Module 5: Introduction to Stochastic Epidemic Models with Inference (Back to future in person!)

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QUOTE FROM ME IN JULY 2020 (PARAPHRASED)

"We will have COVID vaccines for sure in early 2021, and we should have SISMID in person next year (*i.e.*, July 2021)."

Well, at least the first part was true!

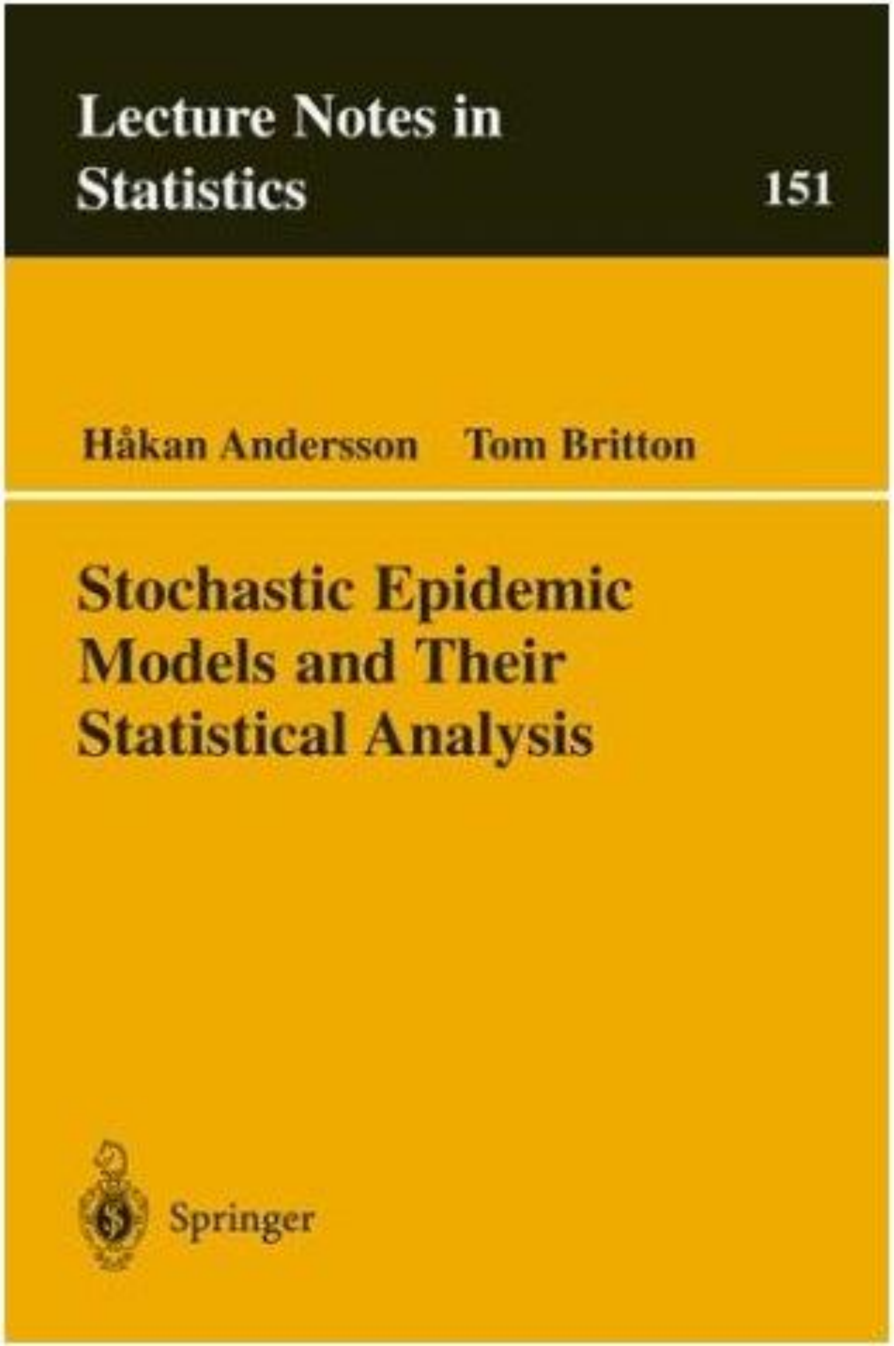
QUOTE FROM ME IN JULY 2022 (PARAPHRASED)

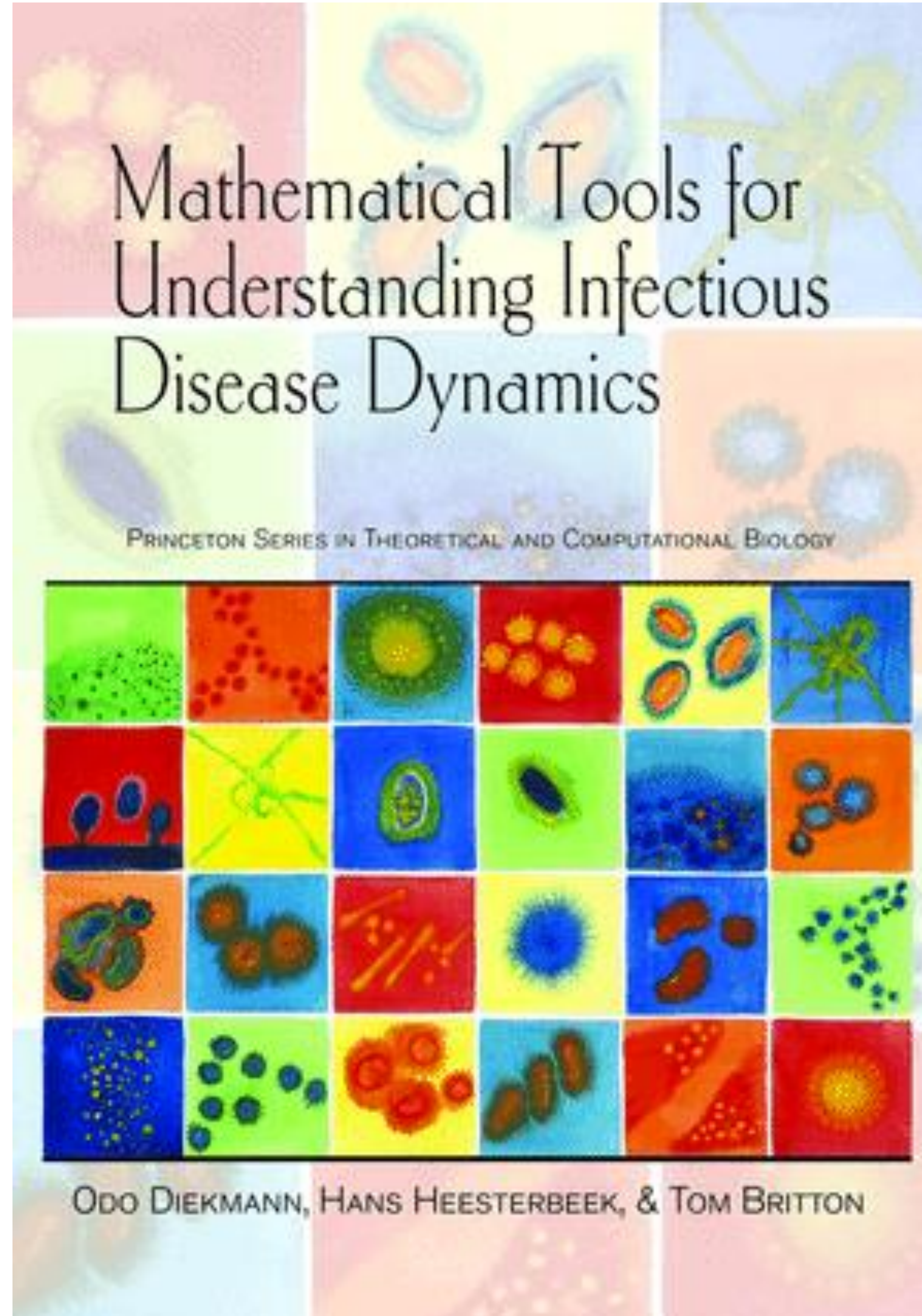
“SISMID will in person next year, I promise (*i.e.*, 2023).”

Philosophy of this course (i.e., Reductionist statements)

- Analytic work on the transmission and control of infectious diseases depends on an understanding of epidemic theory
- A technical understanding of the underlying non-linear, stochastic dynamics of infectious disease transmission is the basis for this understanding
  - This almost always involves non-linear functions for the interaction of ***x*** susceptible and ***y*** infected people at time *t*.
- This technical understanding leads to sound inferential structures for estimation of governing parameters and functions

Some Books of Interest for This Course





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Statistics for Biology and Health

M. Elizabeth Halloran • Ira M. Longini, Jr. • Claudio J. Struchiner

Design and Analysis of Vaccine Studies

Widespread immunization has many different kinds of effects in individuals and populations, including in the unvaccinated individuals. The challenge is in understanding and estimating all of these effects. This book presents a unified conceptual framework of the different effects of vaccination at the individual and at the population level. The book covers many different vaccine effects, including vaccine efficacy for susceptibility, for disease, for post-infection outcomes, and for infectiousness. The book includes methods for evaluating indirect, total and overall effects of vaccination programs in populations. Topics include household studies, evaluating correlates of immune protection, and applications of casual inference. Material on concepts of infectious disease epidemiology, transmission models, casual inference, and vaccines provides background for the reader. This is the first book to present vaccine evaluation in this comprehensive conceptual framework.

This book is intended for colleagues and students in statistics, biostatistics, epidemiology, and infectious diseases. Most essential concepts are described in simple language accessible to epidemiologists, followed by technical material accessible to statisticians.

Elizabeth Halloran and Ira Longini are professors of biostatistics at the University of Washington and the Fred Hutchinson Cancer Research Center in Seattle. Claudio Struchiner is professor of epidemiology and biostatistics at the Brazilian School of Public Health of the Oswaldo Cruz Foundation in Rio de Janeiro. The authors are prominent researchers in the area. Halloran and Struchiner developed the study designs for dependent happenings to delineate indirect, total, and overall effects. Halloran has made contributions at the interface of epidemiological methods, causal inference, and transmission dynamics. Longini works in the area of stochastic processes applied to epidemiological infectious disease problems, specializing in the mathematical and statistical theory of epidemics. Struchiner has contributed to understanding the role of transmission in interpreting vaccine effects.

EPIDEMIOLOGY

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› springer.com

Halloran • Longini
Struchiner

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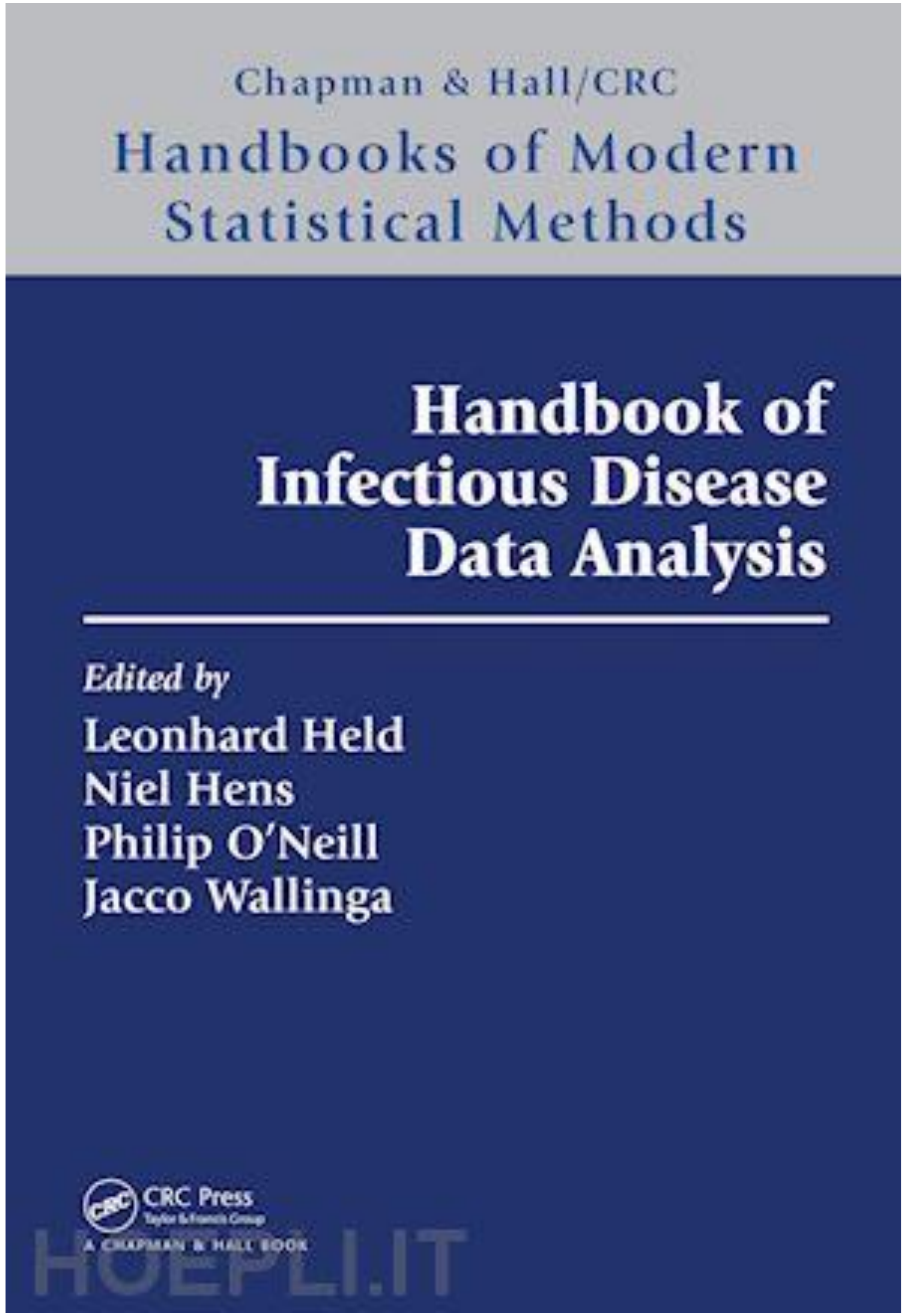

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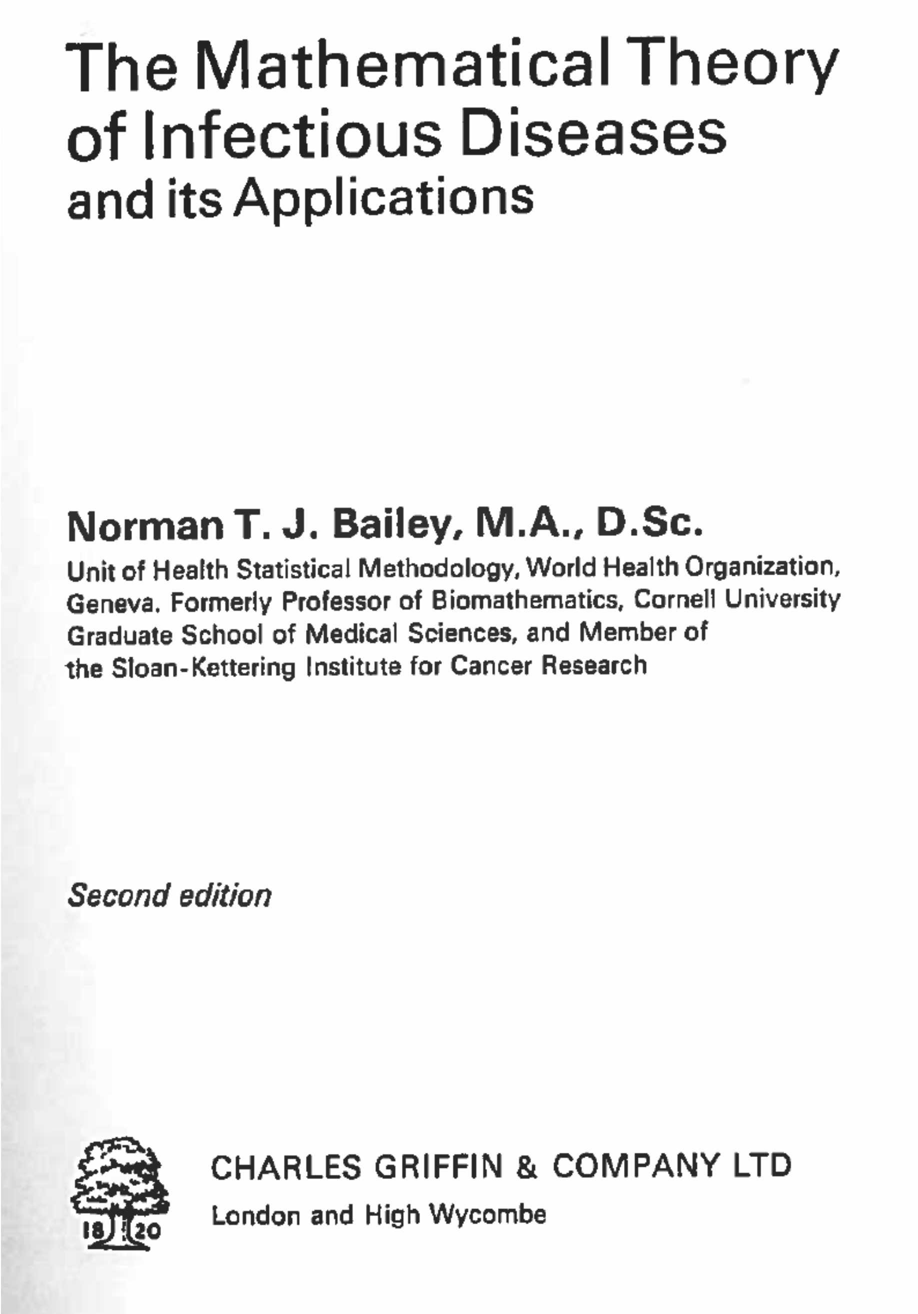
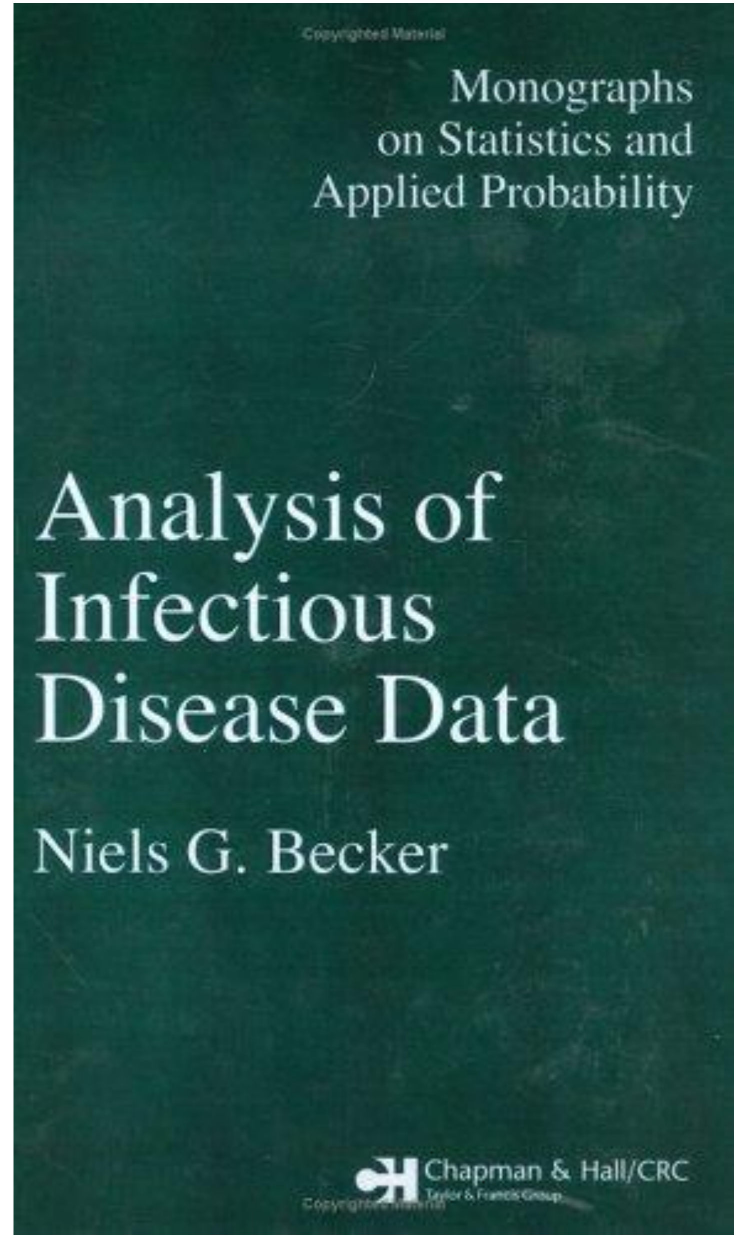

The Mathematical Theory
of Infectious Diseases
and its Applications

Norman T. J. Bailey, M.A., D.Sc.
Unit of Health Statistical Methodology, World Health Organization, Geneva. Formerly Professor of Biomathematics, Cornell University Graduate School of Medical Sciences, and Member of the Sloan-Kettering Institute for Cancer Research

Second edition

1820
CHARLES GRIFFIN & COMPANY LTD
London and High Wycombe



1975, 1st addition 1957

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Inference on infectious diseases modules in addition to this one

- **Module 8**: MCMC I for Infectious Diseases, July 17 – 19
- **Module 9**: Spatial Statistics in Epidemiology and Public Health, July 17 – 19
- **Module 11**: MCMC II for Infectious Diseases, July 19 – 21
- **Module 13**: Statistics and Modeling with Novel Data Streams, July 19 – 21
- **Module 14**: Simulation-based Inference for Epidemiological Dynamics, July 24 – 26
- **Module 16**: Causal Inference, July 24-26.

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WHO R&D Blueprint to combat global pandemics

World Health Organization

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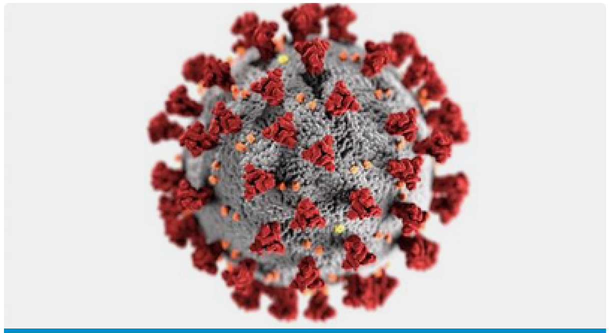
R&D Blueprint

The R&D Blueprint is a global strategy and preparedness plan that allows the rapid activation of research and development activities during epidemics. Its aim is to fast-track the availability of effective tests, vaccines and medicines that can be used to save lives and avert large scale crises. With WHO as convener, the broad global coalition of experts who have contributed to the Blueprint come from medical, scientific and regulatory backgrounds. WHO Member States welcomed the development of the Blueprint at the World Health Assembly in May 2016.

About us >

Key actions by disease



R&D Blueprint and COVID-19

R&D Blueprint and the Pandemic Response

- R&D Blueprint and Ebola/Marburg
- R&D Blueprint and Lassa Fever
- R&D Blueprint and MERS-CoV
- R&D Blueprint and Nipah Virus
- R&D Blueprint and Zika

https://www.who.int/teams/blueprint/

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Blueprint priority diseases

At present, the priority diseases are:

- **COVID-19**
- Crimean-Congo haemorrhagic fever
- **Ebola virus disease** and **Marburg virus disease**
- Lassa fever
- Middle East respiratory syndrome coronavirus (**MERS-CoV**) and Severe Acute Respiratory Syndrome (SARS)
- Nipah and henipaviral diseases
- Rift Valley fever
- Zika
- “**Disease X**”*

** Disease X represents the knowledge that a serious international epidemic could be caused by a pathogen currently unknown to cause human disease. The R&D Blueprint explicitly seeks to enable early cross-cutting R&D preparedness that is also relevant for an unknown “Disease X”.*

https://www.who.int/activities/prioritizing-diseases-for-research-and-development-in-emergency-contexts

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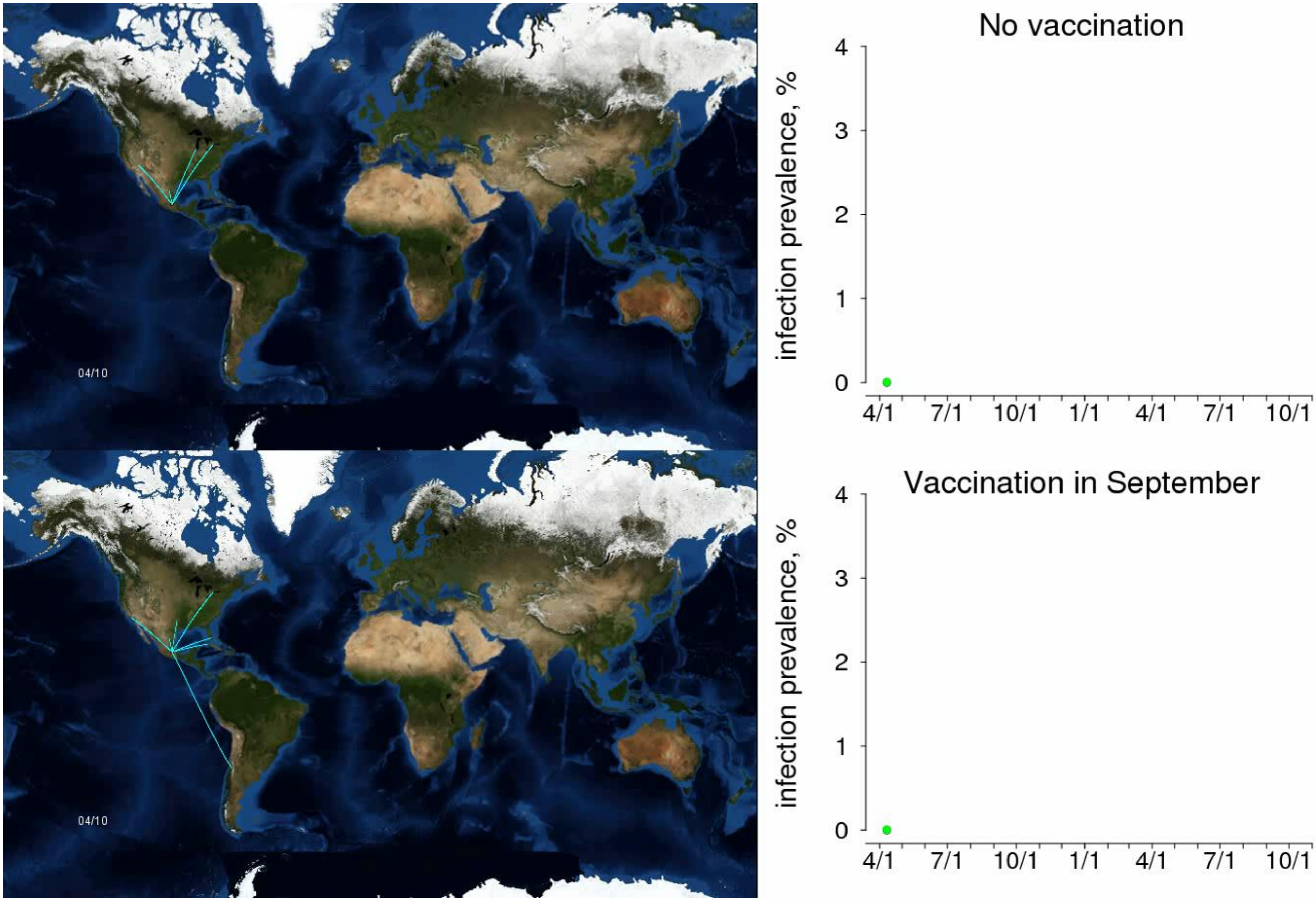
An example

Pandemic H1N1, 2009-2010: Stochastic, Compartmental, Patch Model



Thanks

On with the course!