

Falsifying expectation

Don't fear meat from pigs vaccinated during CSF outbreaks

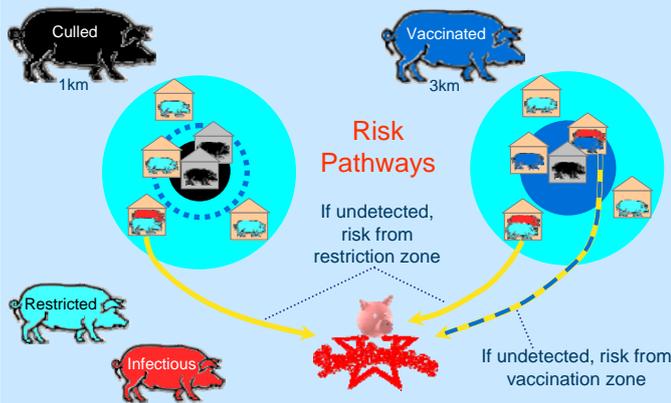
The Motivation

Classical Swine Fever (CSF) epizootics are devastating for pig industry. Major socio-economic damages were caused in the EU. Intervention and control actions are legislated by Directive 2001/89/EC: Along with movement restrictions, contact tracing, and stamping out of infected farms, pre-emptive culling of neighbouring premises is the measure of success. Standard diagnostic screening procedures end the emergency measures (i.e. 30 days after last outbreak detection). The Pre-emptive Culling strategy is expected to be completely safe for subsequent commercialisation of meat of remaining pigs.

Public critique and loss of economic values encourage search for control alternatives. Emergency vaccination is not precluded by legislation. Life-vaccines (C-strain) are available which induce effective protection. rt-RTPCR techniques allow to identify infectious pigs (CSFV+). But antibody detection cannot differentiate between vaccinated pigs and pigs recovered from field infection. Therefore, with the current diagnostic strategy being based on antibody detection, subsequent outbreaks in vaccinated herds likely go undetected and the post-emergency commercialization of meat from vaccinated pigs is expected as unsafe.

The Problem

Let vaccination and infection occur within a herd in close temporal proximity. The resulting outbreak will be limited. Making detection of the herd complicate.

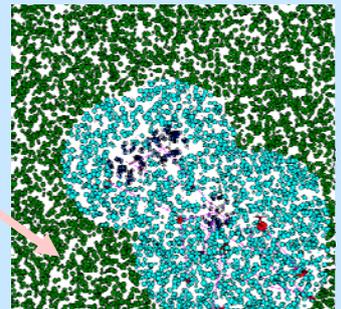


PROBLEM: Are undetected **infectious** farms more often slaughtered after application of **emergency vaccination** compared to pre-emptive culling?

The Model

stochastic; spatially explicit; daily timing; 500x500km randomly located pig farms with density 1/km² and mean stocking of 1000 pigs.

Dot per farm. Colour by herd status.



Epizootic = full scene. Outbreak = one herd.

Simulation of full epizootics until regular lift-up of restrictions

Lift-up conditions (Directive 2001/89/EC):

- 30 days past last detection of an outbreak herd
- Negative diagnostic result of end screening

Diagnostic procedure:

- Random samples from all herds remaining in restriction zone
- Diagnostic test with 100% sensitivity on infectious pigs.

Assumptions (Pre-emptive Culling / Emergency Vaccination):

- Effective Control Zone: 1km / 3km (Backer et al. 2008)
- Control Capacity: 7150 / 14300 pigs (Field experience D)
- Control Delay: 3 / 7 days (EFSA 2009)
- Protective Immunity: 4 days post vaccination (EFSA 2009)
- Herd Immunity: 19 d.p.v. (4+mean individual inf. period; EFSA 2009)
- Compliance with Vaccination protocol: 100%
- High Risk Period: 35-69 days (Field data epizootic NL)
- Tracing Efficiency: 80% (Field data epizootic NL)
- Standstill Compliance: 80% (Field data epizootic NL)

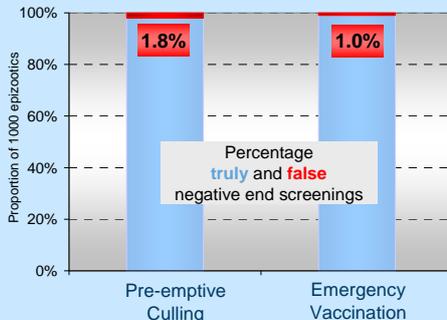
The Result

Comparison of **complete epizootic area** after different control strategies were finished (pathways)

Neither strategy reduced risk of undetected infectious herds to absolute zero.

Vaccinating **not** less safe than culling...

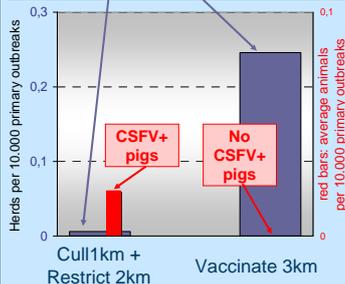
... WHY?



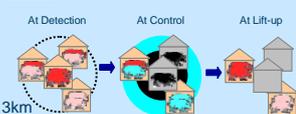
Focus to **3km around primary outbreak** after different control strategies were applied (pathways)



Undetected infected herds after end screening (containing CSFV+ and/or CSFV-AB+ pigs)



Vaccinating 3km masked small outbreaks from detection [0.25 herds per outbreak, left Fig.]. Surviving pigs at lift-up were CSFV-AB+ from field infection*.



With Culling 1km fewer herds remain undetected (left Figure). However, undetected herds likely harbour CSFV+ pigs after lift-up.

* As Lift-up occurs as early as 30 days after vaccination infectious pigs are either dead or recovered!

The End

Emergency Vaccination strategy using fast & effective vaccine (e.g. C-strain) did not decrease the safety of pig meat commercialized post emergency. The control alternative likely save huge amount of production value.

Current legislation aims to remove all herds that harbour pigs with CSF-antibodies (AB+) prior to commercialization of meat. This makes emergency vaccination with C-strain less beneficial.

There are two ways out:

- * Development of an equally protective marker vaccine and respective diagnostic tests.
- * Development of an amended control protocol exploiting that meat from CSFV-AB+ pigs is safe. As our results show, meat will be safe from vaccinated herds remaining post-emergency, whenever a lift-up procedure was performed in accordance to Directive 2001/89/EC.

Field data epizootic NL (1997-98) Special Edition PVM 2001, and others.
Harvey et al. (2007) The North American Animal Disease Spread Model: A simulation model to assist decision making in evaluating animal disease incursions. PVM 82, 176-197.
Backer et al. (2008) Modelling the effectiveness and risks of vaccination strategies to control classical swine fever epidemics. J R Soc Interface.
EFSA-AHAW Panel (2009) Opinion on "Animal health safety of fresh meat derived from pigs vaccinated against CSF". <http://www.efsa.europa.eu/en/scdocs/scdoc/933.htm>

The Credits

Poster: Hans-Hermann Thulke & Frank Koenen. Model & Analysis: Dirk Eisinger. Subject matter validity, experimental design: Martin Beer & EFSA-AHAW WG on CSF i.e. Willie Loeffen, Volker Moennig, Maurice Pensaert, Marie Frédérique Le Potier, Mo Salman, Moez Sanaa, Michael Sharp, Christoph Staubach & Sandra Correia Rodeia, Per Have, Milen Georgiev.