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Risk-based meat inspection and integrated meat safety assurance

Examples of risk-based meat inspection in bovines – TB and cysticercosis

Lis Alban | 4-Feb-21 | Virtual training school

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Agenda

Show studies done in bovines related to

- *Cysticercus bovis*
- bovTB

Explain recent changes to the EU legislation specifically for bovines

EU regulation 854/2004

Bovine carcasses > 6 weeks of age were to be inspected for *C. bovis*

- Incisions into masseter and pterygoid muscles and opening of heart
  - Time-consuming
  - Costly
  - Value in countries with low prevalence?

- Prevalence in DK estimated to 0.1 – 0.7% (1990)
  - In Denmark, cattle are typically lightly-infected
  - Up to 4 cysts per carcass
  - Low sensitivity (15%) of meat inspection of these animals

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PhD project in Denmark 2010-13

Aim: to study how to make meat inspection more risk-based with respect to *C. bovis*

- Part I: Identification of risk factors
- Part II: Scenario tree modeling

- PhD-Student: Francisco Calvo-Artavía

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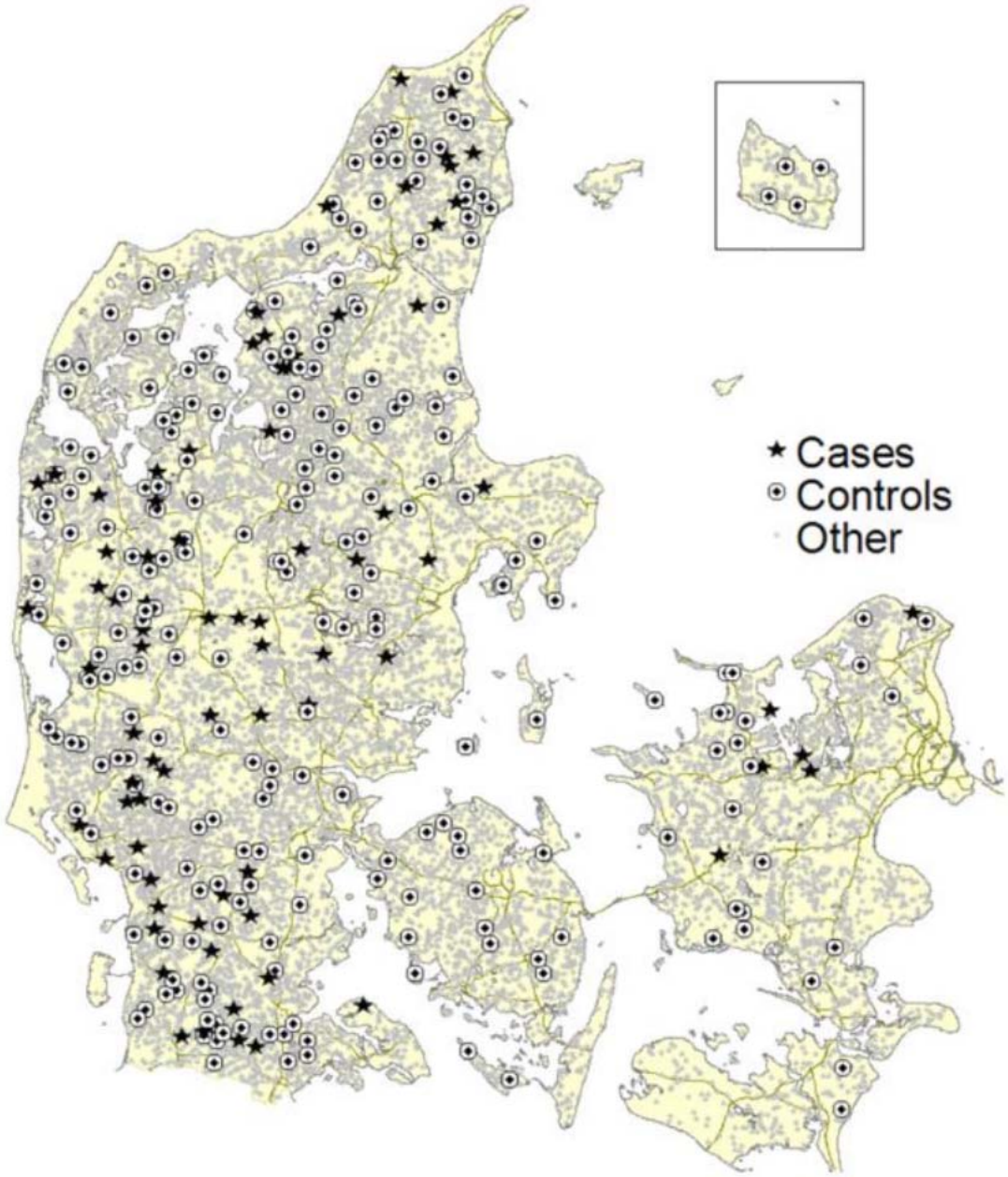
Inspection of spatial distribution

Case-control study

- Definition of case herd:
- At least one animal diagnose with *C. bovis* at meat inspec between 2006 and 2010
- 77 cases and 231 controls

Calvo-Artavia, Ph.D.-thesis



Results of case-control study

Risk factor	Risk group	RR	Proportion	AR
Gender	Female	4.7	0.5	1.7
	Male	1	0.5	0.3
Grazing	Grazing	3.6	0.4	1.8
	Not grazing	1	0.6	0.5
Access to risky water source	Access to risky water source	3.1	0.1	2.6
	No access to risky water source	1	0.9	0.8

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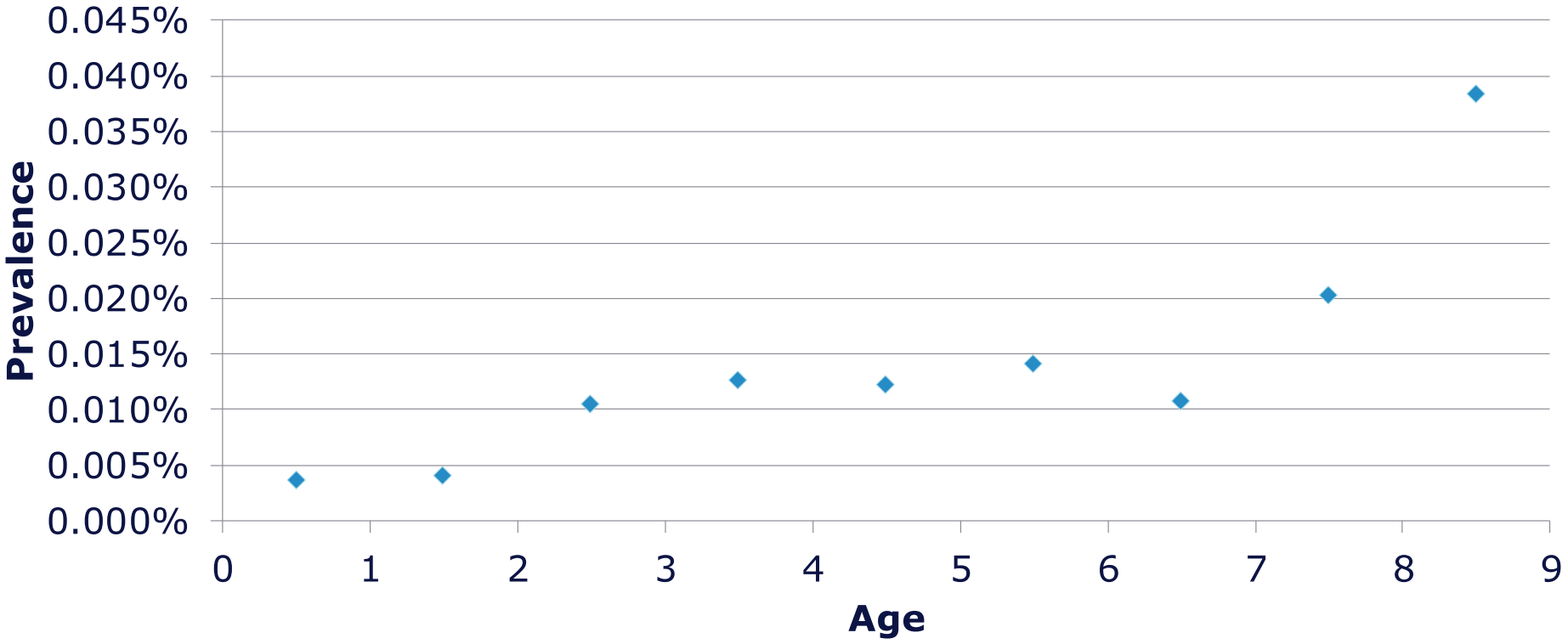
Calvo-Artavía et al., 2012

Prevalence of cysticercosis in Danish cattle, divided according to age, 2004-2011



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Source: Calvo-Artavia et al. Prev. Vet. Med. 2012

Results of simulation of future scenarios

Risk factor and scenarios	No. of detected cases (95% CI)	Sensitivity of surveillance (95% CI)	No. of cattle visually inspected	Net gain in million €/year (95% CI)
Current surveillance	**44** (15, 95)	**0.15** (0.07, 0.22)	**0**	**0**
Gender	**36** (12, 78)	**0.12** (0.06, 0.18)	**251,327**	**0.7** (0.6, 0.8)
Grazing	**31** (10, 67)	**0.10** (0.05, 0.16)	**299,374**	**0.8** (0.7, 0.9)
Access to risky water source	**11** (4, 24)	**0.04** (0.02, 0.06)	**449,061**	**1.2** (1.1, 1.3)

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Source: Calvo-Artavía et al., 2012

Discussion – similar findings in France

Apparent prevalence (%) of cattle with cysticercus according to sex, age and production type, based on post-mortem inspection N=4,564,065 cattle, France 2010

Age	Production type		
	Dairy	Mixed	Beef
Female <8 months old	0 [0;0.03]	0 [0;0.02]	0.01 [0;0.01]
Male <8 months old	0 [0;0]	0 [0;0.01]	0 [0;0]
Female 8–24 months old	0.25 [0.12;0.45]	0.1 [0.01;0.34]	0.06 [0.04;0.07]
Male 8–24 months old	0.06 [0.04;0.07]	0.07 [0.05;0.09]	0.04 [0.04;0.05]
Female 2–3.5 years old	0.27 [0.24;0.31]	0.32 [0.27;0.39]	0.28 [0.26;0.30]
Male 2–3.5 years old	0.33 [0.29;0.37]	0.49 [0.43;0.55]	0.3 [0.26;0.33]
Female 3.5–5 years old	0.28 [0.25;0.31]	0.34 [0.29;0.39]	0.3 [0.28;0.33]
Male 3.5–5 years old	0.32 [0.20;0.49]	0.51 [0.37;0.69]	0.33 [0.26;0.41]
Female 5–10 years old	0.21 [0.20;0.23]	0.25 [0.23;0.28]	0.28 [0.26;0.30]
Male 5–10 years old	0.84 [0.27;1.96]	0.54 [0.15;1.37]	0.15 [0.09;0.22]
Female ≥10 years old	0.19 [0.15;0.24]	0.18 [0.14;0.24]	0.21 [0.19;0.23]
Male ≥10 years old	0 [0;33.63]	4.76 [0.12;23.82]	0.12 [0.02;0.34]

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Dupuy et al., 2014. Veterinary Parasitology 203, 65–72

Also similar findings in United Kingdom

Association between different combinations of age and gender on the odds of *C. bovis* infection, N=2270, United Kingdom 2013-2014

Age-Sex categories	Odds ratio (95% CI)	Wald's test P value
Males 0-20 months	1	-
Females 0-20 months	3.00 (1.87-4.84)	<0.001
Males 21-194 months	3.16 (2.24-4.46)	<0.001
Females 21-194 months	3.19 (2.29-4.45)	<0.001

Marshall et al., 2015. Royal Vet. College for Food Standard Agency, (FS5127002

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Belgian data indicate a different situation

Jansen et al. (2018) estimated a prevalence of 43%

- One may wonder what causes this high prevalence
  - Sewage system? Usage of sewage as fertilizer? Grazing patterns?

With prevalences this high, all beef could be considered high-risk

- Unless farmer decides to document low-risk
  - Role of using serological test? – costly, if used on all slaughter cattle

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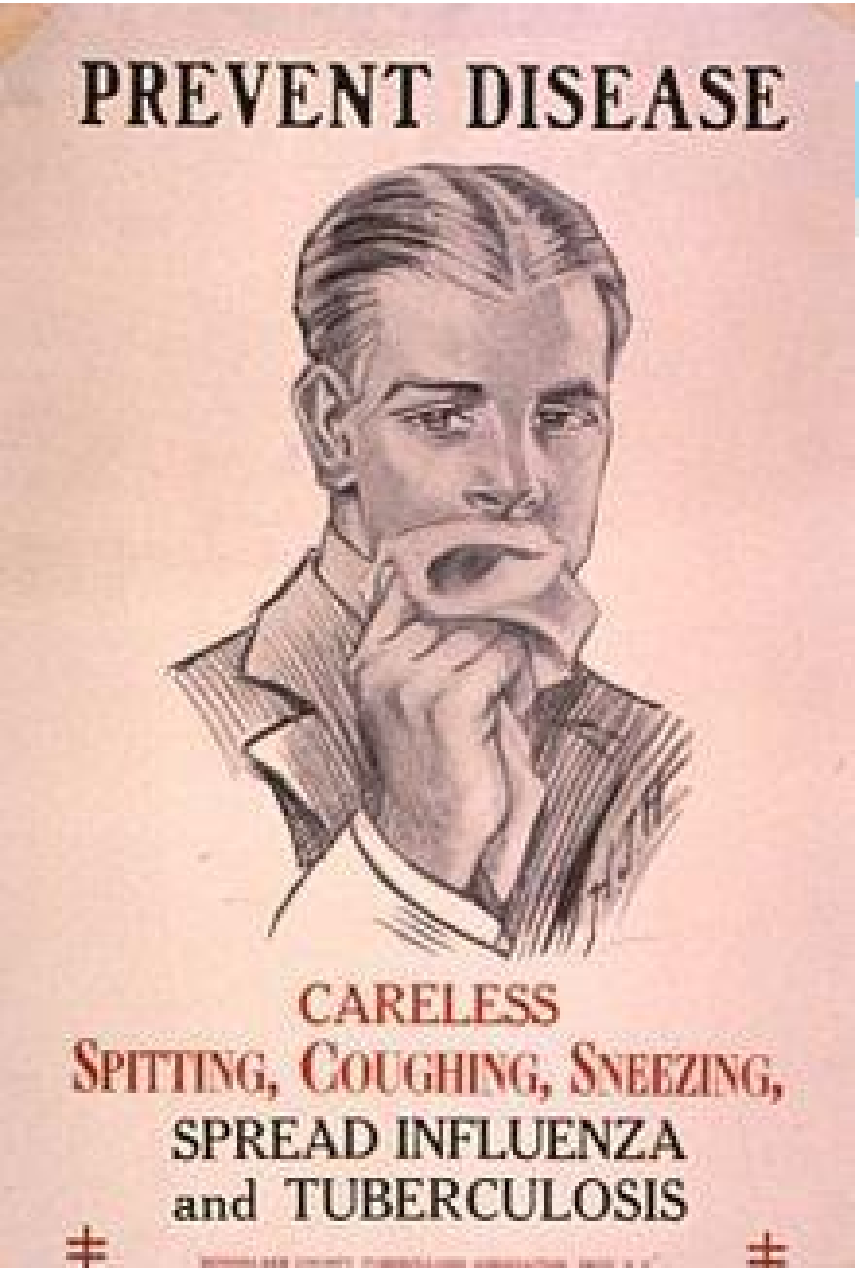

Introduction to bovTB

Zoonotic infection

- Non-pasteurized milk is primary route of human exposure
- As well as direct contact to infected animals

Present in some European countries, eradicated in others

- OTF countries are officially free from bovTB
  - Important to document freedom and avoid reintroduction

EU Meat Inspection Regulation 854/2004

- Incisions into selected lymph nodes of **all** cattle
- But incisions increase probability of spreading *Salmonella*
- bovTB is **not** considered meat-borne
  - Food safety value of incisions at meat inspection being questioned

Effect of changing bovine meat inspection

Denmark officially free from bovTB (OTF) since 1980

- What is probability of maintaining freedom, if visual-only inspection is replacing traditional inspection?

Freedom model approach - developed by Tony Martin and Angus Cameron

- Scenarios: **current meat inspection** or **visual-only** of all slaughtered cattle

Two steps

1. Estimation of annual surveillance system sensitivity (SSe)
   = probability of detecting at least one bovTB infected animal, if present
2. SSe and annual probability of introduction (*Pintro*) used to estimate probability of freedom (*PFree*) over time, based on negative predictive value (NPV)

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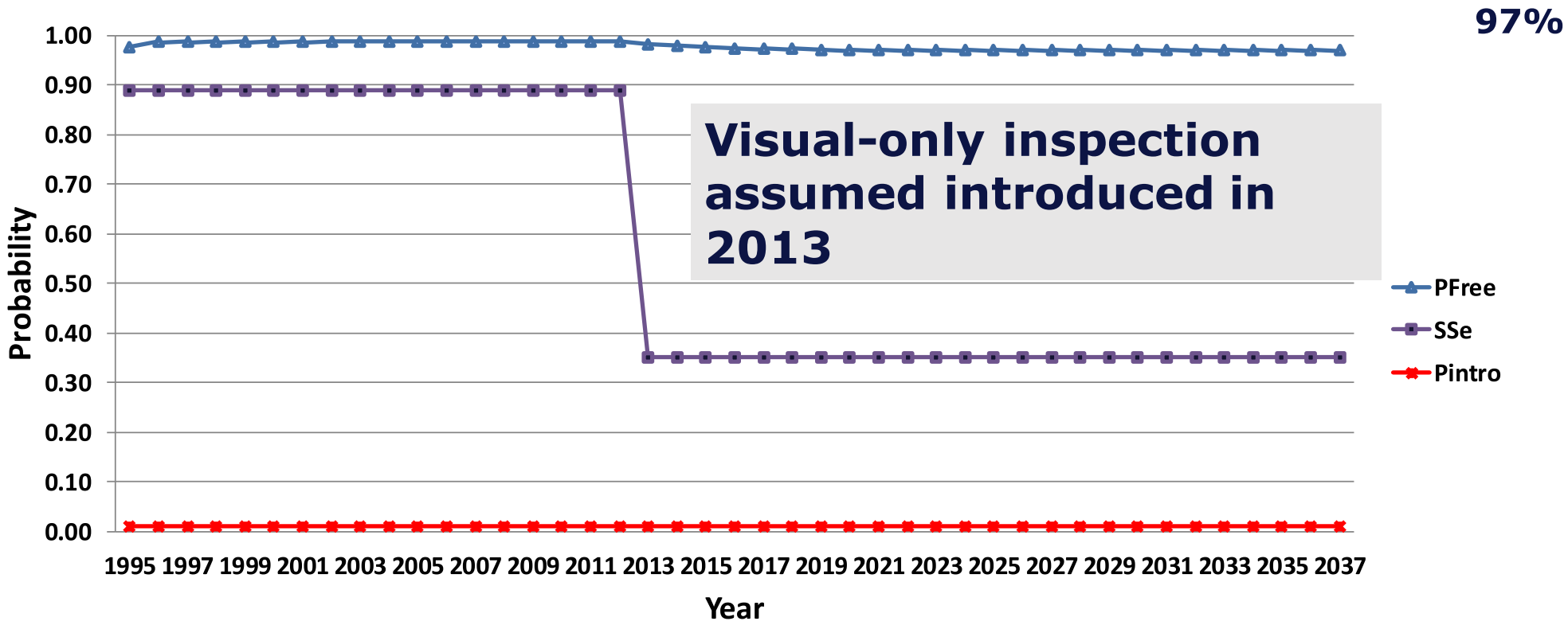
Output of Disease Freedom Model based on *Pfree* approach



Foddai et al., PVM, 2015

Next step: *Pintro*

Simulation model showed that probability of remaining free was high

- Even with visual-only inspection
- However, it was assumed that *Pintro* was 1%

Hence, to have confidence in conclusion, important to estimate country-specific *Pintro*

- This can be done in import risk assessment

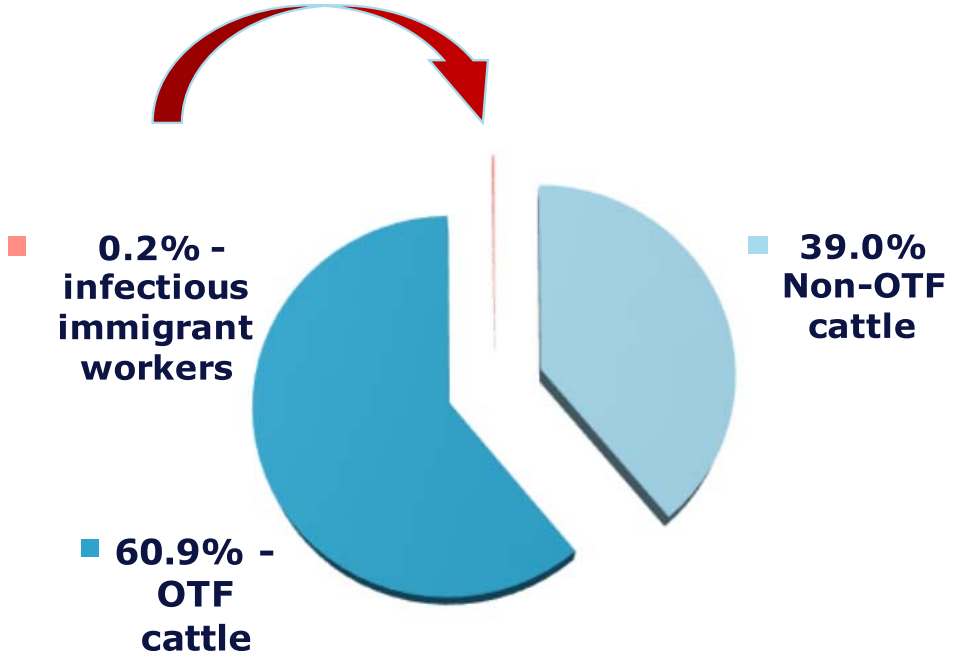
Results – Import risk assessment for *M. bovis*

Median probability of introduction into Danish cattle estimated to 0.7% in 1 year

- Risk mainly driven by imported cattle
  - Infectious immigrant workers played a negligible role

Risk related to cattle from OTF countries was higher than cattle from non-OTF countries

- Because of higher number of cattle imported from OTF-countries



Relative contribution of 3 sources of introduction of *M. bovis* to Danish cattle

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Foddai et al., 2015

Discussion – bovTB free/non-free countries

EFSA's AHAW panel:

- Detection of bovTB would be more difficult, if palpation and incision of relevant organs were removed from inspection tasks
  - But the panel did not look specifically at countries, entirely free from bovTB

Free countries have safe trade patterns

- Thus, high biosecurity at national level
  - Reduces *Pintro*

High confidence in freedom from bovTB can be maintained

- Despite lower confidence in detection by visual-only inspection
  - Targeted inspection in bovine with higher risk (area-wise / herds importing)

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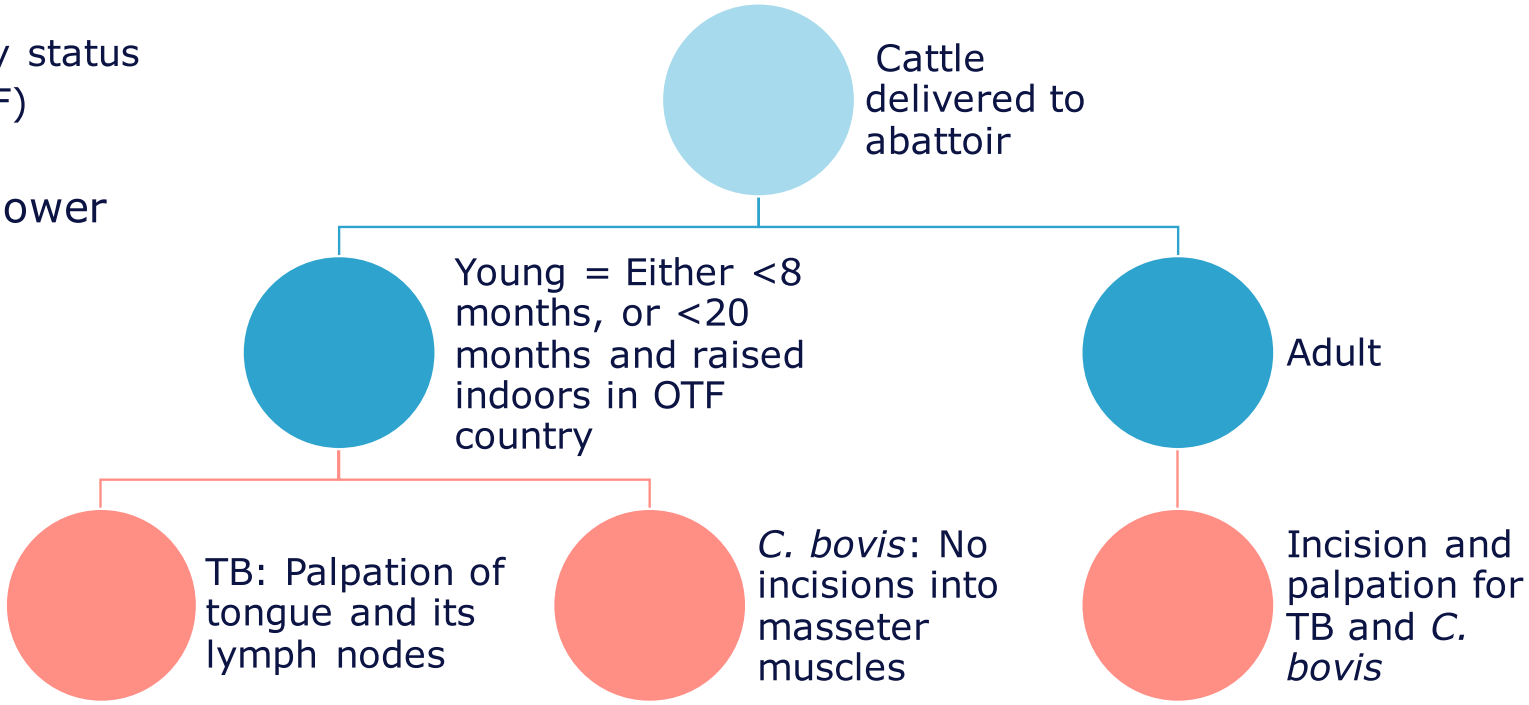
EU Food Inspection Regulation 2019/627

New legislation for *C. bovis* and bovTB

- Compromise between Member States
- Differentiated approach
  - taking into account country status with respect to bovTB (OTF)
- New legislation will lead to lower costs related to sampling
  - Implementation in pipeline in many countries



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Next steps

- Like in swine, focus is on lesions indicating prior septicaemia

- How can generalised disease stages be differentiated from local?
  - Microbiological testing in place in more countries
    - Methodology might need an updating

Contents lists available at ScienceDirect

International Journal of Food Microbiology

journal homepage: www.elsevier.com/locate/ijfoodmicro

Assessing the value of bacteriological examination as a diagnostic tool in relation to meat inspection in cattle

Elvetia Kogka [a,b], Marianne Halberg Larsen [b], Maybritt Kiel Poulsen [a], Jesper Valentin Petersen [a], Camilla Thougaard Vester [c], Lis Alban [a,b,*]

Lesions indicative of prior septicaemia

Ways of handling slaughtered bovines with such lesions

- Total condemnation
  - Often unnecessary
  - Will lead to food loss, economic loss, and higher carbon footprint
- Partial condemnation
  - How to detect all abscesses?
  - Make a study to identify locations
- De-boning
  - Is it needed?
  - Consider alternatives

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Summary

EU Commission recently implemented risk-based inspection

- If reared indoors in OTF country
  - No incisions required in masseter muscles on bovines <20 months
  - Fewer lymph nodes to cut
- Based upon extensive scientific work

Next steps related to septicaemia

- How to differentiate between generalised and local
- How to detect all abscesses

Thank you for the attention.

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