Alternatives provided by recent system modelling in animal health for the upscaling of vaccine efficacy to the population level

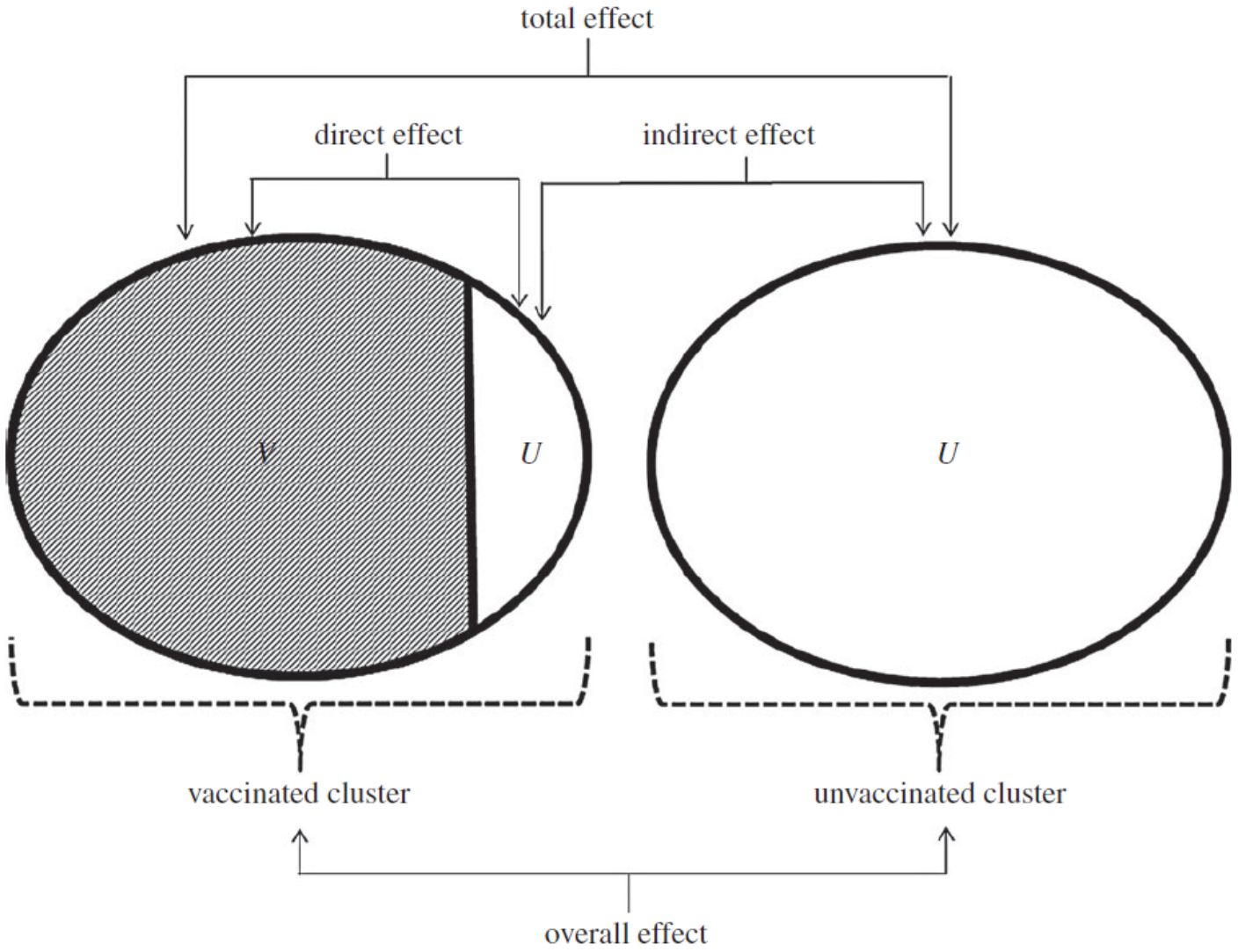
Hans-Hermann Thulke

Field trials
On purpose

Vaccine efficacy (VE)

- Specific ability of the biological product to **produce the result** for which it is **offered** when **used under the conditions recommended** by the manufacturer

Knight-Jones et al 2014. Veterinary and human vaccine evaluation methods. Proc. R. Soc. B 281: 20132839



VE = 1 – R vaccinated / R unvaccinated

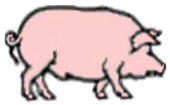
(measure of condition or disease)

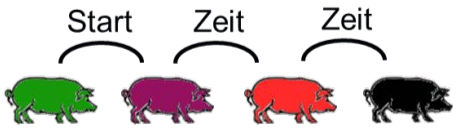
Knight-Jones et al 2014. Veterinary and human vaccine evaluation methods. Proc. R. Soc. B 281: 20132839

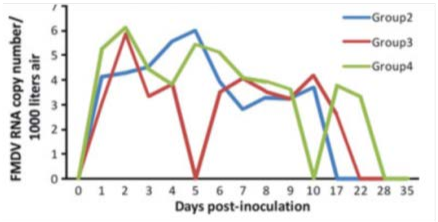
Field trials
On alternative

System modelling as pseudo field trials

Details of transmission and immune response







 Impfwirksamkeit

 Diagnostisches Profil

TIEREBENE

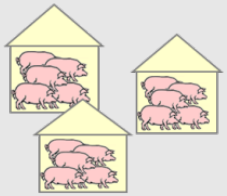
Tier- od. Laborversuch

Immunologic details

Epidemiologic model

Field

System environment



Kontakte

Übertragungswege

Sperrgebiete

Anordnung + Ausführung Maßnahmen

Ausbrüche x Personal pro Tag

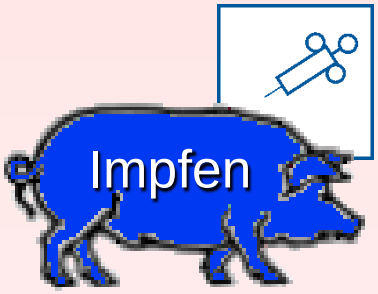
Eintrag x Ausbreitung x Test

POPULATIONSEBENE

Modellsimulation

Efficacy quantification

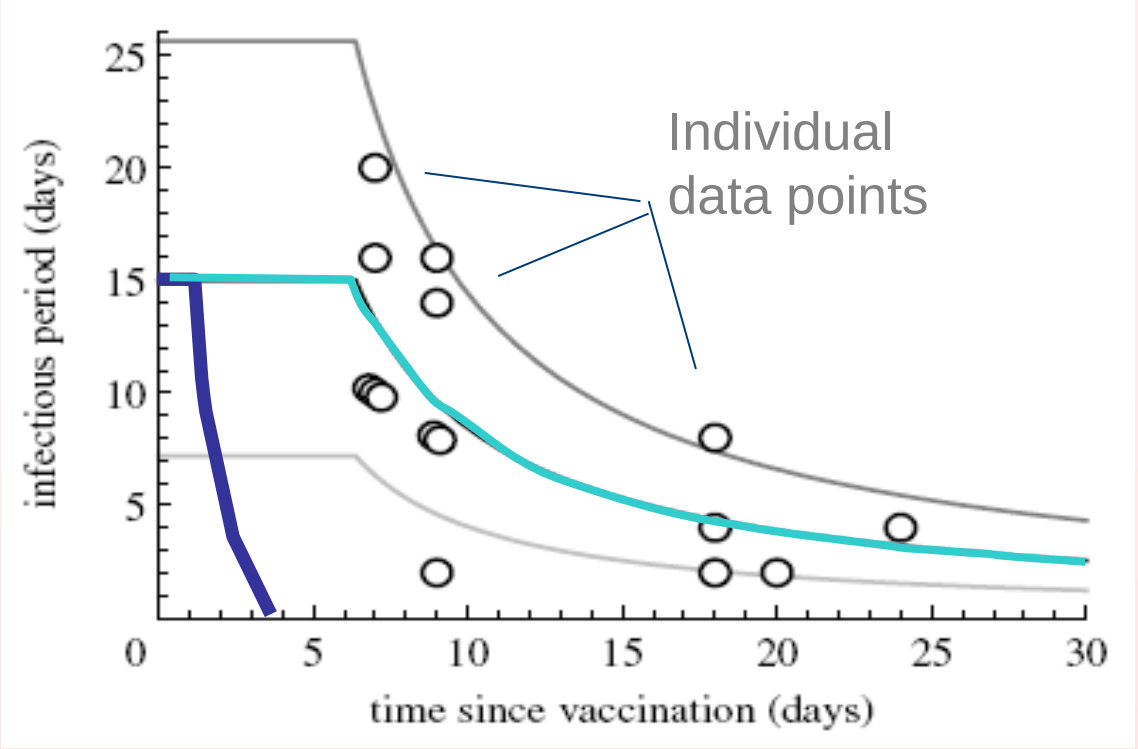
Alternative vaccine parameter



parenteral

DIVA: e2 Subunit

DIVA: Suvaxyn Marker



Baker et al (2009) J. R. Soc. Interface 6 849-861

Simulated field trial - efficacy

Vaccine A vs. Vaccine B

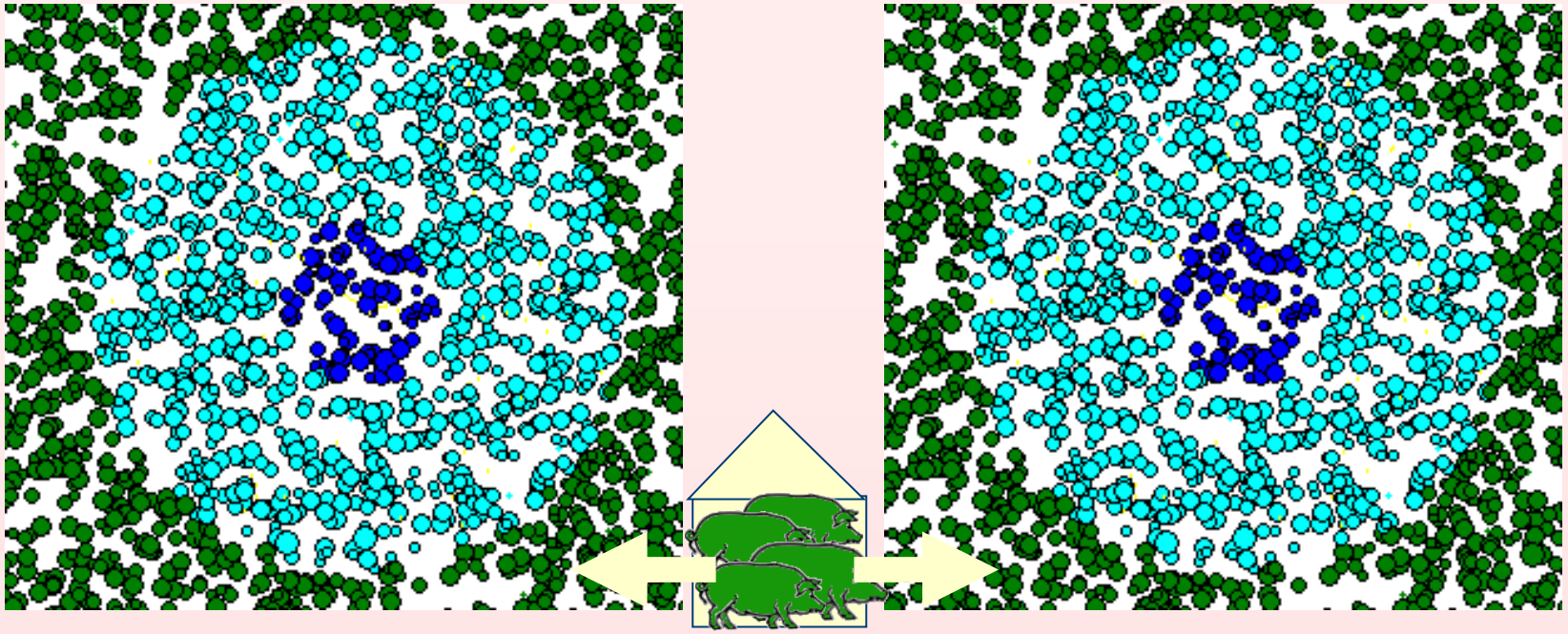
Two DIVA vaccines in pigs (now) licenced

DIVA: Suvaxyn Marker

Vaccination

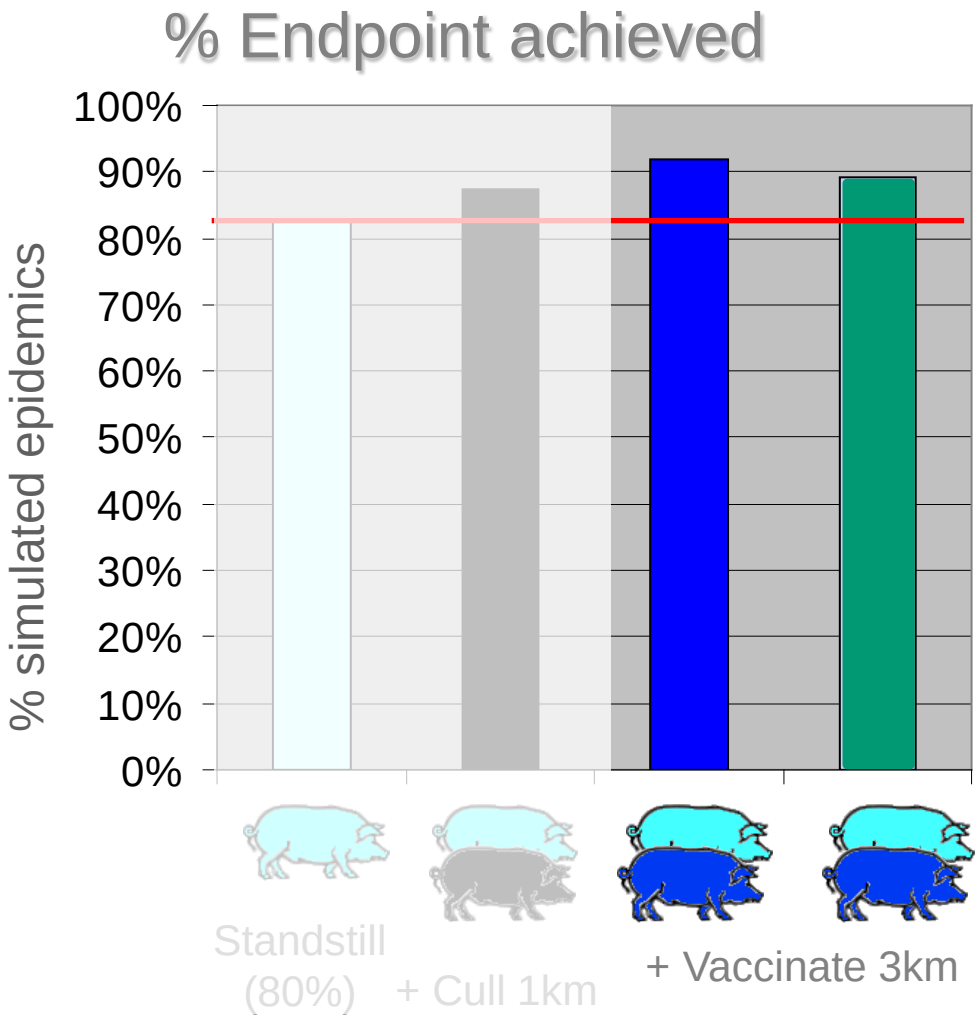
DIVA: e2 Subunit

Vaccination



Free – Infected – Infectious – Standstill – Culled – Vaccinated – Tested – Cleared – Tracing

Efficacy Quantification



DIVA: Suvaxyn CSF Marker

DIVA: e2 Subunit

Restriction compliance 80%

Positive holdings culled

Test by rtRTPCR

In the **neighbourhood** of every positive holding

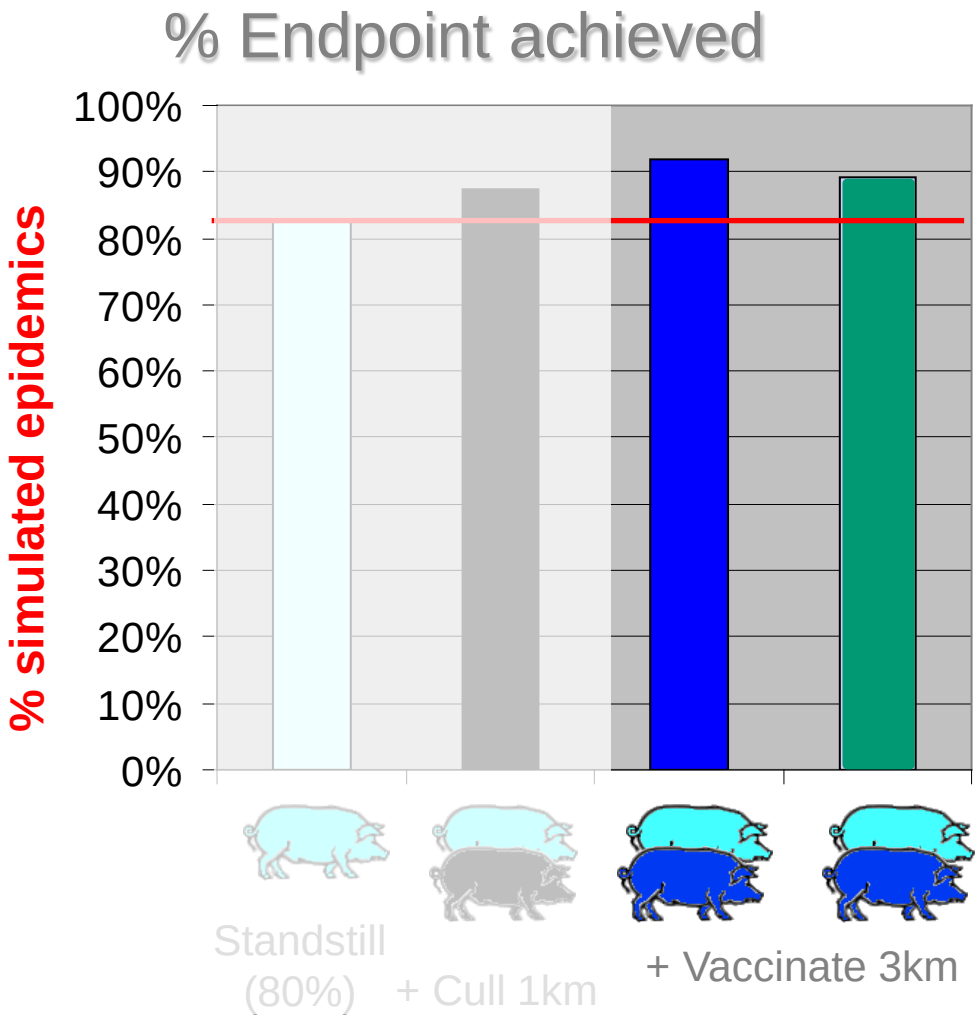
Only restrictions

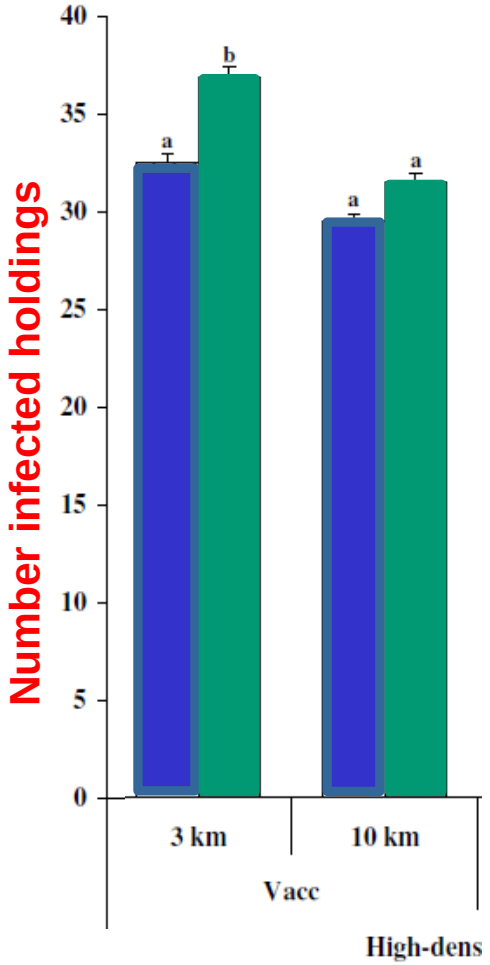
Restrictions + Cull

Restriction + Vaccinate

Efficacy Quantification / Validation

Restriction compliance 80%





DIVA: Suvaxyn CSF Marker

DIVA: e2 Subunit

Brosig et al.(2012).Transboundary & Emerging Diseases, 2006.

Field trials
On arguments

Endpoints of claimed efficacy

Endpoints for vaccine application correlated with **prevention or reduction** of

- Infection/Susceptibility
- Disease/adverse effect

Individual animal characteristic, challenge experiments, min max of titre

- Transmission
- Infectiousness

Multiple animal characteristic, contact experiments, range of titre

- spread
- persistence

Population characteristic, Field trials under programme conditions / sufficient transmission data + model-based upscaling

Quantified efficacy supports

Design,

Planning,

Budgeting and

Monitoring

of intervention programmes

Who is responsible for
inadequate efficacy revealed in the field
post authorisation?

Summary

- One fits all answer = field trial based quantification of efficacy needed

- Conditional request = consideration of
  - Claim
  - Quality of laboratory data
  - Needs and benefits of possible programmes