FACULTY OF HEALTH AND MEDICAL SCIENCES
UNIVERSITY OF COPENHAGEN

PROHEALTH

Foot pad infections in broiler breeders – significance and prevalence

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Background - intensive poultry production systems

- Foot pad integrity declines throughout production

- Increase in mortality due to septicaemic infections in late production period
  - Sepsis, Endocarditis, Arthritis

- Aetiology of these infections is often Gram positive cocci
  - *Staphylococcus aureus*
  - *Enterococcus* spp.
  - *Streptococcus* spp
  - *Staphylococcus* spp

- Pathogenesis of in poultry is not fully elucidated

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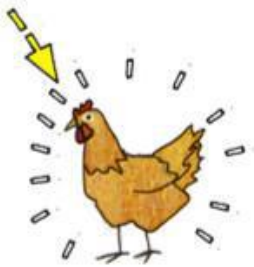
- Overall experimental design

Pathology

Necropsy

Appr. 10 random dead-on-farm per week per flock

Causes of mortality in broiler breeders
Prevalence, aetiology and age



Infectious

Non-infectious

Broiler parents

997 birds Investigated by *post mortem*

55% died from lesions associated with bacterial infections

→

E. coli responsible for 62% of this mortality

E.coli was the cause of mortality in 85% of the salpingitis/peritonitis cases

- Top 5 causes of death (primary lesions)- overall

Total (n=991)	20-29	30-39	40-49	50-
Salpingitis-Peritonitis 29.2%	Salpingitis-Peritonitis 22.9%	Salpingitis-Peritonitis 32.8%	Salpingitis-Peritonitis 26.8%	Salpingitis-Peritonitis 33.5%
Egg bound 8.3%	Egg bound 13.7%	Egg bound 9.1%	Fatty liver 15.8%	Salpingitis 8.1%
Fatty liver 8.0%	Emaciation 9.3%	Cannibalism 8.4%	Arthritis 8.2%	Uraemia/ nephropathia 7.2%
Arthritis 6.4%	No lesions 9.3%	Fatty liver 6.2%	Salpingitis 7.2%	Septicaemia 6.8%
Cannibalism 5.5%	Sudden Death Syndrome 8.3%	Heart failure 6.2%	Amyloidosis 5.8%	Cannibalism 6.8%

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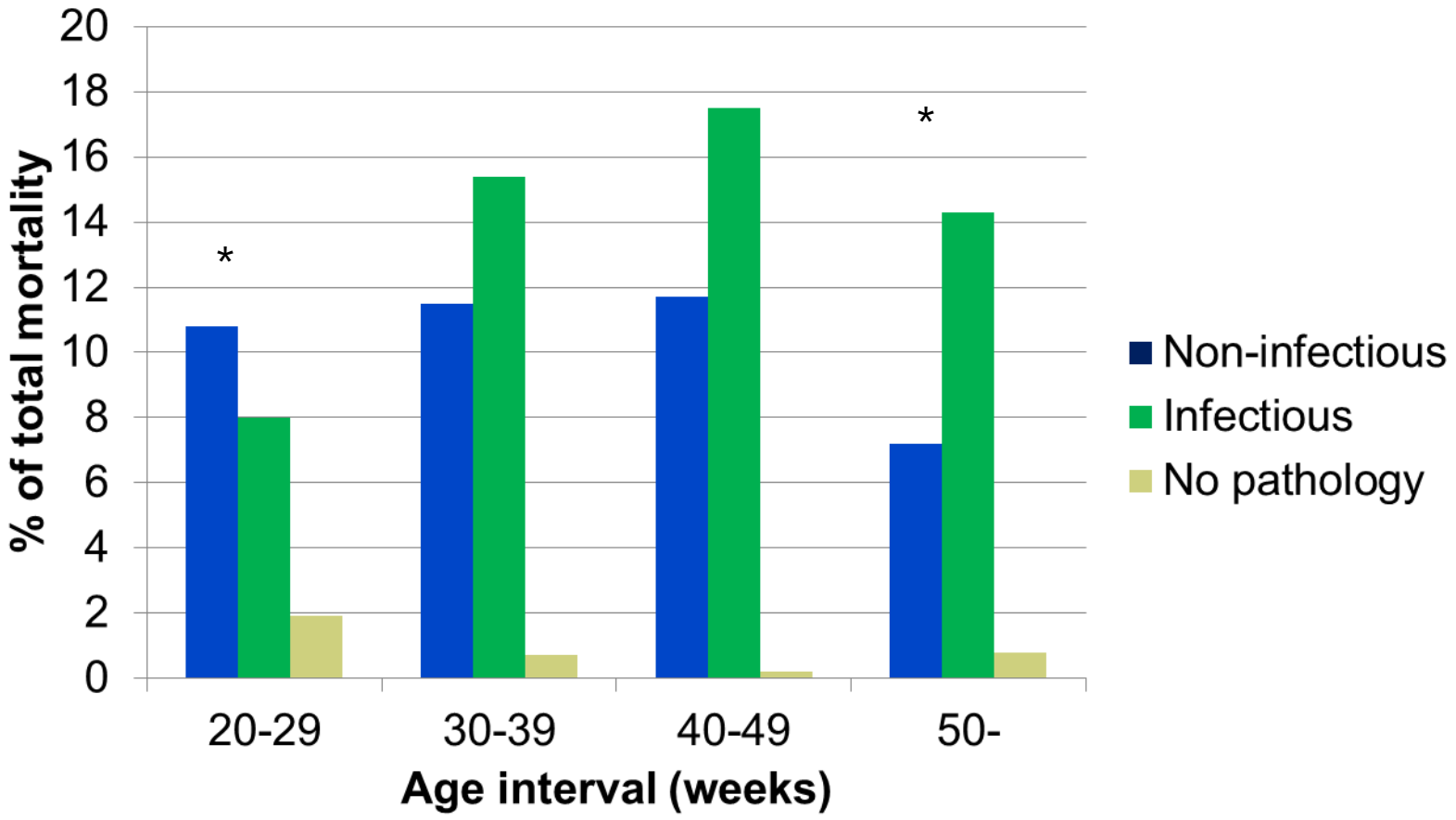
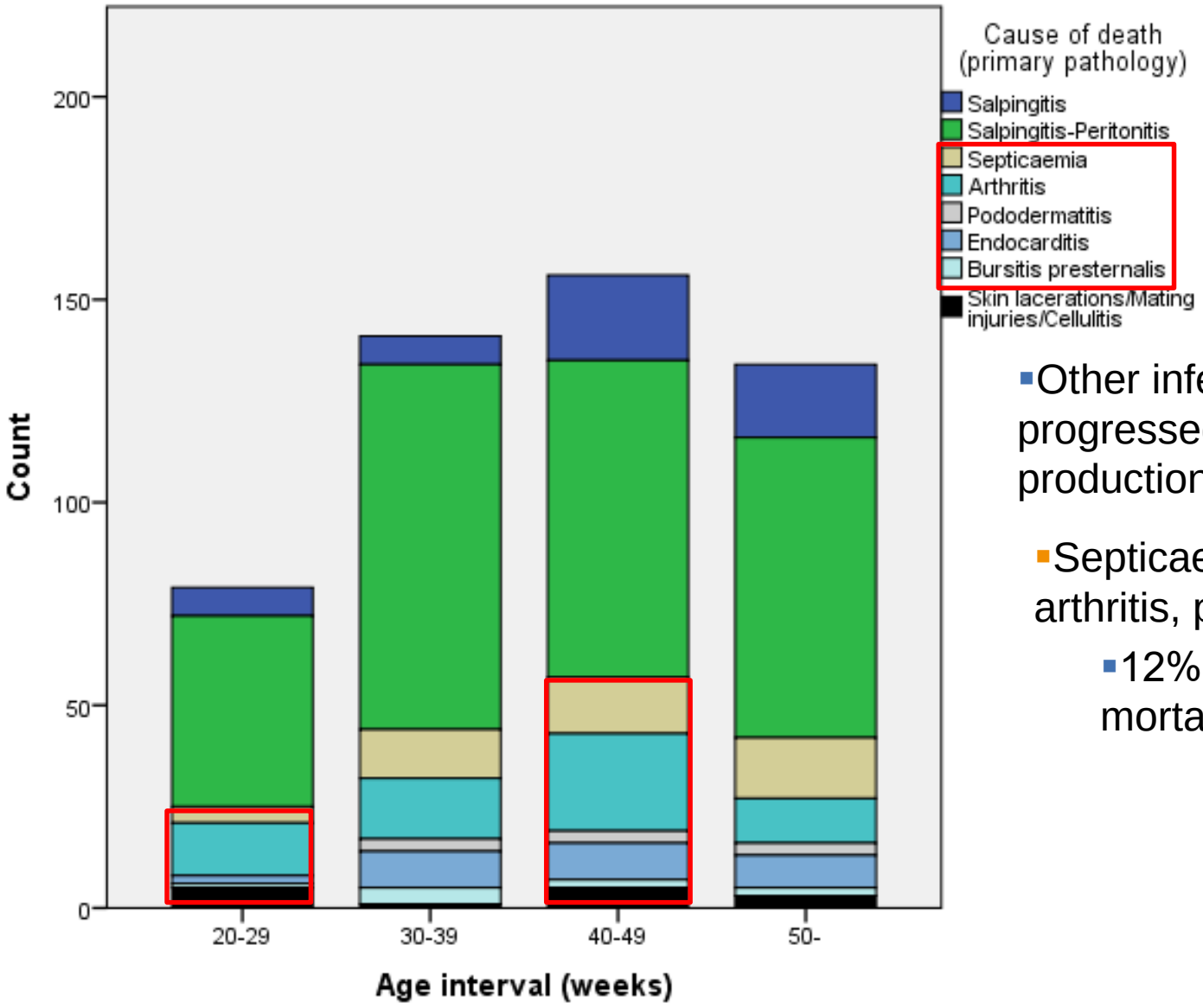
- Distribution of overall aetiology of mortality – Age level

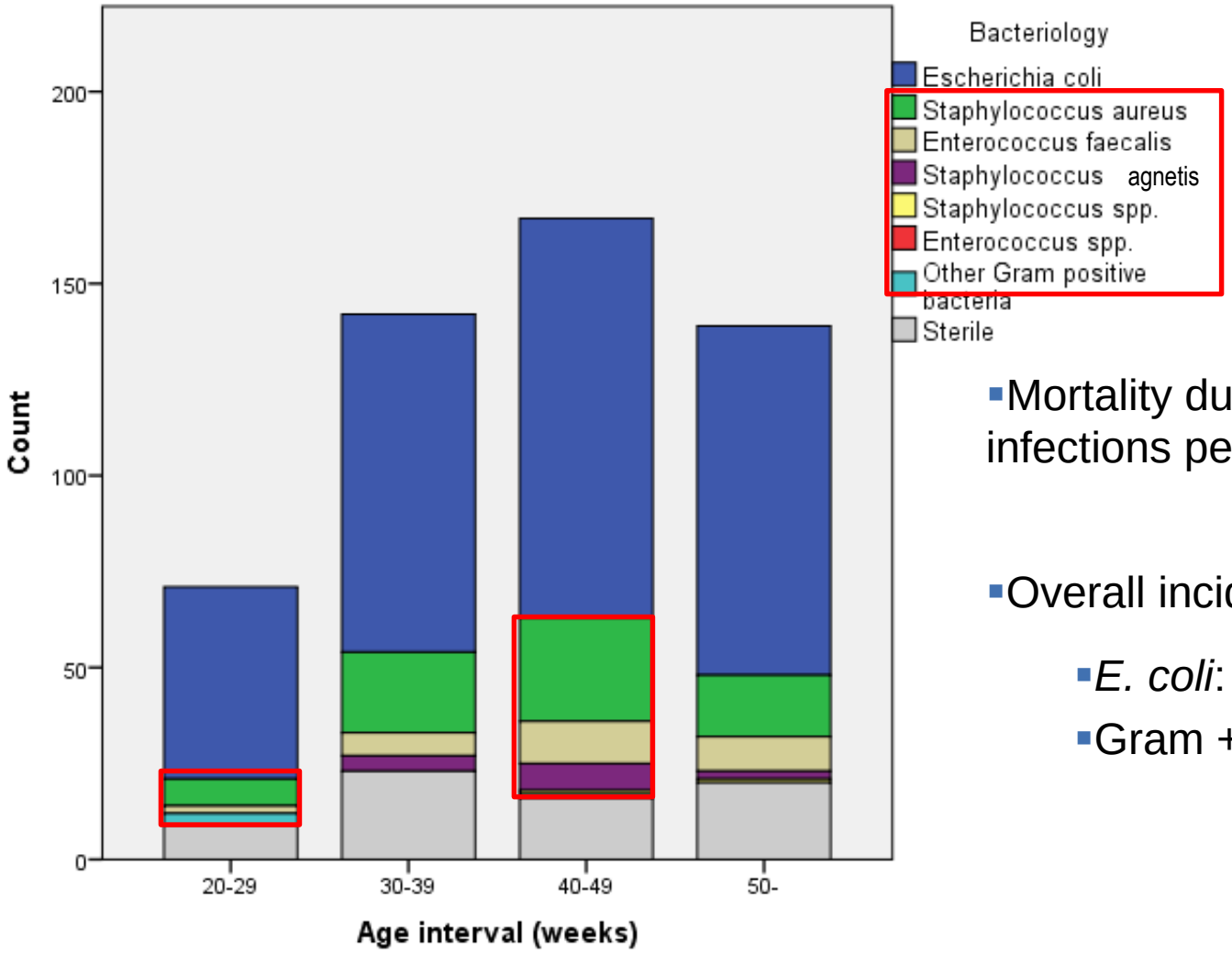


- Infectious mortality - Age related lesion



- Other infections incidence progressed throughout production peaking weeks 40-49
  - Septicaemia, endocarditis, arthritis, pododermatitis etc
    - 12% → 20% of total mortality

- Bacteriology



- Mortality due to bacterial infections peaks weeks 40-49
- Overall incidence
  - *E. coli*: 34%
  - Gram +: 13%

Footpad health in broiler breeders
- Relation to cause of mortality and age

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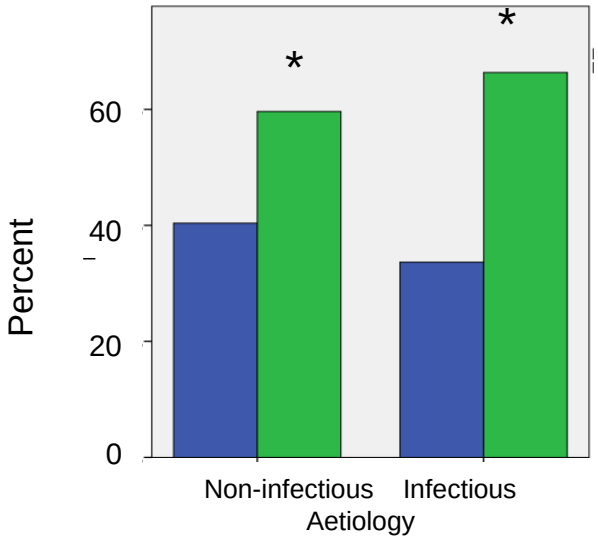
Foot lesions (all types) dead birds - Pathology and farm association

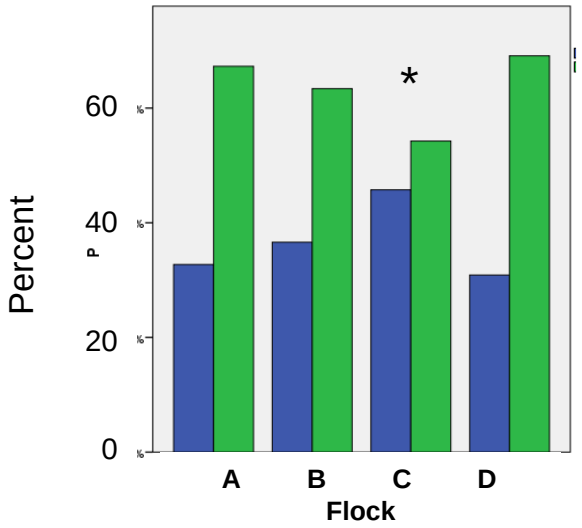
- Correlation between foot lesions and overall mortality

(p=0.041, Fisher's exact test)



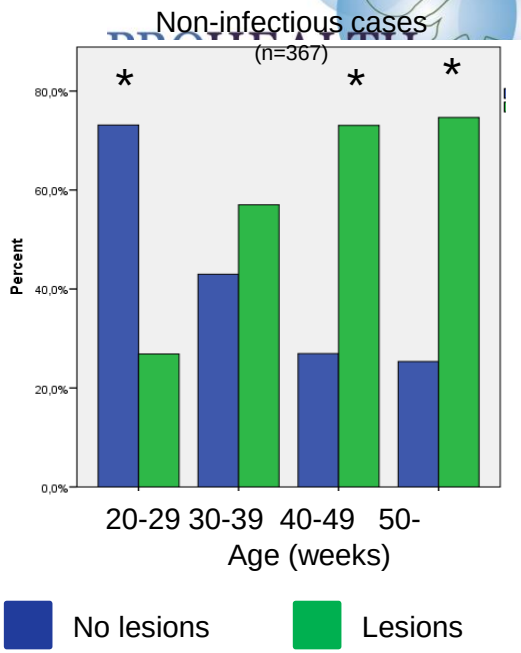
- Significant farm variation
  - Healthier feet at Flock C

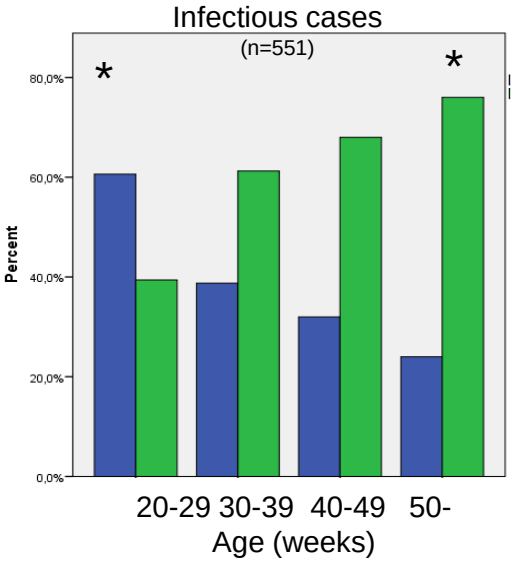
(p<0.05, X^2 & Bonferroni correction)



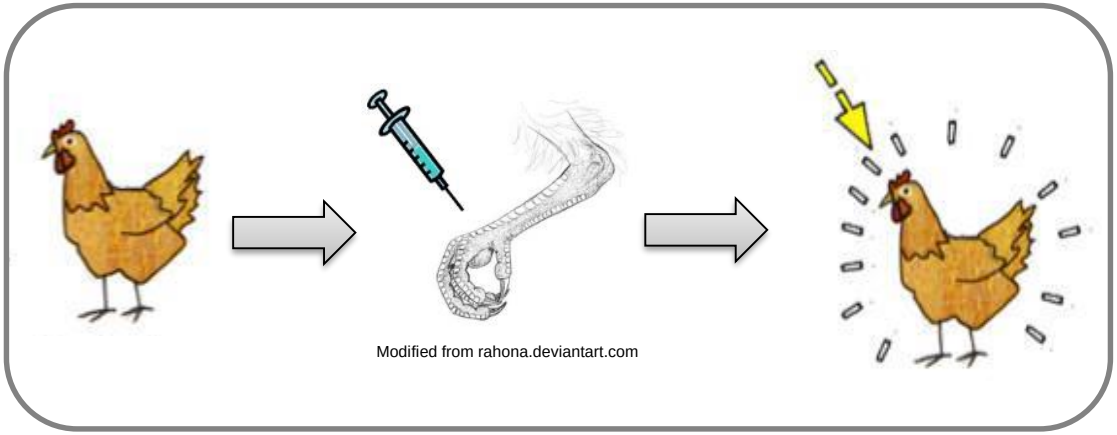
Foot lesions dead birds – During production

- Good foot health in young birds
  - <30 weeks
  - infectious or non-infectious causes
    (p<0.05, X^2 & Bonferroni correction)
- Poorer foot health in old birds
  - infectious (>50 weeks)
  - non-infectious causes (>40 weeks)
    (p<0.05, X^2 & Bonferroni correction)





Footpad infection model
- Species/strain variation



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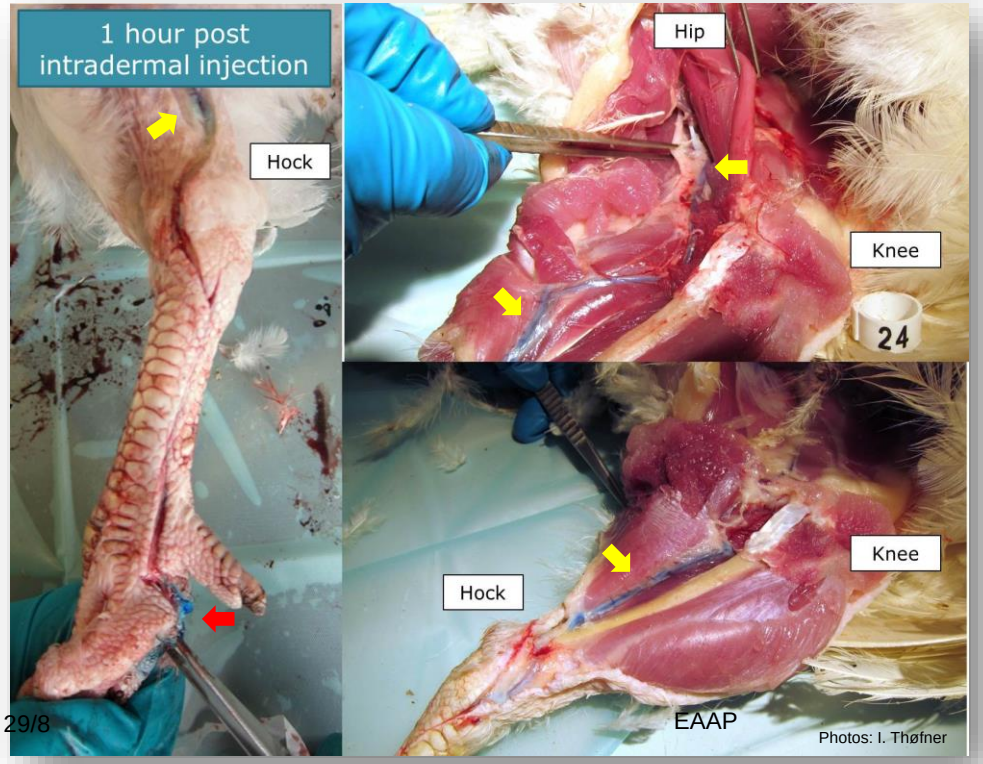
Preparation

Intradermal injection



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– *S. aureus* infection trial

3 DPI	Foot pad		Joint		Liver		Spleen		Heart		Bone marrow	
	Lesion	BU	Lesion	BU	Lesion	BU	Lesion	BU	Lesion	BU	Lesion	BU
Control (n=2)	0	0	0	0	0	0	0	0	0	0	-	0
High dose (n=4)	4	3	4	2	4	4	4	4	1	2	-	1
Low dose (n=4)	3	0	3	0	4	0	4	1	0	0	-	0
7 DPI												
	Lesion	BU	Lesion	BU	Lesion	BU	Lesion	BU	Lesion	BU	Lesion	BU
Control (n=2)	0	0	0	0	0	0	0	0	0	0	-	0
High dose (n=4)	4	2	4	1	4	3	4	3	3	2	-	1
Low dose (n=4)	4	0	2	0	1	0	1	0	0	0	-	0
14 DPI												
	Lesion	BU	Lesion	BU	Lesion	BU	Lesion	BU	Lesion	BU	Lesion	BU
Control (n=2)	0	0	0	0	0	0	0	0	0	0	-	0
High dose (n=4)	4	4	1	0	2	0	2	0	1?	0	-	0
Low dose (n=4)	1	1	1	0	0	0	2	0	0	0	-	0

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– *E. faecalis* infection trial

3 DPI	Foot pad		Joint		Liver		Spleen		Heart		Bone marrow	
	Lesion	BU	Lesion	BU	Lesion	BU	Lesion	BU	Lesion	BU	Lesion	BU
Control (n=2)	0	0	0	0	0	0	0	0	0	0	-	0
High dose (n=5)	5	4	3	2	4	2	3	2	1	2	-	1
Low dose (n=4)	3	1	0	0	1	0	3	0	0	0	-	0
7 DPI												
	Lesion	BU	Lesion	BU	Lesion	BU	Lesion	BU	Lesion	BU	Lesion	BU
Control (n=2)	0	0	0	0	0	0	0	0	0	0	-	0
High dose (n=4)	3	1	0	0	3	0	4	0	1	0	-	0
Low dose (n=4)	0	0	0	0	2	0	1	0	0	0	-	0

– *E. coli* infection trial

- Minimal pathology – injection site
- Very low bacterial reisolation – injection site

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Local lesion

Injection site abscess

Systemic lesions

Spleen proliferation

Liver multifocal necrosis

Significance and perspectives

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Significance

- Gram positive infections increase dramatically over time (13% total)
- Weeks 40-49 is identified as a critical period in relation to mortality due G+ infections
  - Gram-positive infections peaks (18% in age interval)
  - Poor foot health (70% in age interval)
  - Significant occurrence of amyloidosis (approx 45% in age interval)
- Experimental infections demonstrate
  - Range of lesions similar to IRL observations

    Septicaemia (death), Arthritis, Endocarditis, Local abscess

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Perspectives

- Established a tool for more in depth studies of the pathogenesis of Gram positive cocci
  - When and why some strains cause more severe disease in some hosts and not in other similar hosts
  - Bacteria-host mechanics
  - Systematic mapping of the host immune response

    Acute infections

    Chronic/long term infections

    Systemic amyloidosis

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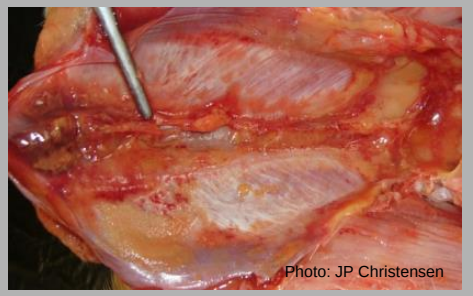
Amyloidosis – a complication to G+ infection

- Amyloidosis in birds can be divided into two syndromes
  - Amyloid athropathy (AA)
    layer type chickens' articular space.
  - Systemic reactive amyloidosis (SRA)
    generalised deposition of amyloid fibrils
- SRA is often associated with chronic inflammation
- SRA previously reported as primary manifestation of amyloidosis in broiler breeders
  - Increasing prevalence
- Associated aetiology:
  - *Enterococcus faecalis*, *Staphylococcus aureus*, *Eschericia coli*, *Mycoplasma gallisepticum, M. synoviae*, *Salmonella* Enteridis, Hepatitis E virus

Typical manifestations of SRA and AA

Amyloid arthroptia (SRA) associated *E. Faecalis* infection

Localized necrosis and amyloid (SRA) infiltration



Amyloid (SRA) deposition in the deep pectoral muscule

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Overall incidence 14.6%

	Total	Amyloidosis	(%)
E. coli	341	47	13.8
S. aureus	76	46	**60.5**
E. faecalis	29	12	**41.4**
S. agnetis	17	3	17.6
Staphylococcus spp.	2	1	50.0
Enterococcus spp.	2	0	0.0
Other Gram +	7	0	0.0
Sterile	91	30	**24.8**
No BU performed	402	7	1.7
Overall	997	146	14.6