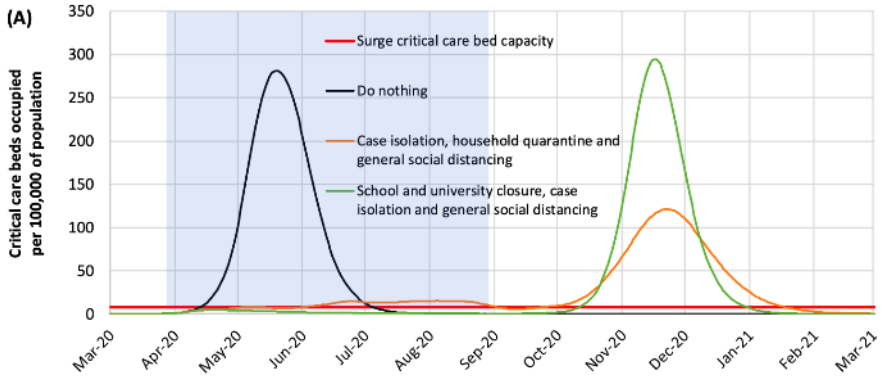


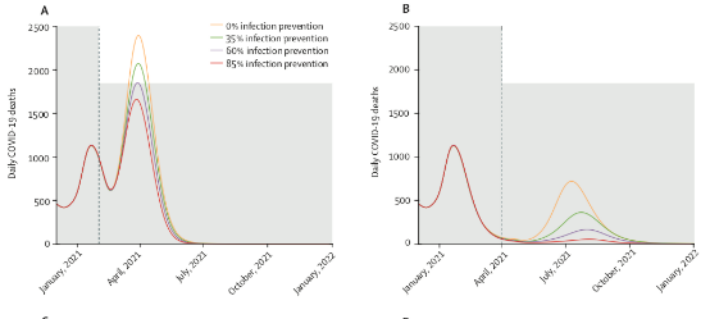
Ferguson, Neil, et al. "Report 9: Impact of non-pharmaceutical interventions (NPIs) to reduce COVID19 mortality and healthcare demand." (2020).

Comparing scenarios of what “could be”
not prediction of what “will be”

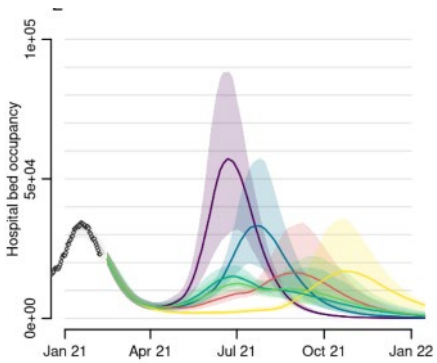
Phases of modelling – disease dynamics and interventions

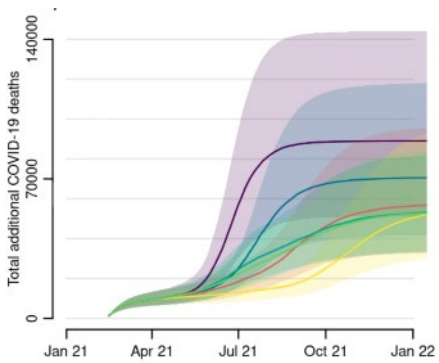
Phases III : more quantitative estimates towards decision making

- Combination interventions – scenarios
- Geospatial decisions
- Economic decisions



Vaccination and non-pharmaceutical interventions for COVID-19: a mathematical modelling study
Moore et al. Lancet Inf Dis 2021





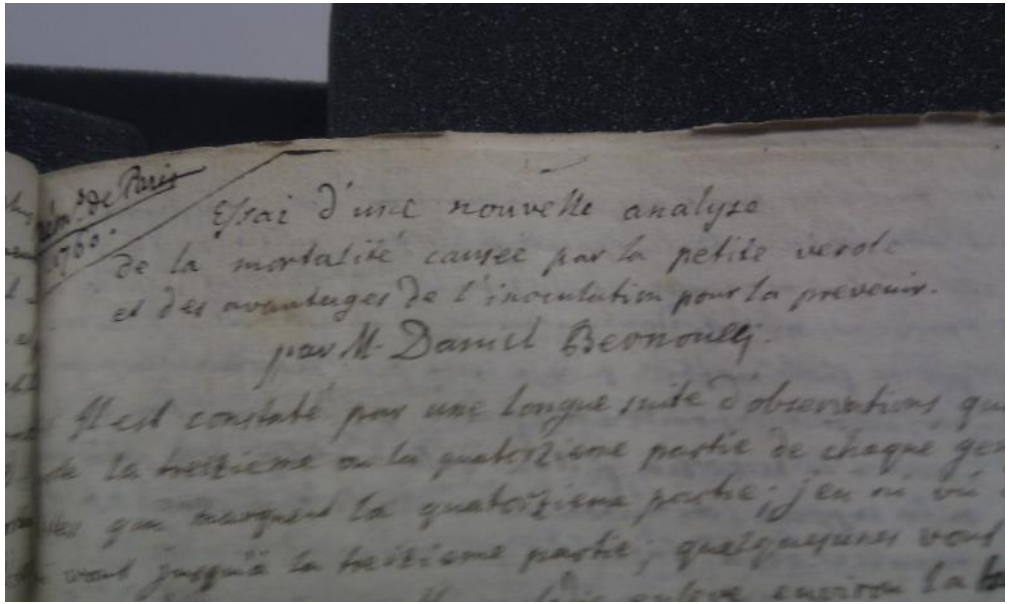
"Unlocking" Roadmap Scenarios for England v2 Whittles et al.

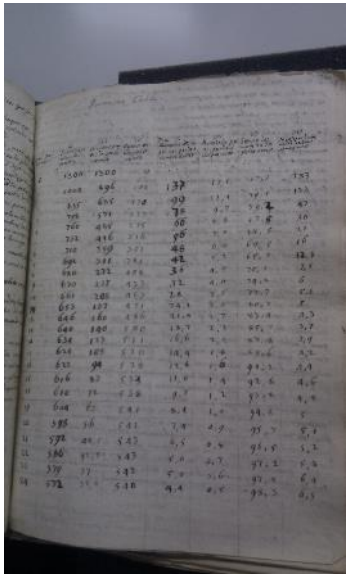
Swiss TPH

Quantitative Epidemiology

Essai d'une nouvelle analyse de la mortalité causée par la petite vérole

'I simply wish that, in a matter which so closely concerns the wellbeing of the human race, no decision shall be made without all the knowledge which a little analysis and calculation can provide' - Daniel Bernoulli 1760.





History of reproductive number and threshold conditions

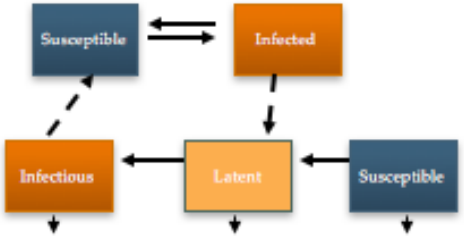
"To say that a disease depends upon certain factors is not to say much, until we can also form an estimate as to how largely each factor influences the whole result. And **the mathematical method of treatment is really nothing but the application of careful reasoning to the problems at issue**."

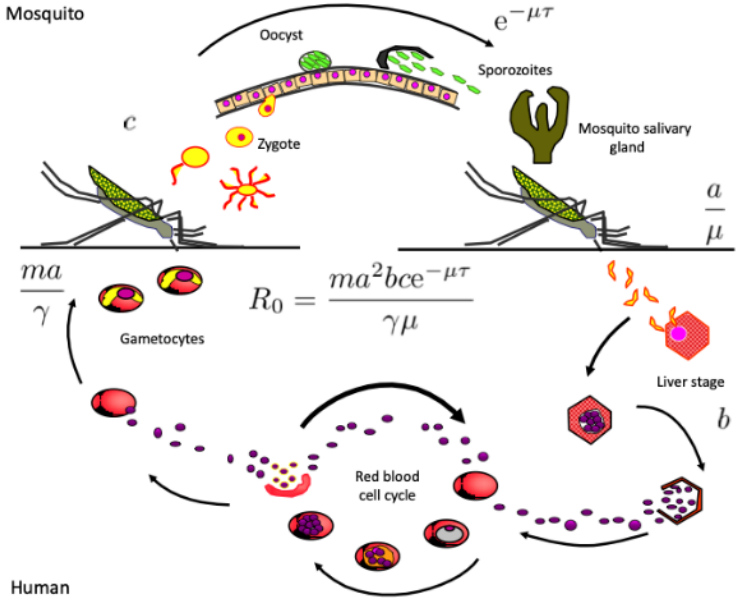
Ronald Ross, 1916

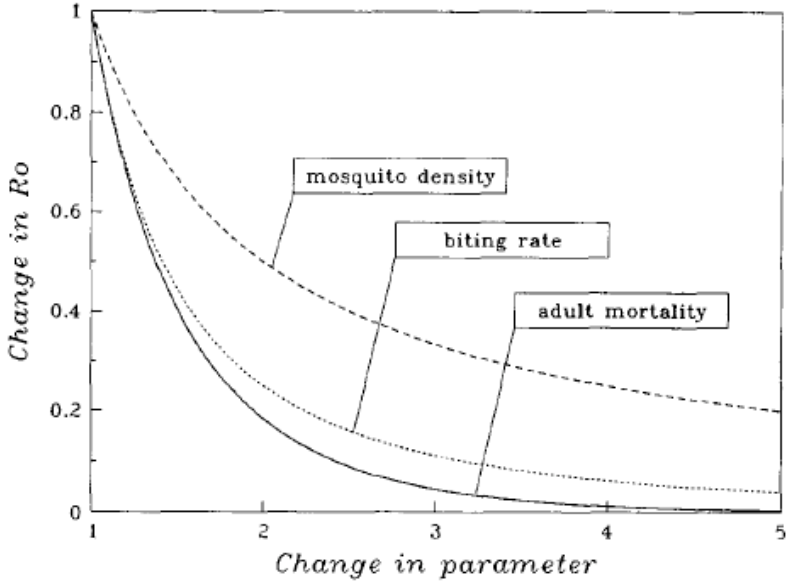
"Pathometry" …. with the mosquito theorem they introduced the **concept of** thresholds **that is central to dynamical modeling**.

Hilda Hudson

Ross-Macdonald Model for Malaria

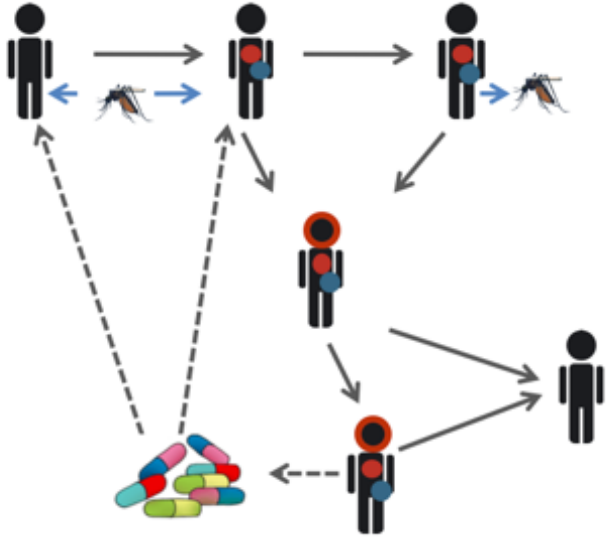


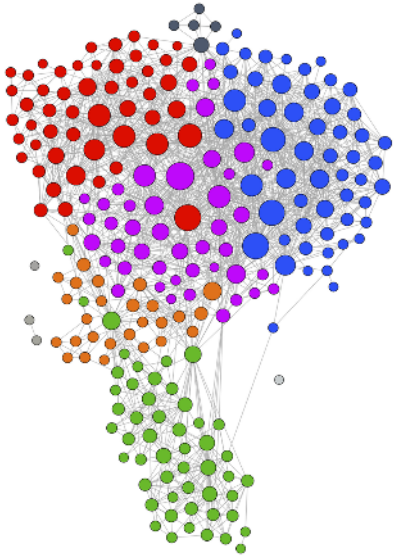


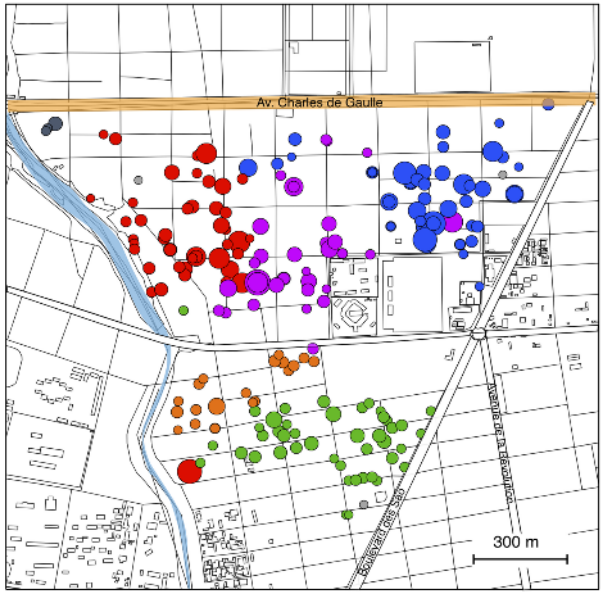


Koella (1991)

Stochastic individual-based models

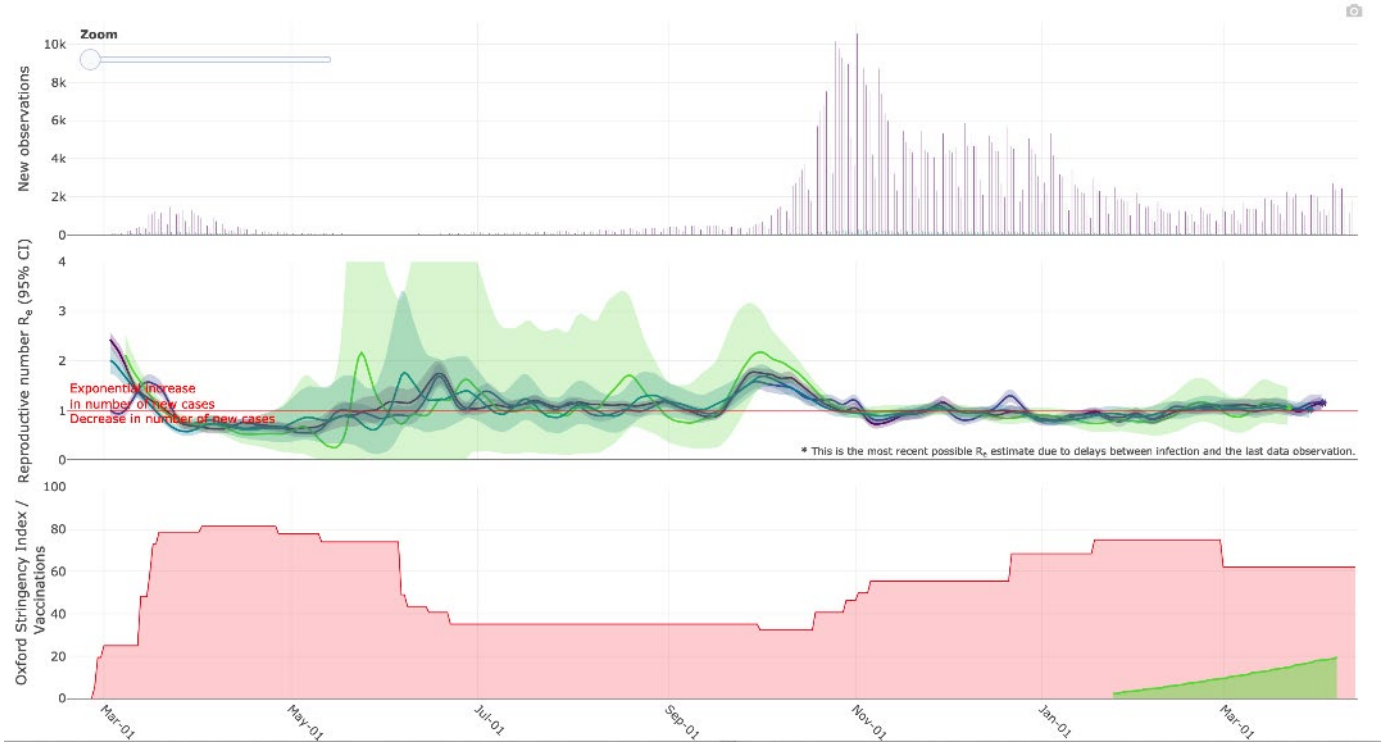






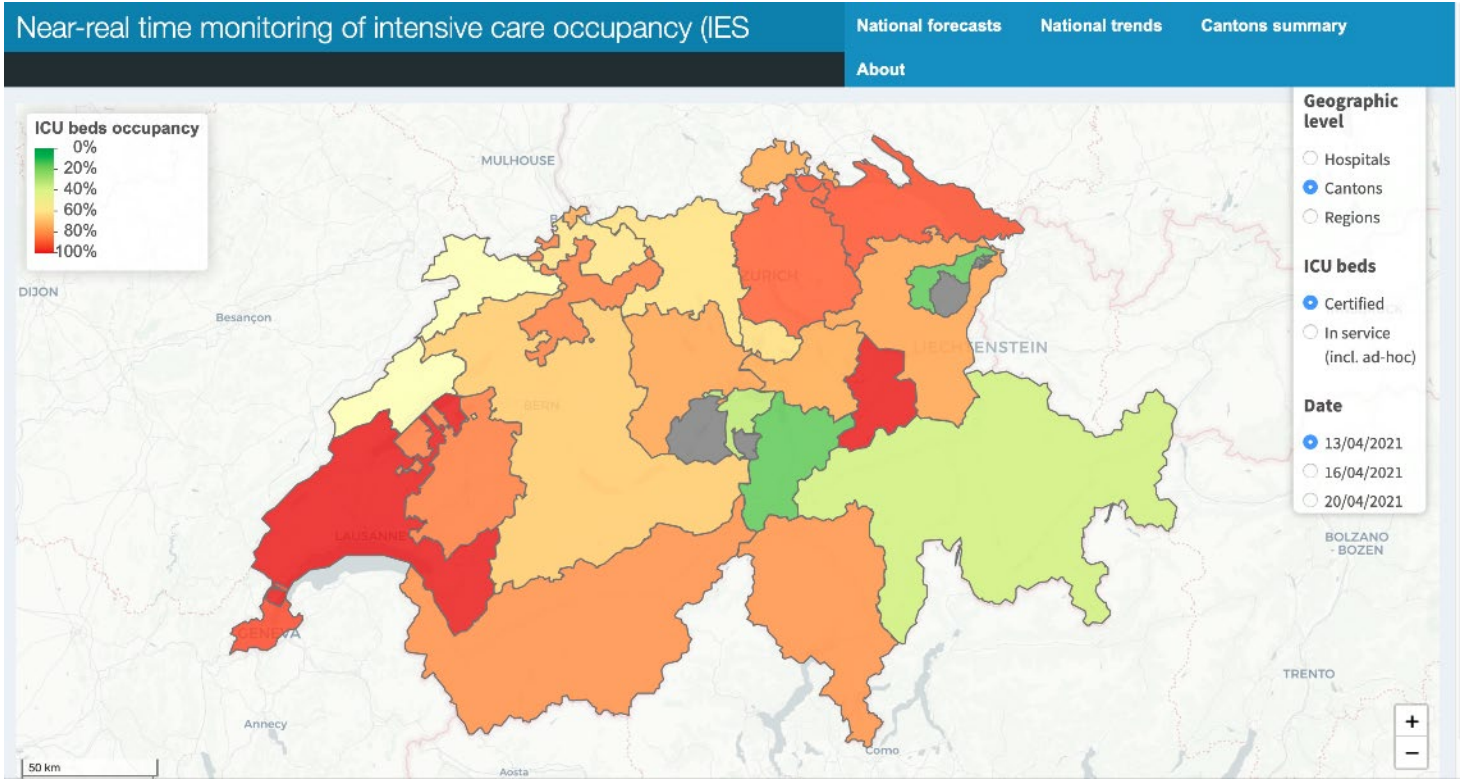
Laager et al. (2018)

Effective Reproductive Numbers for COVID-19



https://sciencetaskforce.ch/en/current-situation/

ICU Capacity



https://icumonitoring.ch/

Poll question #2

Are quantitative sciences being used appropriately for COVID-19 decision making in Switzerland?

1. Science is under utilised
2. The current use is appropriate
3. Too much weight is placed on science.

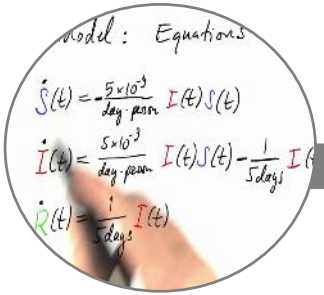
Swiss TPH

Quantitative sciences and modelling for COVID-19 decision making

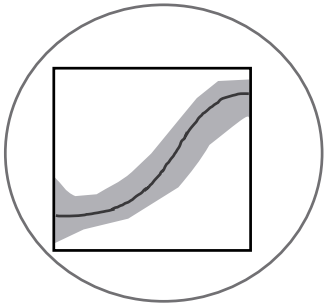
Process of evidence generation

Scientists,
Partners,
Stakeholders

+ DATA +



Models



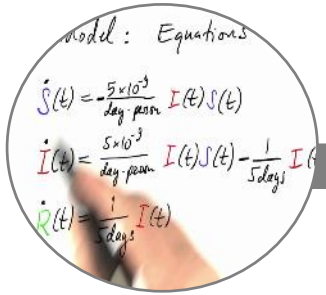
Model based evidence and insights

Process of evidence generation

"Modelling is not the decision"

Iterative

+ DATA +



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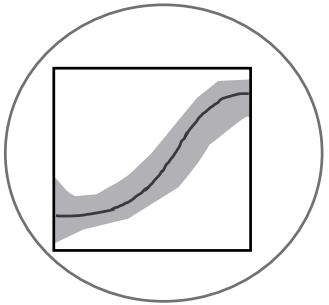

Model based evidence and insights

Scientists, Partners, Stakeholders

Iterative

"Modelling guided our thinking on…"

Context
Questions
Stakeholders

Poll question #3

What's most important for modelling to support decision-making for COVID-19?

1. The question
2. The context
3. The stakeholders (who is the model informing)
4. The model
5. The data
6. The modeller

Power and influence of quantitative approaches

Power:
to elucidate relationships, understand trends, and guide thinking

Influence:
is hard to quantify and hard to track

Swiss COVID-19 Science

Sarah Nadeau (ETH Zürich):
Genomic surveillance of SARS-CoV-2 in Switzerland

Andrew Shattock (Disease Modelling Unit, Swiss TPH)
The impact of COVID-19 interventions in Switzerland: what can models tell us?

BRC CH Botnar Research Centre for Child Health

FNSNF Swiss National Science Foundation

sciCORE | Center for Scientific Computing

Andrew J. Shattock, Epke A. Le Rutte, Robert P. Dünner, Swapnoleena Sen, Sherrie L. Kelly, Nakul Chitnis, Melissa A. Penny "**Impact of vaccination and non-pharmaceutical interventions on SARS-CoV-2 dynamics in Switzerland**" ***submitted***

- Swiss National COVID-19 Science Task Force
- Swiss Federal Office of Public Health

Q&A session

Please type your questions in the **chat** and indicate who you would like your question to be directed to.

Botnar Research Centre for Child Health

Swiss National Science Foundation

Swiss TPH

Thank you for your attention

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Q&A session

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