Modelling the economic impact of diseases in animal husbandry

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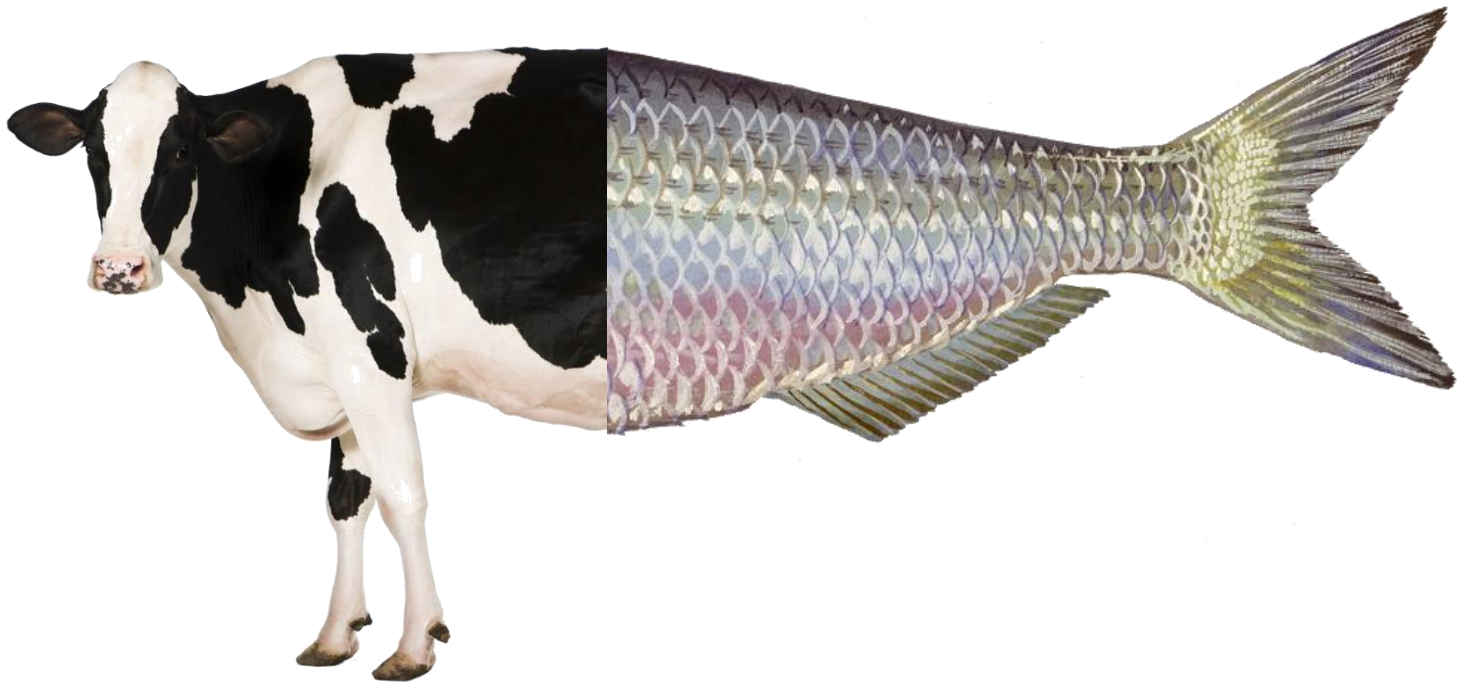
Outline

- Introduction
- Components in a model
- Examples of results
- Perspectives

Introduction

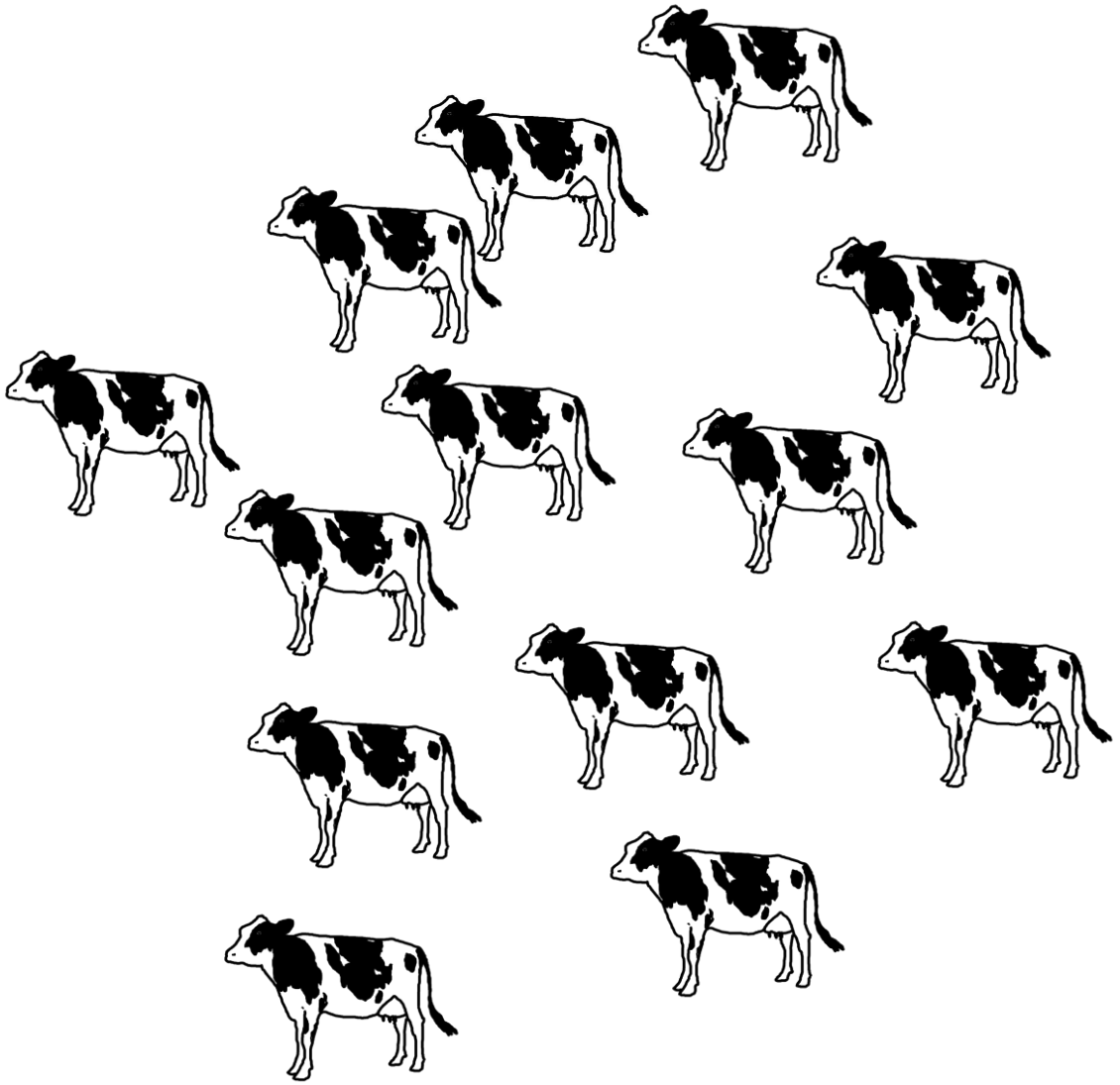
- A dairy herd

- Pathogen transmission
- Welfare issue
- Economic impact
- Decision support



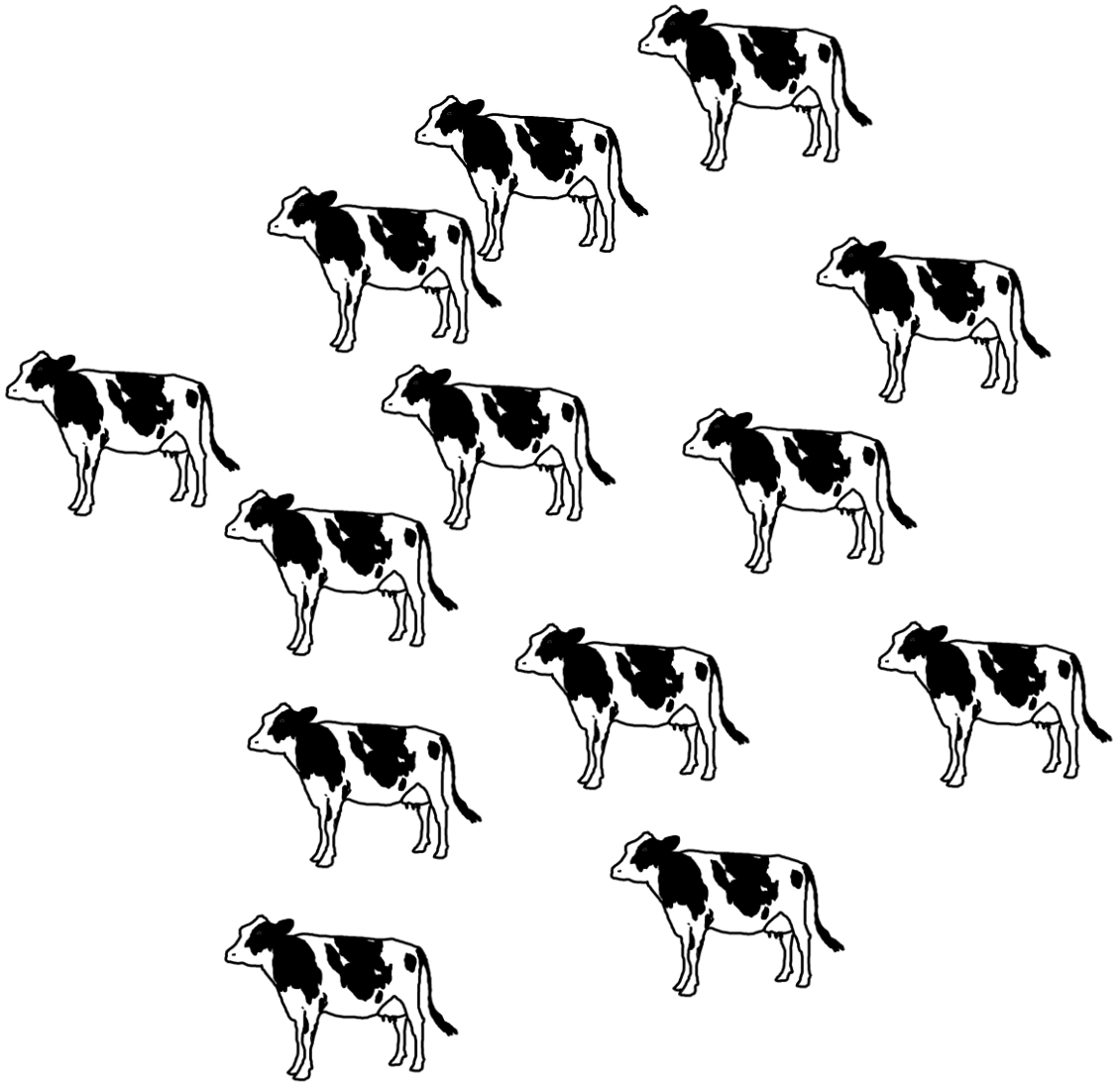
Mechanistic model

- Details
- Stochastic
- Markov chain



A dairy herd

- Specific or general
- 200 cows
- Life cycle
- Production
- Disease
- Costs
- Income

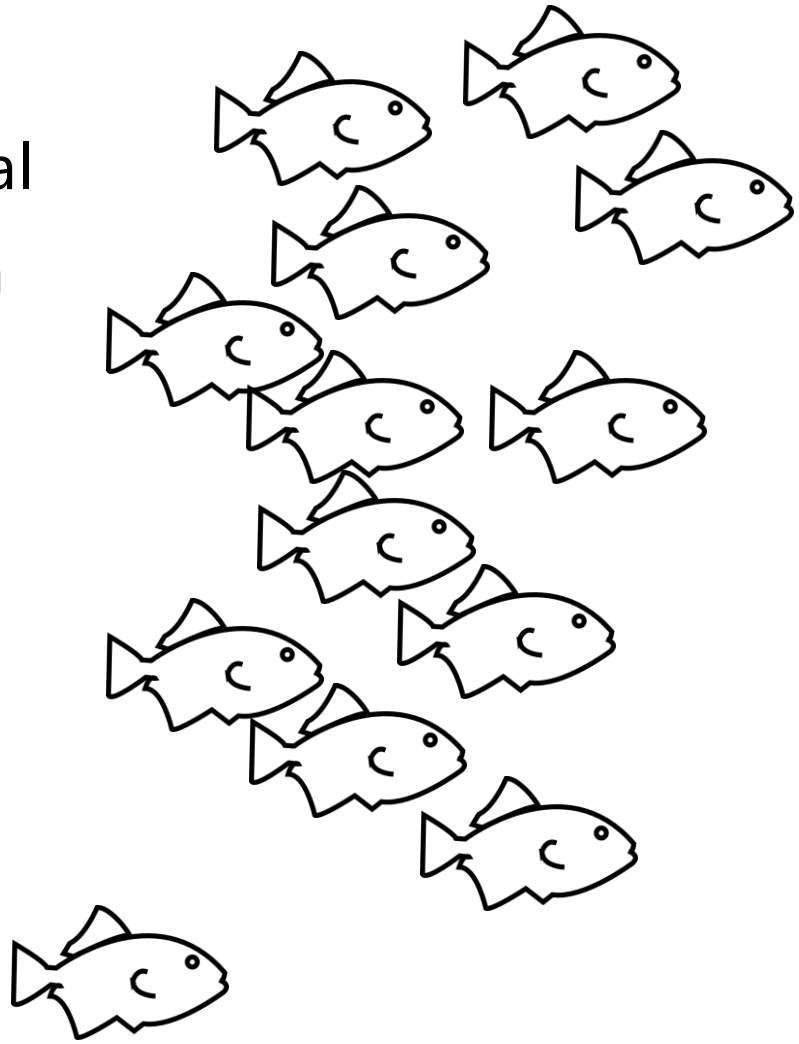


A dairy herd

- Specific or general
- 200 cows
- Life cycle
- Production
- Disease
- Costs
- Income

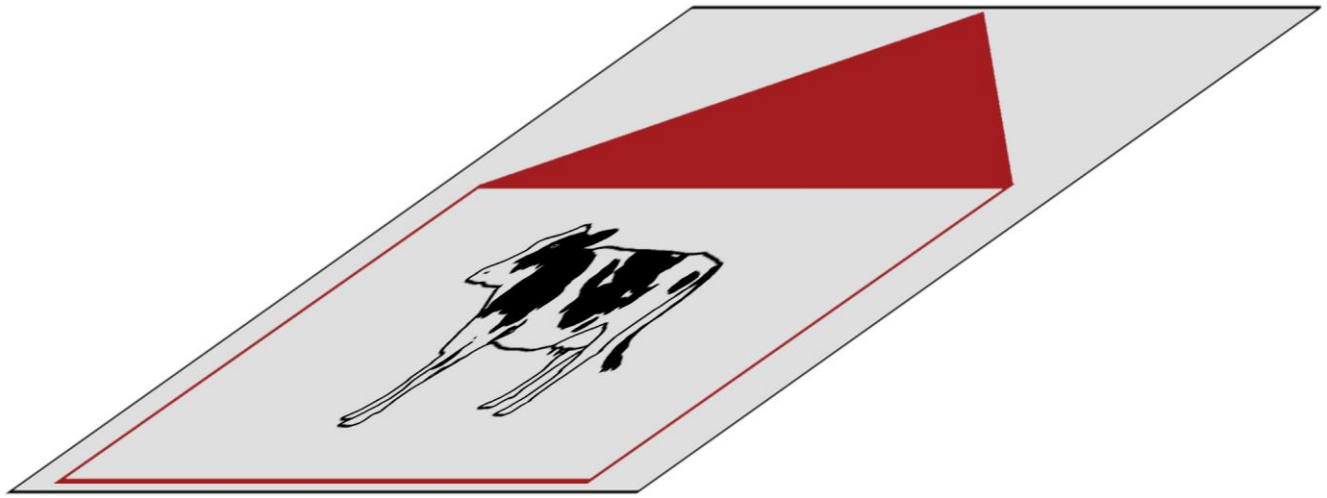
A fish farm

- Specific or general
- Thousands of fish
- Life cycle
- Production
- Disease
- Costs
- Income



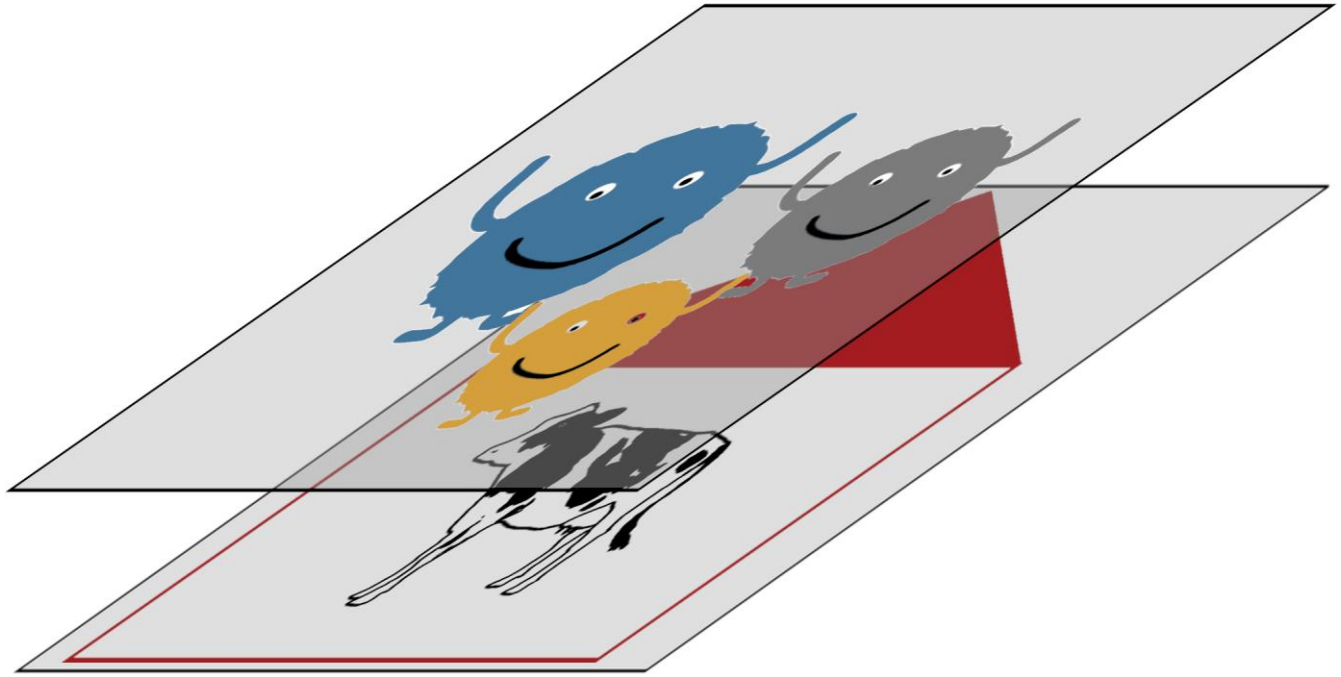
The model

- Population



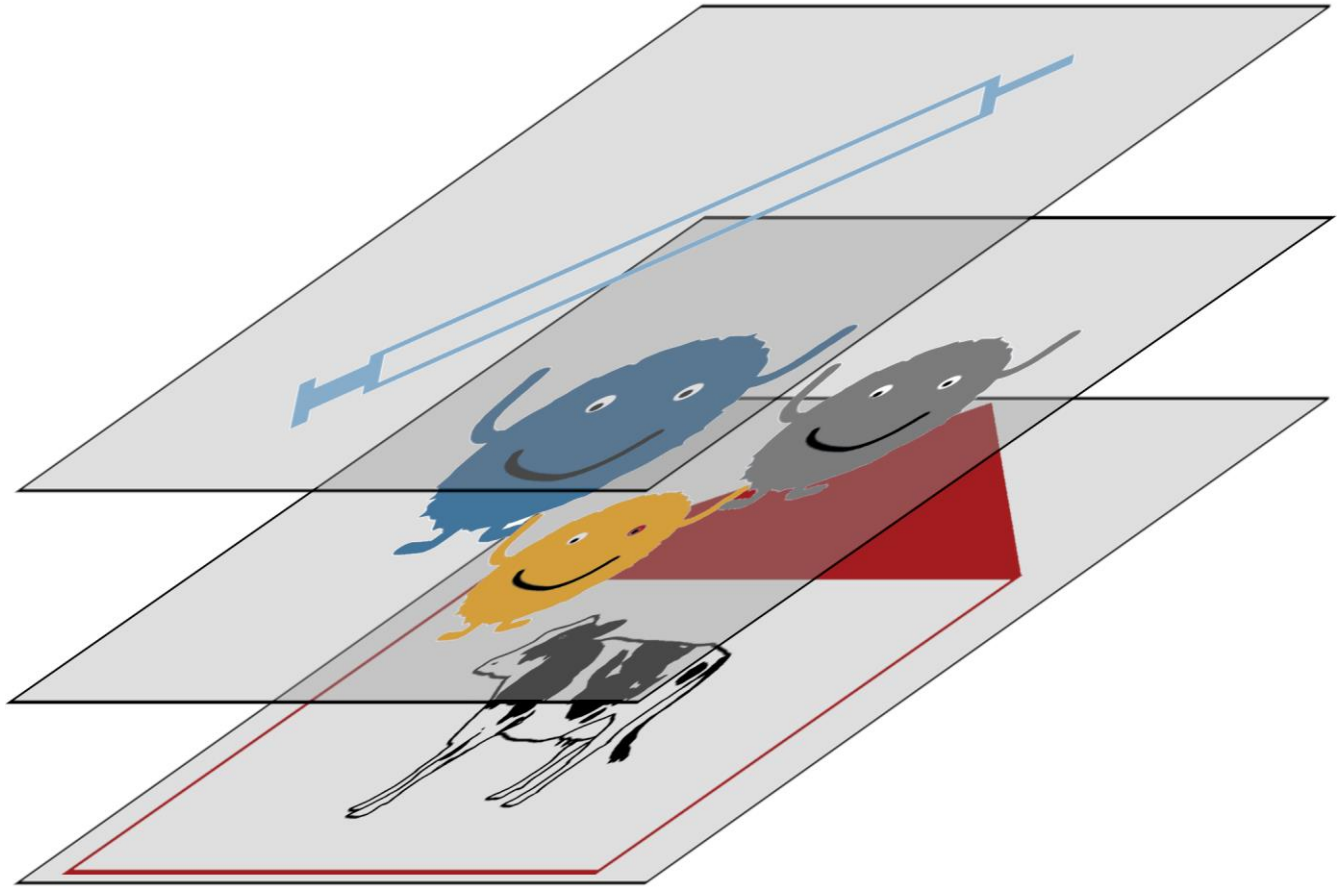
The model

- Population
- Transmission framework



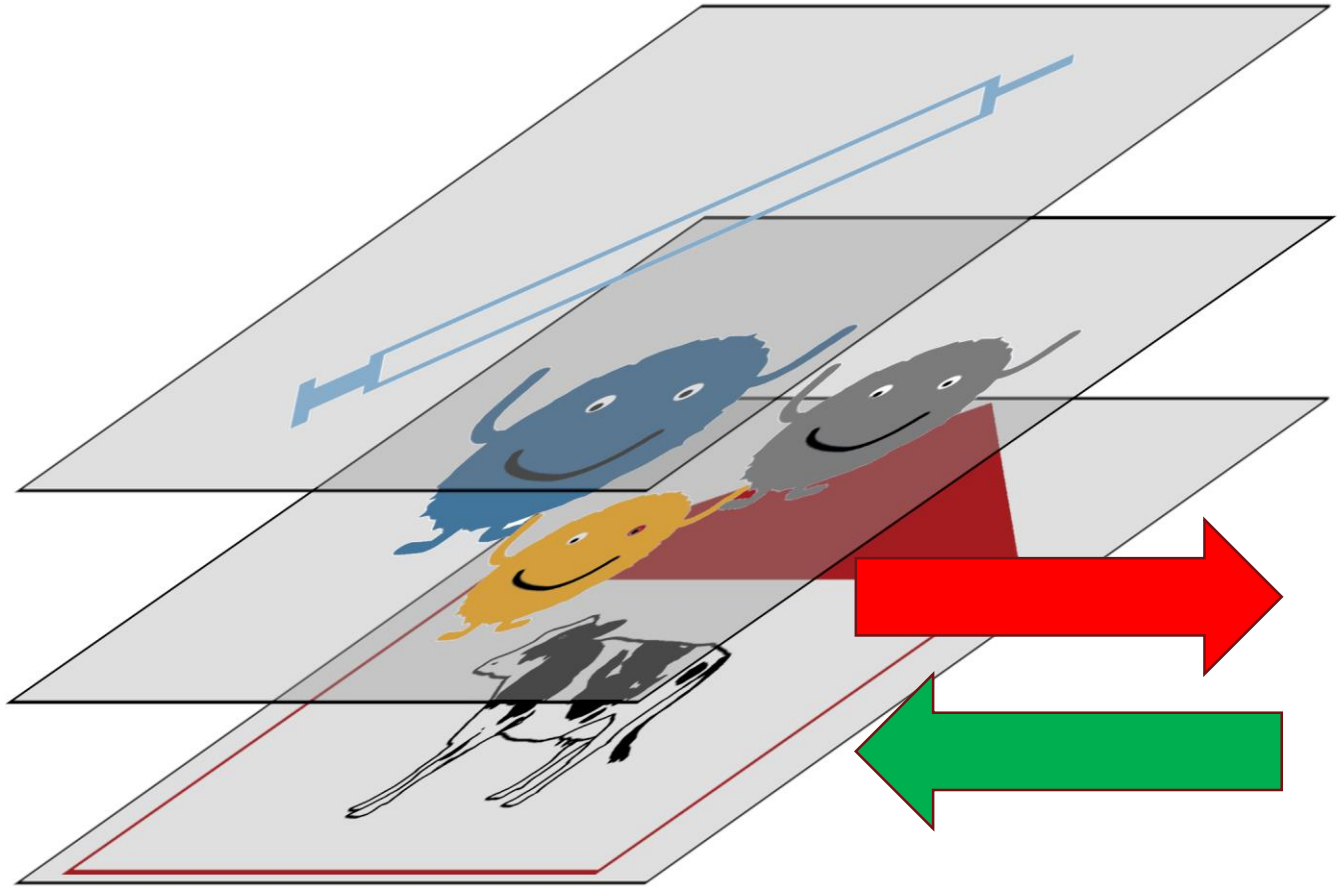
The model

- Population
- Transmission framework
- Intervention measures



The model

- Population
- Transmission framework
- Intervention measures
- Cost-benefit



Cost-benefit analysis

- Income
  - Milk
  - Slaughter
  - Sold animals
- Expenses
  - Feed
  - Treatments
  - Vet
  - Acute culling

Cost-benefit analysis

- Income
  - Milk
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  - Vet
  - Acute culling

- Housing
- Machinery
- Personnel
- Maintenance
- Etc.

Intervention measures

- Cull infected cows
- Treat infected cows
- Test
- Do nothing…

Intervention measures

- Cull infected cows
- Treat infected cows
- Test
- Do nothing…

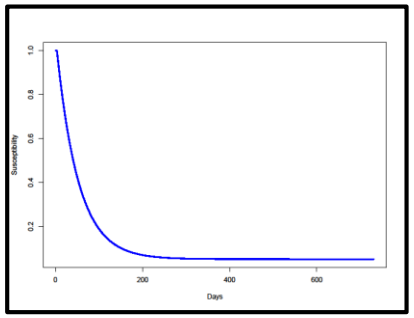
- Slaughter infected fish
- Vaccination / treatment
- Test
- Leave it…

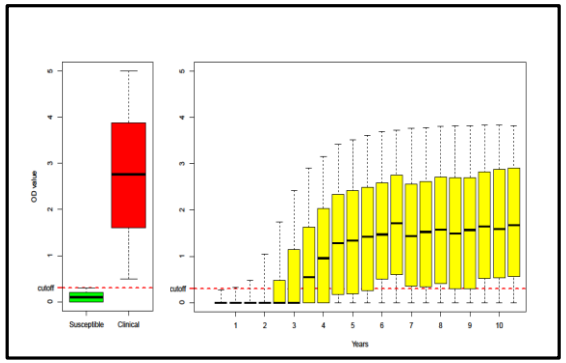
Simulation

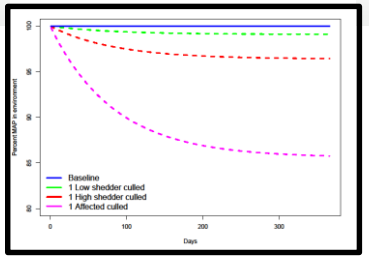
Simulation

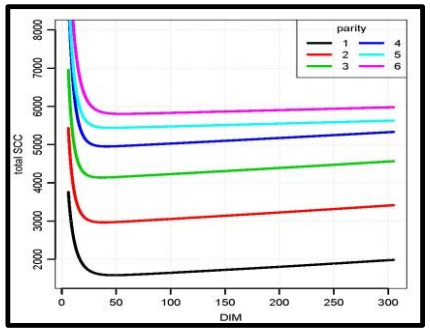
Lactating cows | Heifers | Calving area

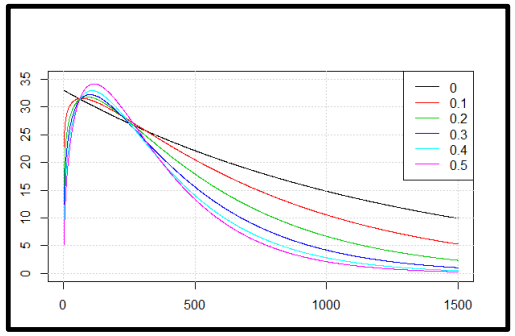
Dry cows | Calves

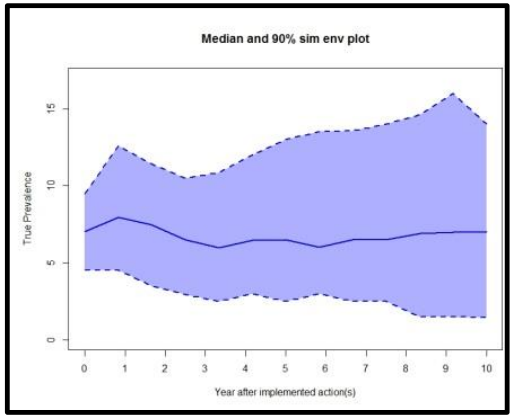


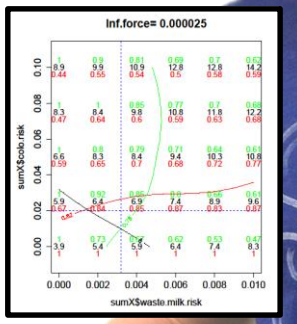


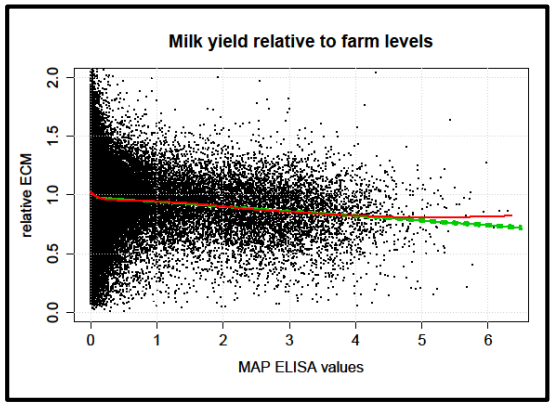


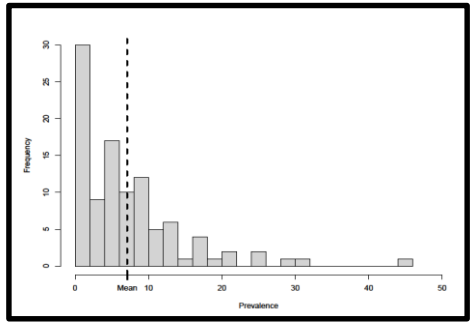


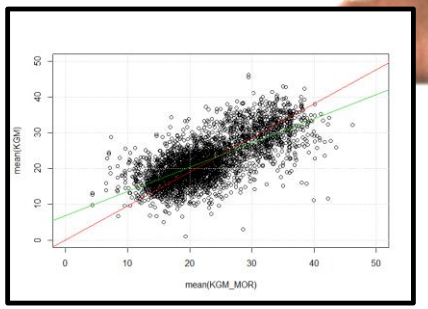












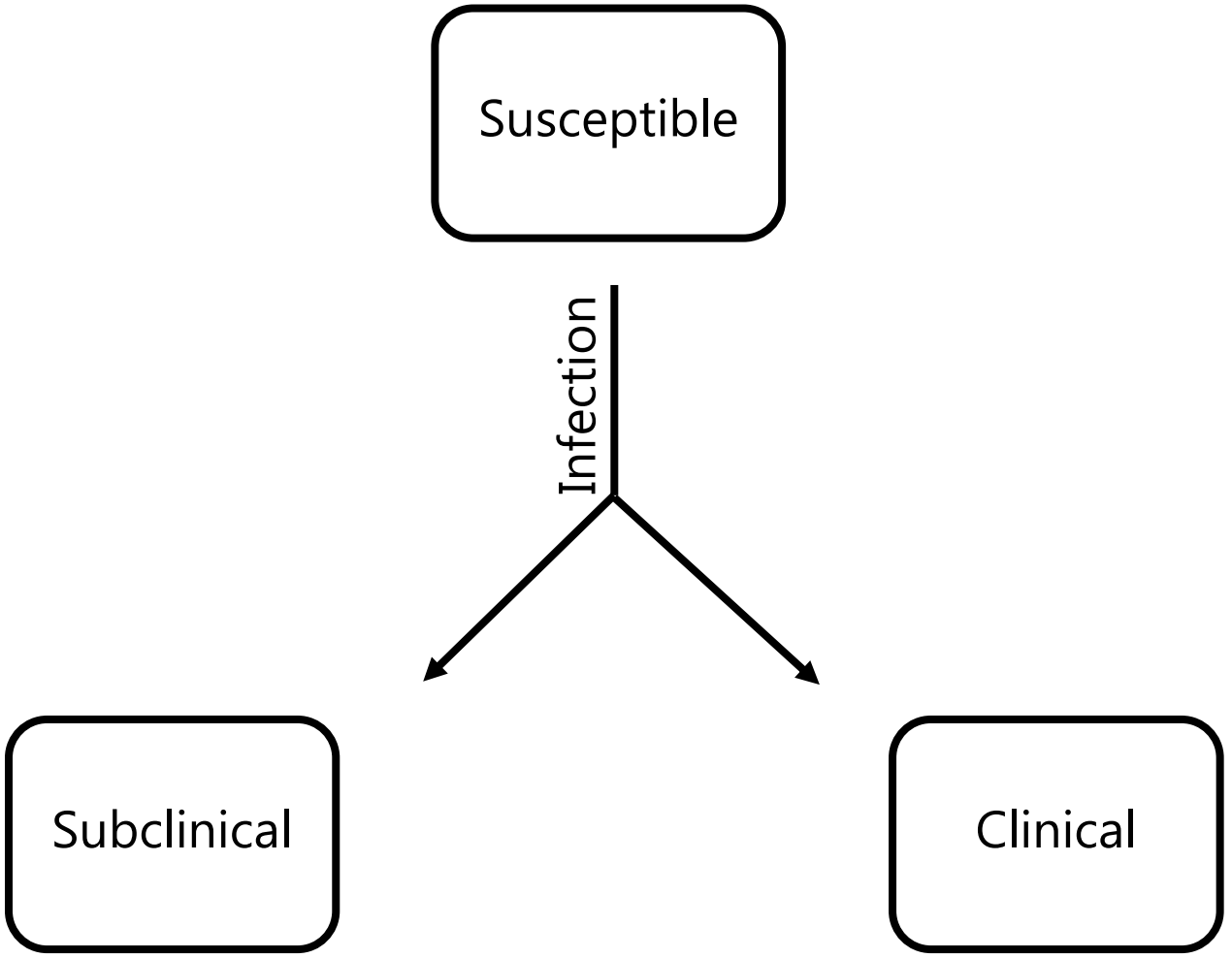
Simulating the Epidemiological and Economic Impact of Paratuberculosis Control Actions in Dairy Cattle

PLOS ONE
Adaptive Test Schemes for Control of Paratuberculosis in Dairy Cows

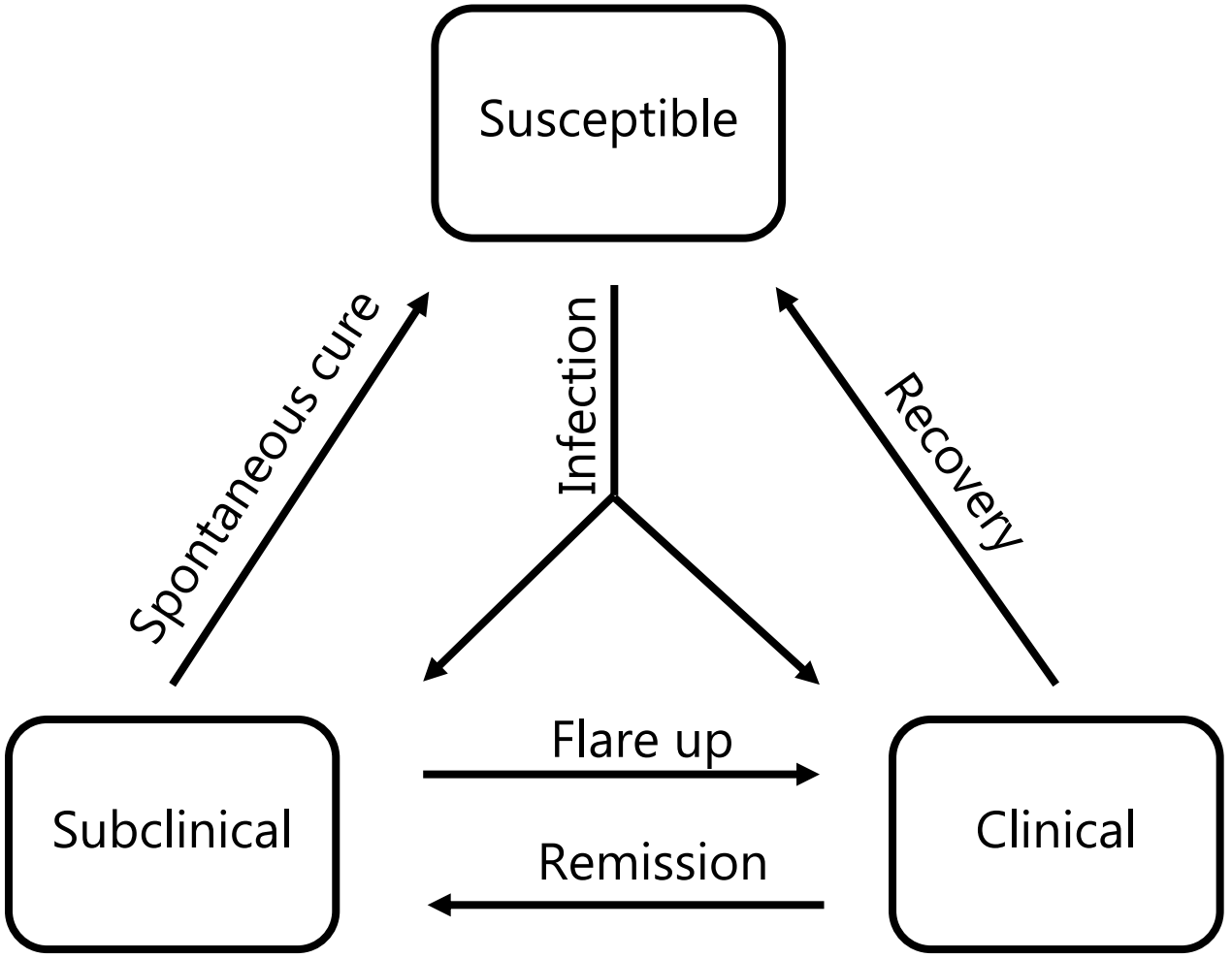
frontiers in Veterinary Science
Models to Estimate Lactation Curves of Milk Yield and Somatic Cell Count in Dairy Cows at the Herd Level for the Use in Simulations and Predictive Models

frontiers in Veterinary Science
A Robust Statistical Model to Predict the Future Value of the Milk Production of Dairy Cows Using Herd Recording Data

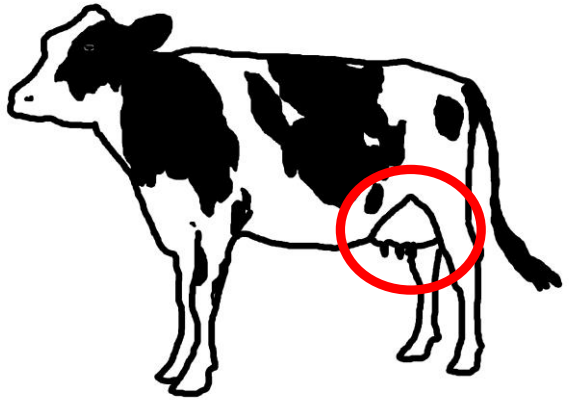
Transmission framework



Transmission framework

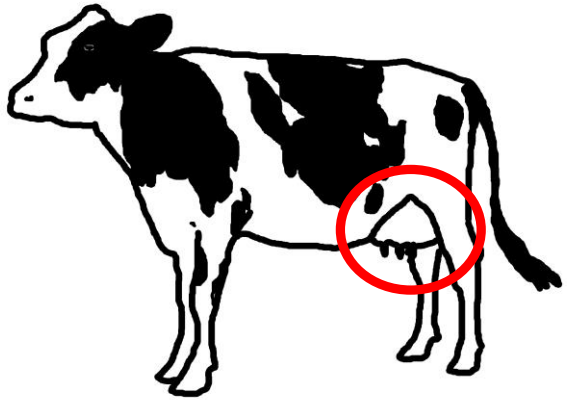


Mastitis



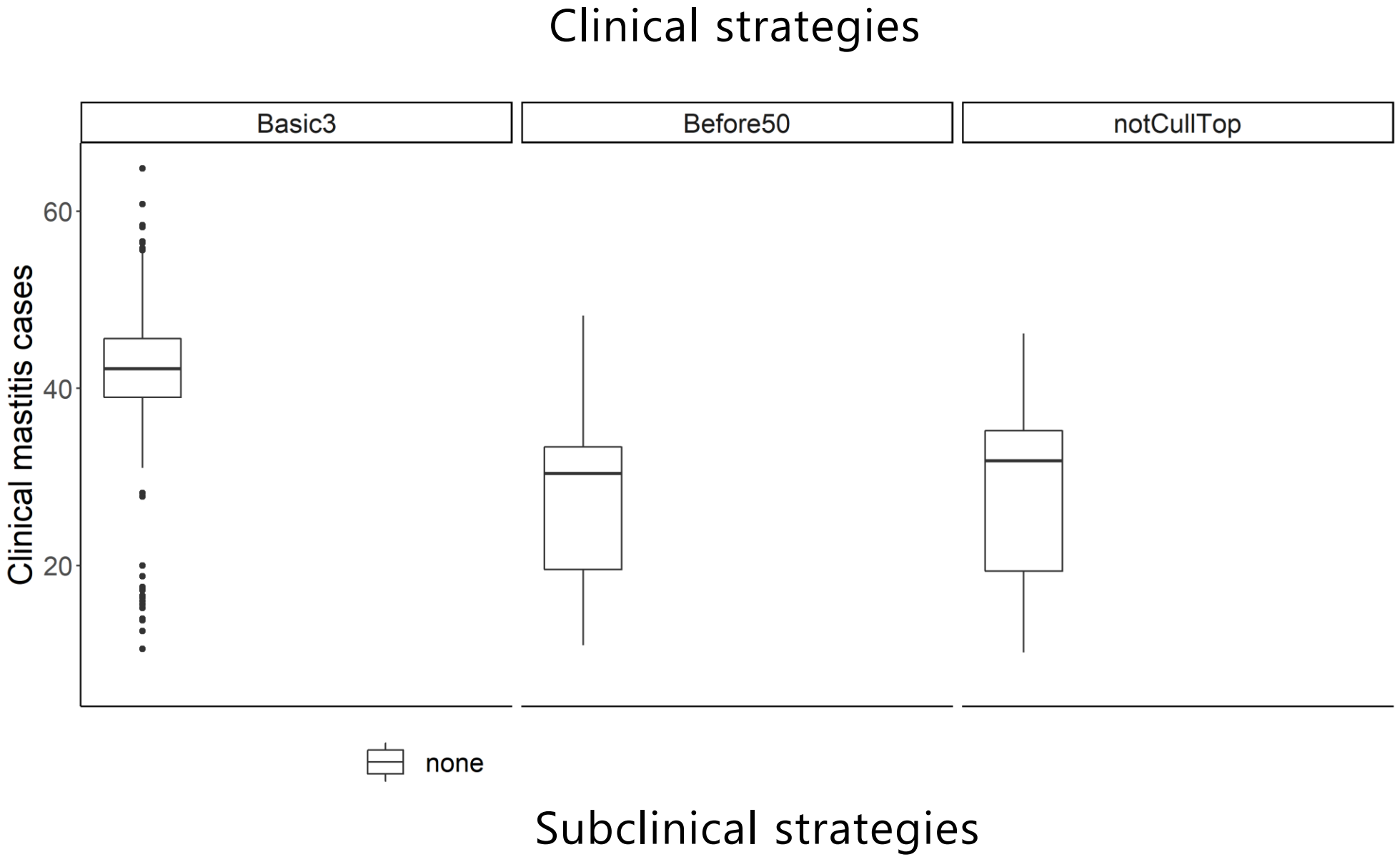
- Udder inflammation
- Bacteria
- Subclinical / clinical
- Contagious or environmental
- Opportunistic

Mastitis

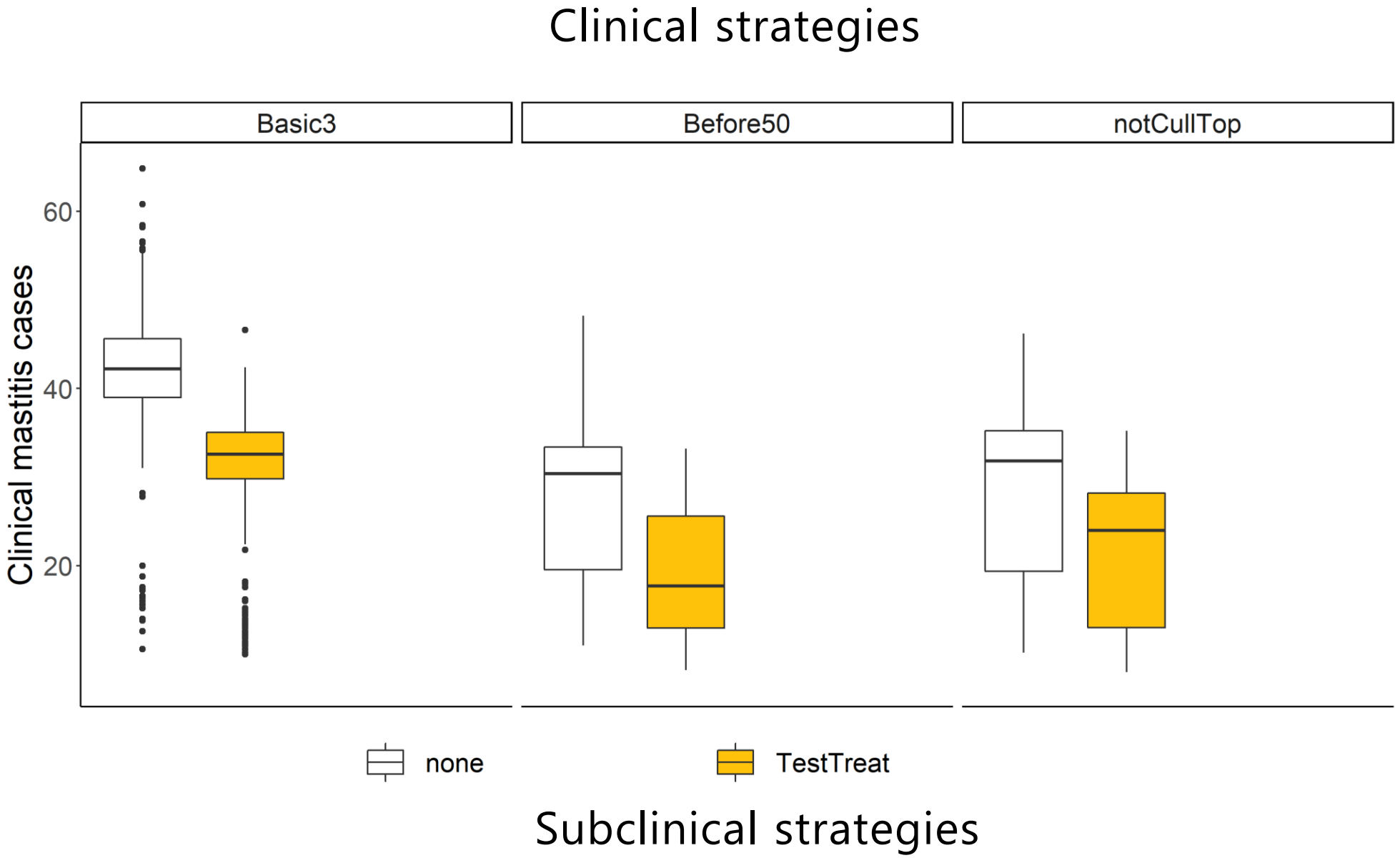


- Milk yield ↓
- SCC ↑
- Culling ↑
- Treatment ↑

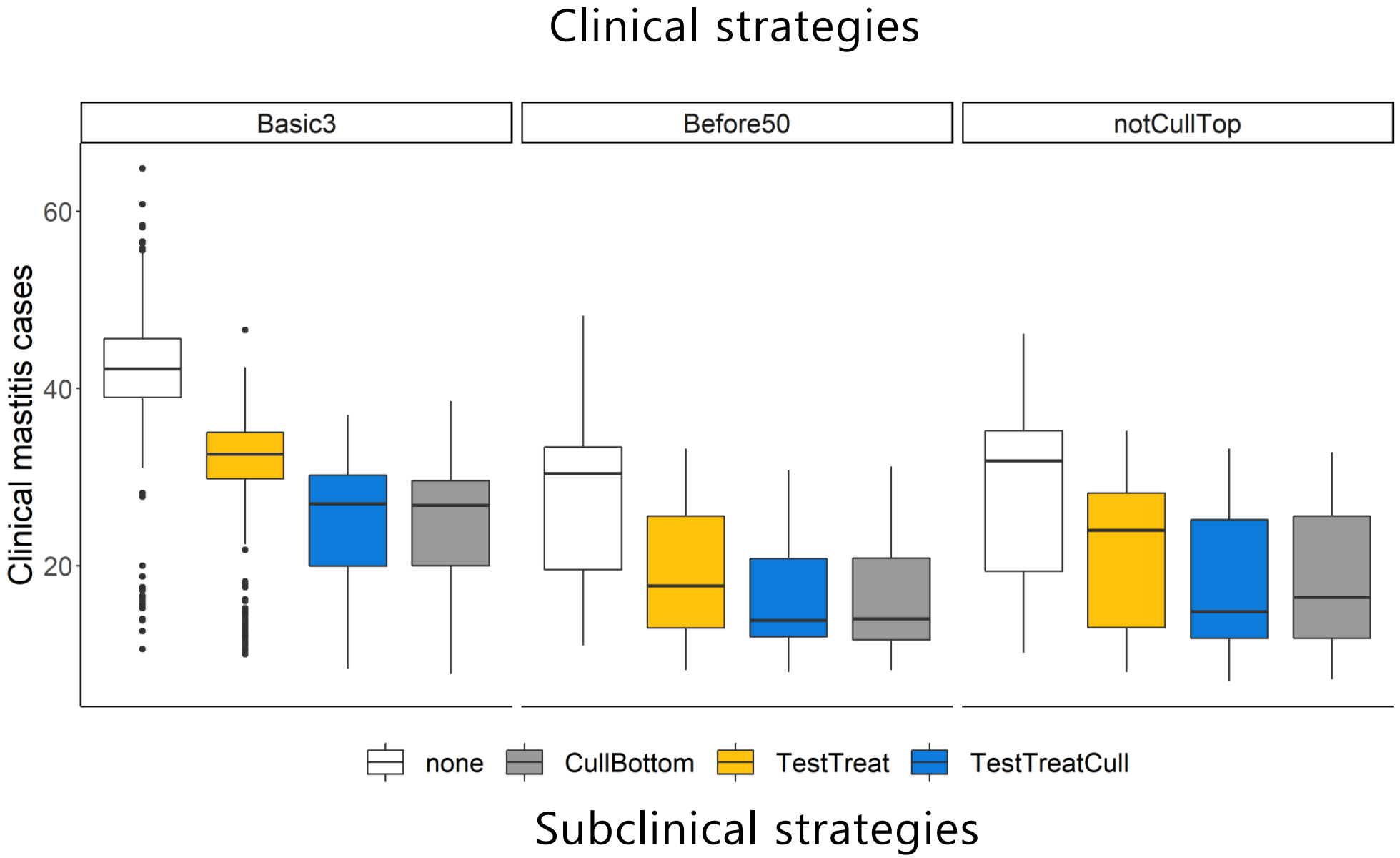
Results - *S. aureus*



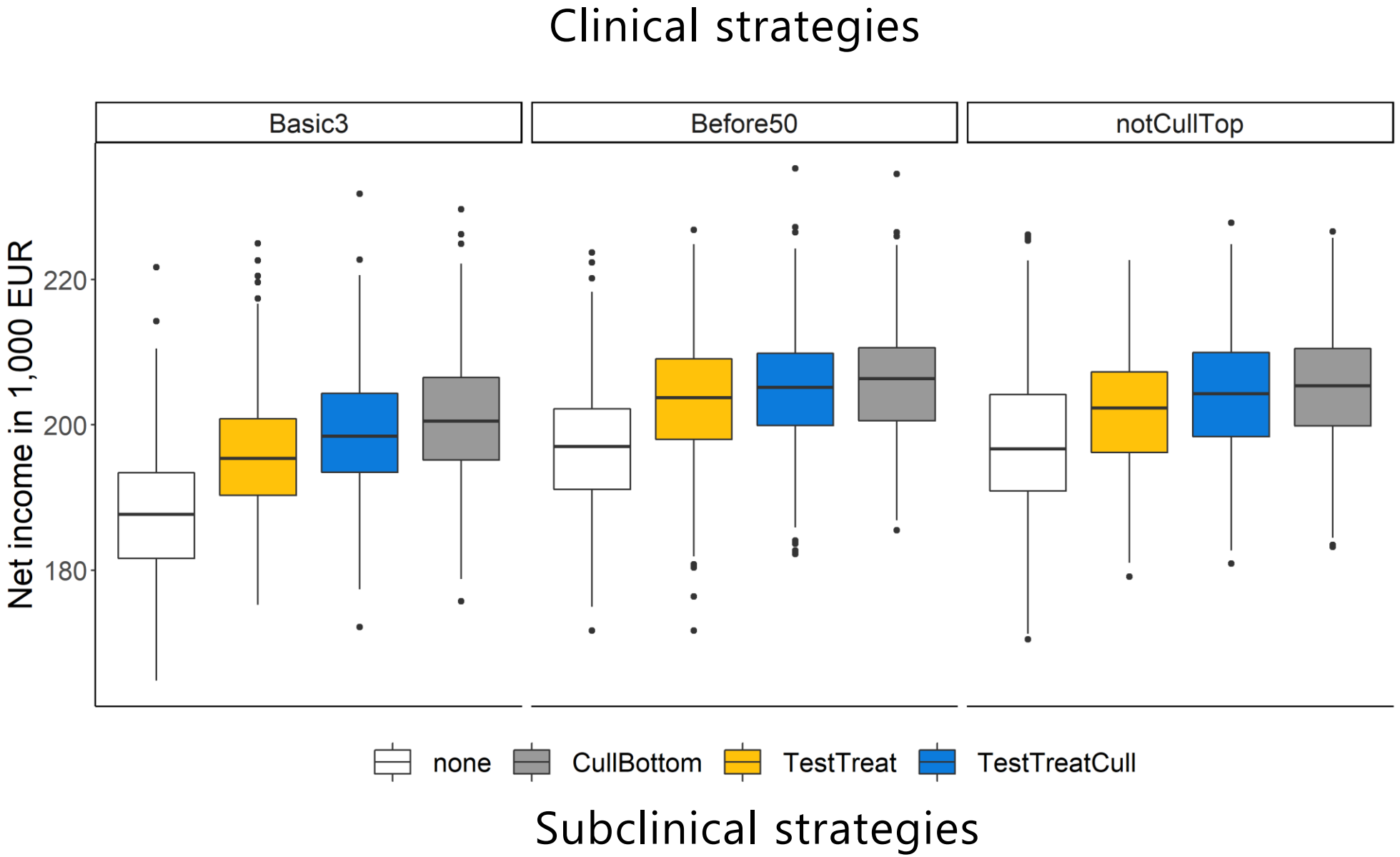
Results - *S. aureus*



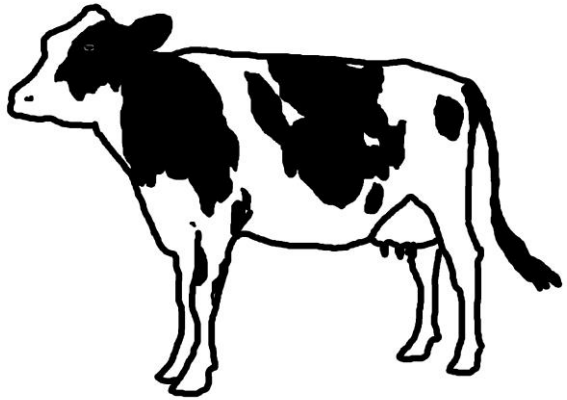
Results - *S. aureus*



Results - *S. aureus*

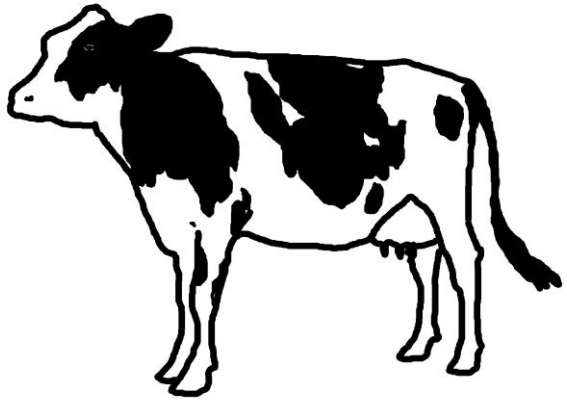


Paratuberculosis



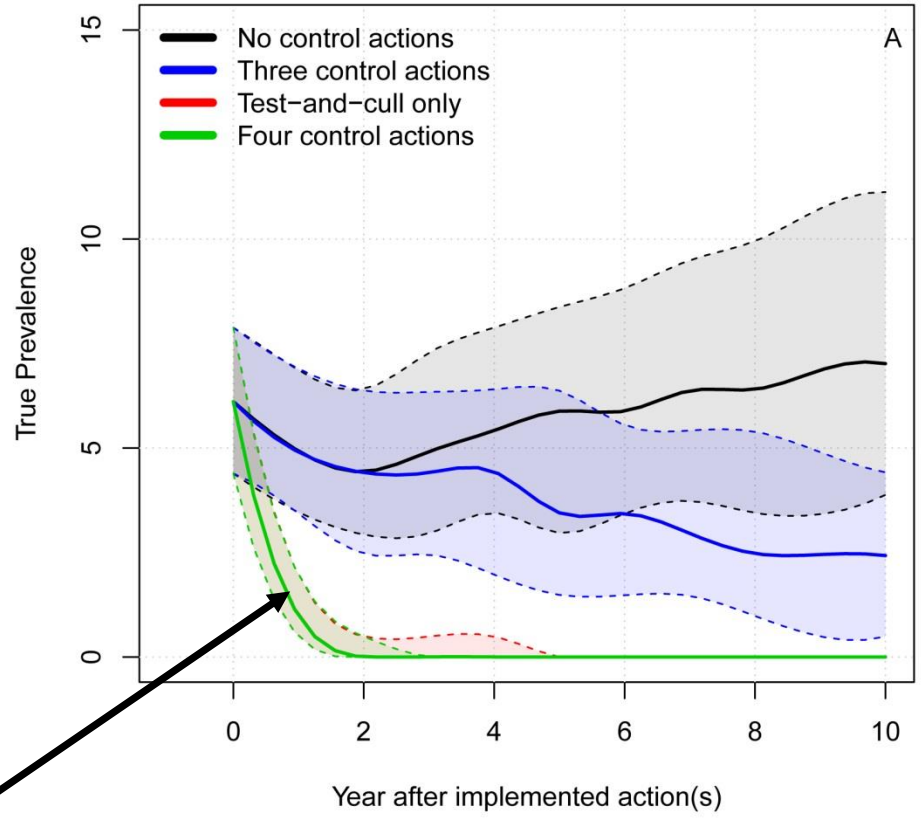
- Chronic disease
- Non-contagious
- Slowly developing

Paratuberculosis



- Milk loss
- Fatal diarrhea

Paratuberculosis



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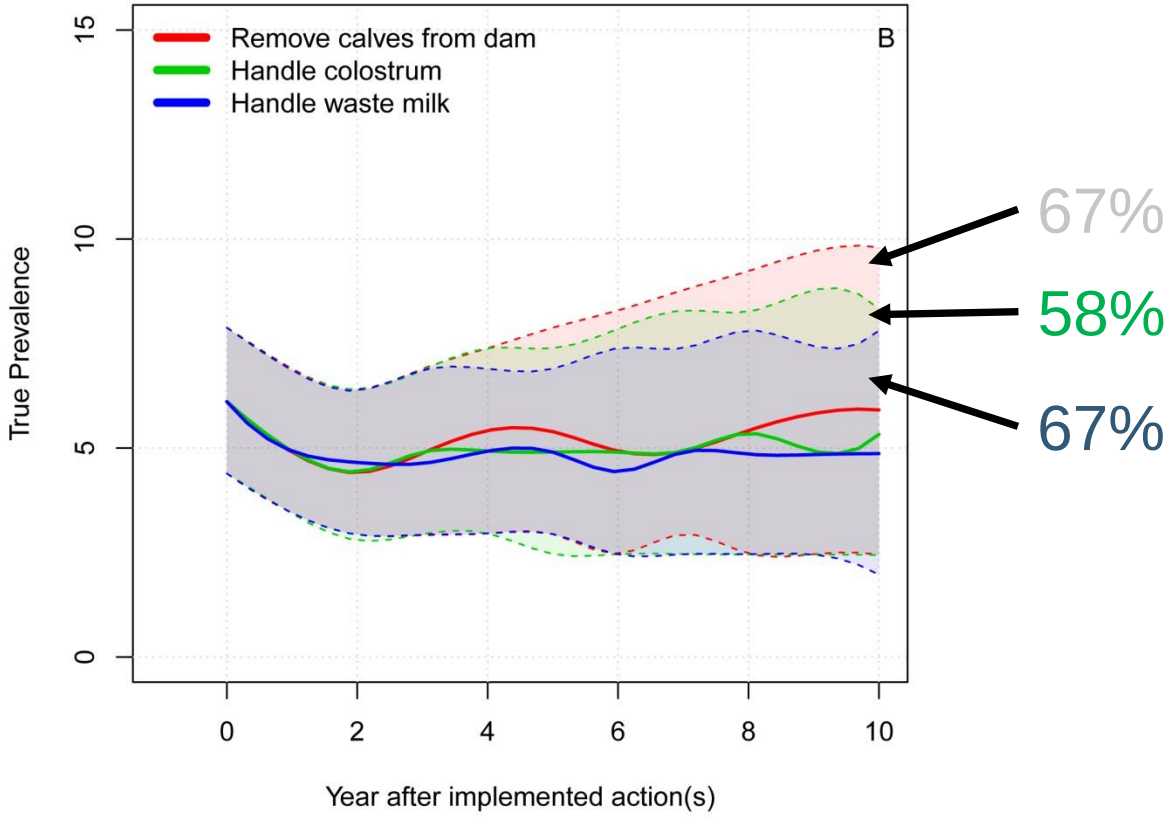

67%

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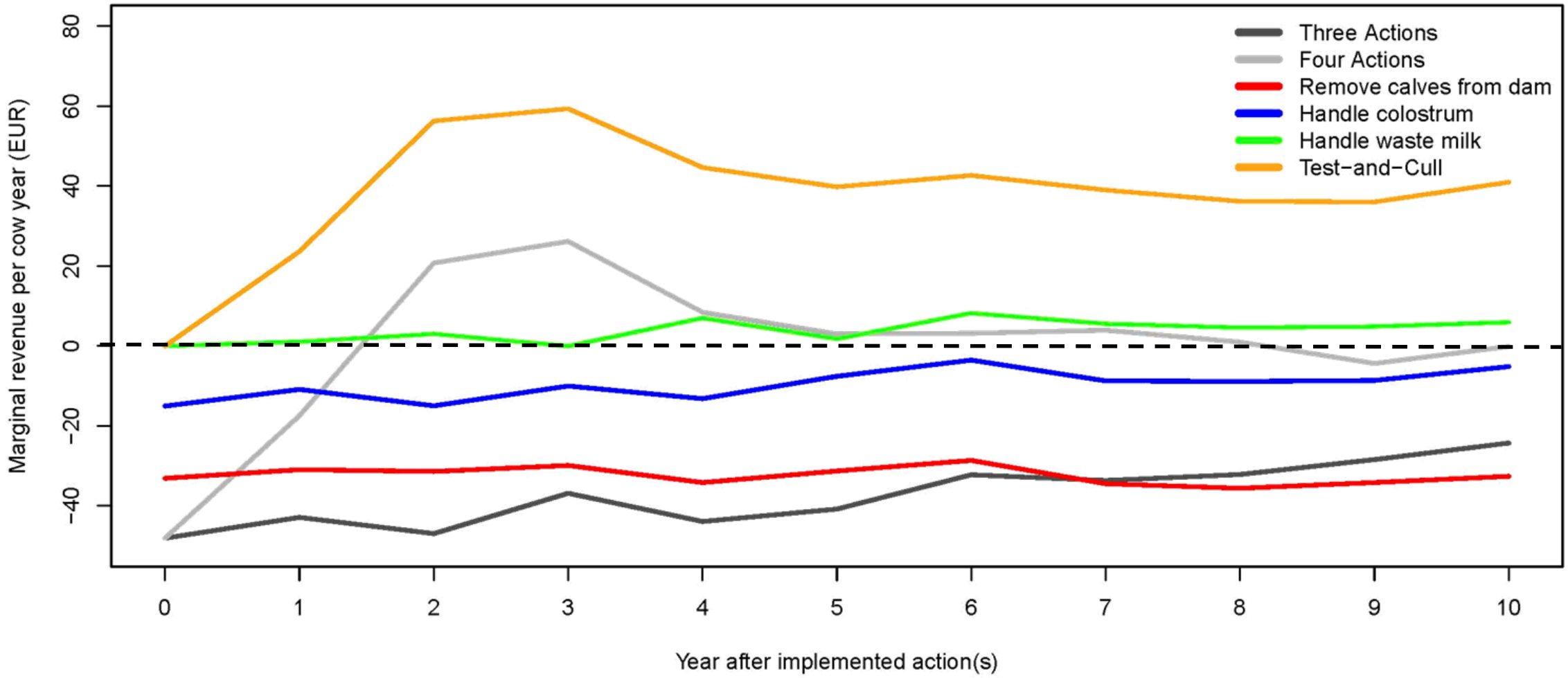
67%

Paratuberculosis



Perspectives

- Many different models
- Mechanistic: High detail level
- Decision support
- Economic scenarios

Teaching

THE UNIVERSITY OF SYDNEY

UNIVERSITY OF COPENHAGEN

Introduction to Modelling of Disease Spread and Control

Special course 2019

Course description

Simulation modeling is an approach often used in the veterinary and human medicine for modeling disease spread and control. The course will focus on fundamental concepts in modeling. It will teach the student how to structure a system into a simulation model and the fundamental aspects that must be considered when building a simulation model of disease spread. The student will learn how to model diseases using SIS, SIR and SEIR infection model structures. Students will be introduced to modelling using difference and differential equations as well as mechanistic modelling. An important part of simulation is how to present model results in a clear and coherent way. Students will learn how to collect the results either during the simulations or after, and to present them in tables and graphics.

Course requirements

Basic knowledge and experience of programming using the software R.

Learning objectives

Students who have met the course objectives will be

- Select appropriate infection models
- Model different mechanisms of disease spread between individuals as well as disease control
- Collect the results from the simulations in a sound way and present them visually

Course materials

Complete notes, R code, relevant scientific papers

Course information

Course language: English
ECTS points: 5
Target group: Post-graduate students in veterinary and medical infectious diseases fields
Location: Camperdown Campus and on-line
Fee: AUD 500
Teaching form: E-learning and on-site lectures, computer exercises and group work.
Duration:
1 week off-site self-study (during 3—21 June 2019)
1 week of on-site teaching including lectures and group work (24-28 June 2019)
1 week off-site work on own project (1-5 July 2019)
Assessment: Evaluation of an assignment.

Collaboration

- Fish farms / wild population
- Economic impact of disease
- Dynamics of disease transmission
- Cost-benefit of actions
- AMR strategies

ckir@sund.ku.dk

Thank you.
Any questions?

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