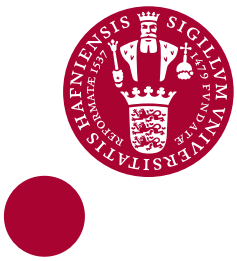

A multivariate dynamic linear model for early warnings of diarrhea and pen fouling in slaughter pigs

Jensen, Dan B.

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Up to date with pig

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THE FACULTY OF HEALTH AND MEDICAL SCIENCES
UNIVERSITY OF COPENHAGEN

CENTER FOR RESEARCH IN PIG PRODUCTION
AND HEALTH

Book of presentations of the 3rd CPH Pig seminar
February 3, 2016

Up to Date with Pig Research

www.cphpig.ku.dk

Table of Contents

Preface

The Center for research in pig production and health – CPH Pig – enhances, consolidates and raises the profile of pig production research. The importance of research and innovation for the Danish pork industry remains crucial. The Danish pig producers face tight financial pressures and many factors contribute to the volatility surrounding the pork industry. The production of finishers in Denmark is declining as producers export a significant and increasing number of weaners to be finished elsewhere in Europe. A goal of CPH Pig is, in collaboration with its many partners, to support the Danish pig industry with R&D that is essential in addressing drivers of a profitable and sustainable pork production in a global market.

The 2016 seminar presents the recent developments across a diverse range of disciplines impacting on pig production particularly on increased productivity, survival among piglets, MRSA, reduction in antibiotic usage and objective measurements of animal welfare. With this in mind, the research presentations of the CPH Pig seminar will cover four main themes: “Growing pigs”, “Sows and Piglets”, “Welfare” and “MRSA”. It is our hope that this third CPH Pig seminar will provide an excellent forum to present new findings, foster in-depth discussions, and hopefully provide solutions to some of the industry’s challenges.

The University of Copenhagen and CPH Pig are integral in the training of undergraduate and postgraduate students and generating junior scientists who are essential to the future of the industry. CPH Pig outwardly promotes the involvement of students and early-career scientists at the meeting. The seminar again has a considerable number of young scientists attending and presenting their work and for many it will be their first opportunity to interact with key industry figures and organisations.

It is a pleasure to direct the CPH Pig seminar and contribute to facilitating the networking of those involved in pig research and pork production. This seminar is possible because a dedicated group of individuals coordinated and arranged all aspects of the event. We wish to thank everyone for their contribution and dedication. However, most importantly, thank you for participating and making the seminar a great success. Thank you for your support and we hope you will continue to be part of the future achievements of the center.

Hans Henrik Dietz
Chairman

Christian Fink Hansen
Center Director

Programme

CPH Pig Seminar February 3, 2016
Up to Date with Pig Research

Time	Presenters	Title
9:00-9:10	Hans Henrik Dietz Head of Department, Department of Large Animal Sciences, University of Copenhagen	Welcome
9:10-9:30	Jens Ulrich Nielsen Director, Innovation, SEGES Pig Research Centre	Key Lecture: Benefits of linking universities and the Danish pig industry – from the industry's point of view
Session 1: Growing pigs		*Chair: Jens Peter Nielsen*
9:30-9:45	Gitte Blach Nielsen, Industrial PhD student, Department of Large Animal Sciences, University of Copenhagen & MSD Animal Health	PCV2 infection dynamics: Diagnostics, between-batch consistency and correlation to productivity parameters
9:45-10:00	Dan Børge Jensen, PhD student, Department of Large Animal Sciences, University of Copenhagen	A multivariate dynamic linear model for early warnings of diarrhea and pen fouling in slaughter pigs
10:00-10:15	Louise Kruse Jensen Assistant Professor, Department of Veterinary Disease Biology, University of Copenhagen	Osteomyelitis in Danish slaughter pigs
10:15-10:30	Anna Helena Stygar, Post doc., Department of Large Animal Sciences, University of Copenhagen	Monitoring growth in finishers by weighing selected groups of pigs
10:30-11:00	**MORNING TEA/COFFEE**	
Session 2: Sows and Piglets		*Chair: Anne-Helene Tauson*
11:00-11:15	Ana Carolina Lopes Antunes PhD Student, DTU National Veterinary Institute	Monitoring PRRS using laboratory data
11:15-11:30	Sophie Van Vliet PhD student, Aarhus University	Impact of feeding regime on growth in prepubertal gilts
11:30-11:45	Thomas Sønderby Bruun, Senior Specialist, SEGES Pig Research Centre	Increasing the dietary level of protein for lactating sows affects litter gain and sow weight loss
11:45-12:00	Charlotte Amdi Williams, Post doc., Department of Large Animal Sciences, University of Copenhagen	Gastric emptying rate and blood values in newborn intra-uterine growth restricted piglets
12:00-13:00	**LUNCH**	

Session 3: Welfare		*Chair: Björn Forkman*
13:00-13:15	Karl Johan Møller Klit PhD student, Department of Large Animal Sciences, University of Copenhagen	The use of virtual herds in veterinary and agricultural education
13:15-13:30	Marlene Kirchner Assistant Professor, Department of Large Animal Sciences, University of Copenhagen	Assessing farms with the Danish animal welfare index
13:30-13:45	Helle Pelant Lahrmann Industrial PhD student, Department of Large Animal Sciences, University of Copenhagen & SEGES Pig Research Centre	Tail biting: prevalence among docked and undocked pigs from weaning to slaughter
13:45-14:00	Janni Hales Pedersen Post doc., Department of Large Animal Sciences, University of Copenhagen	Loose housed sows with low piglet mortality
14:00-14:30	**AFTERNOON TEA/COFFEE**	
Session 4: MRSA		*Chair: Anders Miki Boyesen*
14:30-14:45	Julie Elvekjær Hansen PhD student, DTU National Veterinary Institute	Levels of MRSA on pigs and environmental samples
14:45-15:00	Carmen Espinosa-Gongora Post doc., Department of Veterinary Disease Biology, University of Copenhagen	Can we reduce MRSA ST398 in positive farms by eliminating a few pig carriers?
15:00-15:15	Anna Camilla Birkegård PhD student, DTU National Veterinary Institute	How to pool fecal samples in a cross-sectional study of antimicrobial resistance genes in Danish pig herds
15:15-15:30	Nicolai Weber, PhD student, Department of Large Animal Sciences, University of Copenhagen	Can pooled faecal samples be used for resistance profiling? -Resistance in *E. coli* isolates from diarrhoeic nursery pigs?
15:30-15:35	Christian Fink Hansen Professor, Department of Large Animal Sciences, University of Copenhagen	Concluding remarks

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List of participants

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Merete Fredholm	Professor, KU
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Mette Hillersborg	Dyrlæge, Ceva Animal Health
Mette Klarlund	Student, Veterinary medicin
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Vibe Pedersen Lund	Research Assistant, University of Copenhagen
Vivi Aarestrup Moustsen	Senior Scientist, SEGES Pig Research Centre

Key Lecture: Benefits of linking universities and the Danish pig industry – from the industry's point of view

By Jens Ulrich Nielsen, Director, Innovation, SEGES Pig Research Centre

BENEFITS OF LINKING UNIVERSITIES AND THE DANISH PIG INDUSTRY – FROM THE INDUSTRY'S POINT OF VIEW

SEGES Pig Research Centre
Jens Ulrich Nielsen, Director, Innovation

Dan Avl
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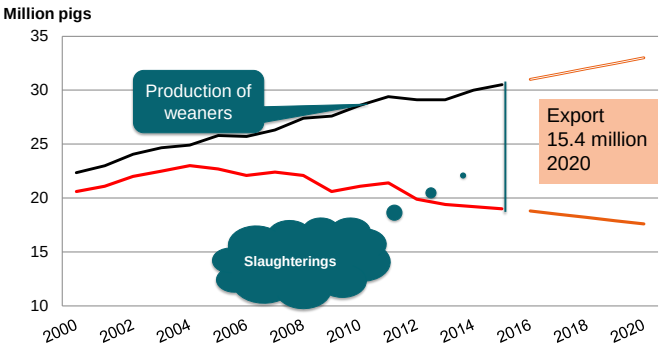
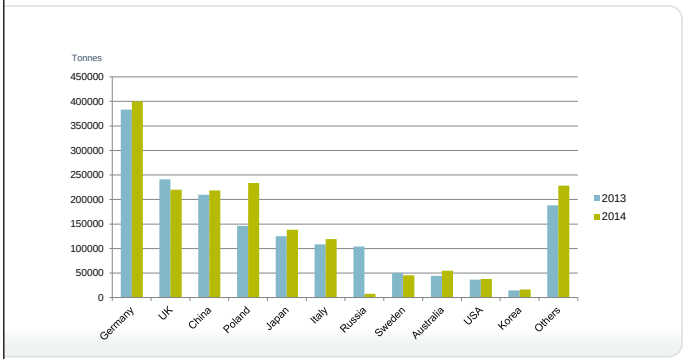
SEGES Pig Research Centre

PRODUCTION OF PIGS IN DENMARK



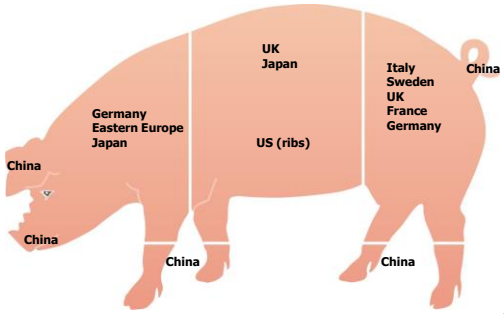
Danish pork exports

THE DANISH STANDARD:



DANISH

Global exports – no leftovers



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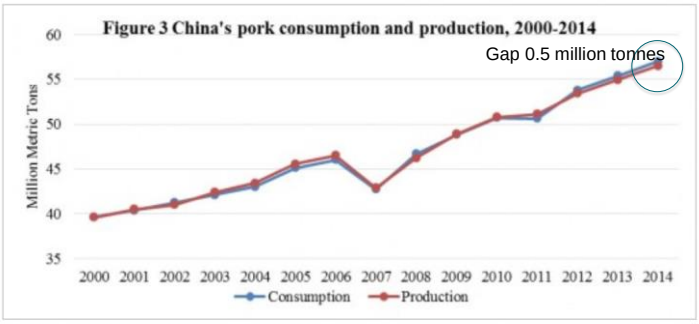

Source: USDA Foreign Agricultural Service

5

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CONSUMER PRIORITIES

6

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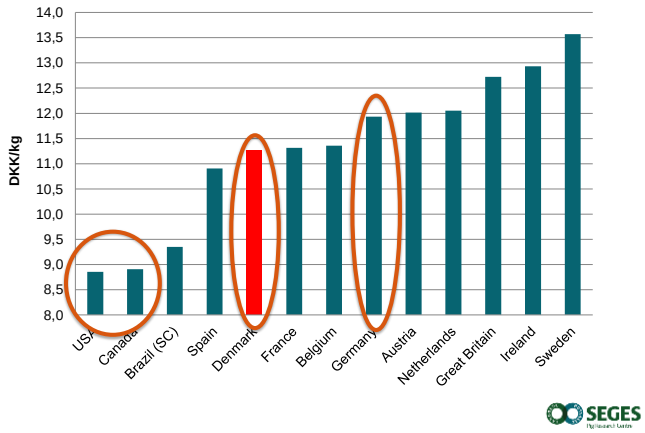
COST PER KG CARCASS 2014



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NEW PRODUCTION METHODS BASIS OF ADDED VALUE IN THE FUTURE

- Digitalization of the entire value chain
- Data/Realtime data as the basis of documentation, production monitoring, decision support, benchmarking
- Emission-based environment and climate production
- Biotechnology (biogas, ethanol, new protein sources etc.)
- Cost-efficient environmental technology
- Production concepts adapted to pig producers' conditions and to the future structure

8

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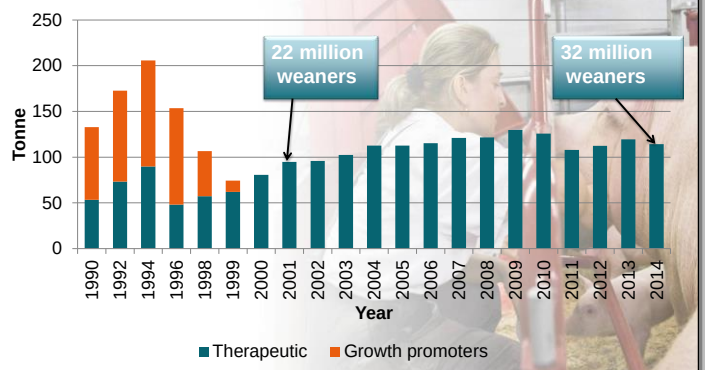
NEW URGENT NEEDS FOR RESEARCH

- Big data
- Data-driven innovation
- Internet of things in production technology
- Reduction in use of antibiotic and zinc

9

ANTIBIOTIC USE FOR PIGS



ZINC AND COPPER IN SLURRY AND SOIL

Report from DCE - Danish Centre for Environment and Energy
Significant increase in zinc levels in soil
Risk of future environmental and health problems
Minister for the Environment and Food: more research necessary
Supports reduction based on scientific grounds
Research in reduction of zinc in feed
Research in antibodies

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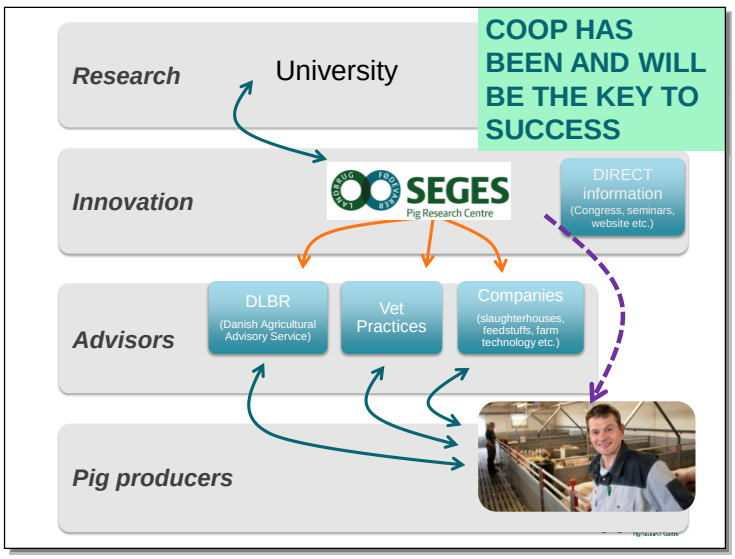

DANISH PIG RESEARCH CENTRE

- Financed by Danish pig farmers
- 160 employees
- Responsible for research and development programmes and knowledge transfer to the Danish pig industry
- Support the development of a responsible and economically sustainable pig industry with the highest possible level of welfare and a minimum impact on the environment
- Trials for 15 million Euro annually
- Operate on 200 commercial farms

SEGES

STRONGHOLDS IN COOPERATION WITH THE UNIVERSITIES

- Ensure that the industry benefits from research
- More relevant pig research
- Involvement of central qualifications
- Improve credibility and validation of SEGES PRC's work
- Access to more funds
- Knowledge transfer to the industry
- Supplementary training of employees
- Recruitment of new employees
- Mutual uality assurance
- Most recent knowledge included in education

14

SEGES

MANY CHALLENGES - LOTS OF RESEARCH

WE ARE LOOKING FOR ANSWERS AND SOLUTIONS, NOT COSTS

sows with gastric ulcers

Routine tail docking

Environmental impact

Thank you

Castration

MRSA

Antibiotic use

High sow mortality rates

SEGES

Session 1: Growing Pigs

PCV2 infection dynamics:
Diagnostics, between-batch consistency and correlation to productivity parameters

By Gitte Blach Nielsen, Industrial PhD student, Department of Large Animal Sciences, University of Copenhagen & MSD Animal Health

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Faculty of Health and Medical Sciences

PCV2 infection dynamics:
Diagnostics, between-batch consistency and correlation to productivity parameters

Preliminary results

CPH Pig February 3rd 2016

Gitte Blach Nielsen
Industrial PhD student, DVM, Certificate in Swine Health and Management
Department of Large Animal Sciences, Section for Animal Welfare and Disease Control
MSD Animal Health, Swine
gitte.blach.nielsen@merck.com
Supervisors: Hans Houe, Jens Peter Nielsen, John Haugegaard

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Background

Porcine circovirus, type 2 (PCV2) known worldwide as a cause of reduced productivity in growing pigs

'Not killing pigs for diagnosis' – blood samples 'golden standard'

Impact of infection: Level of viremia in serum by PCR-analysis

Oral fluid sampling – quick, more animals, welfare


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Research questions

Does level of PCV2:
- Correlate between serum and oral fluid ?
- Vary between batches in the same herd ?
- Correlate to productivity parameters and antibiotic usage ?

Sub-dataset from vaccination field trial
Only non-vaccinated pigs included – vaccination influences PCV2 level



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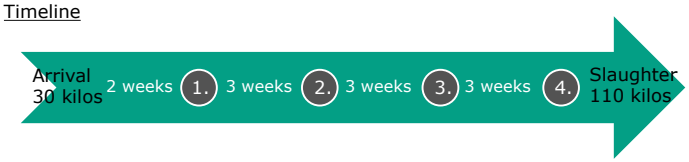
Study design

1 finishing herd 'Blue SPF' – highest health status

14 batches included (arriving 2 weeks apart), 2-5 pens sampled in each:
4 blood samples per pen -> 1 pool for PCV2-PCR-analysis
2 cotton ropes for oral fluid collection per pen -> 1 pool for PCV2-PCR-analyse

PCV2-PCR at DTU-Vet. -> 'viral copies per ml sample' on a log(10)-scale

Timeline



The same 4 pigs bled at consecutive sampling time points
– unless removal due to death or disease had occurred

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Results

Totally, 65 pens sampled 4 times = 260 serum/oral fluid pairs

Results are not published yet and therefore omitted

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Diagnostics
– serum and oral fluid correlations

Results are not published yet and therefore omitted

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PCV2 infection dynamics within batch

Timeline

Arrival 30 kilos — 2 weeks — 1. — 3 weeks — 2. — 3 weeks — 3. — 3 weeks — 4. — Slaughter 110 kilos

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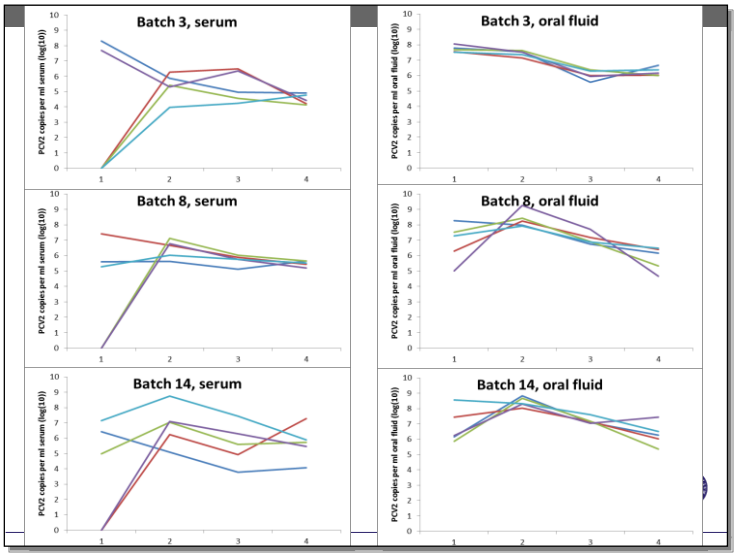
7



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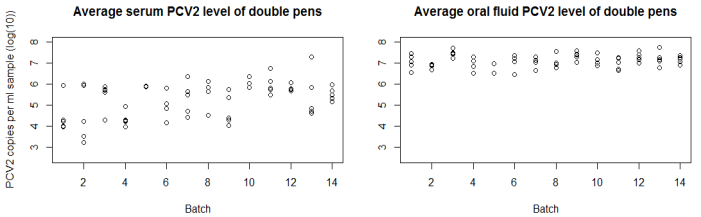
Between-batch consistency

Viremia over time ~ average of the 4 time points



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Correlations – PCV2 level and other parameters

Results are not published yet and therefore omitted

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Key points for the pig industry

Based on the results from this study:

Oral fluid sampling seems to be a relevant alternative to blood sampling
- The prevalence of positives was higher
- The level was higher

Serum level differed between batches (sections) within a herd,
oral fluid level did not

PCV2 level was positively correlated to mortality and antibiotic usage

MSD Animal Health

A multivariate dynamic linear model for early warnings of diarrhea and pen fouling in slaughter pigs

By Dan B. Jensen, PhD student, Department of Large Animal Sciences, University of Copenhagen

A multivariate dynamic linear model for early warnings of diarrhea and pen fouling in slaughter pigs

Dan B. Jensen
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Department of Large Animal Sciences, University of Copenhagen

(Early) warnings – what's the point?

1. **So many pigs, so little time!**
   - A modern farm typically contains ***thousands of pigs***
   - Health is assessed by farm staff walking through the herd
     - Problems are ***easy to miss***

2. **Sensors: always vigilant!**
   - 24/7 sensor monitoring combined with detection algorithms
   - Identification of high risk pens:
     - ***focused attention***
     - ***Proactive response***

3. **We need to know what to look for!**
   - Some data are more valuable than others

In Conclusion

Take Home Messages

1. ***Automatic detection*** and early warnings can help the farmers ***focus their attention*** on high risk pens

2. ***Drinking behavior*** and ***Temperature*** hold the most useful information for predicting diarrhea and pen fouling

3. ***Different data*** types might be best exploited in ***different ways*** (*e.g.* summaries vs. modeling)

Acknowledgements:
Council for Strategic Research
Pig Research Center (VSP)
The technical staff at Aarhus University

Materials and methods:
Multivariate Dynamic Linear Model

– a Quick Introduction

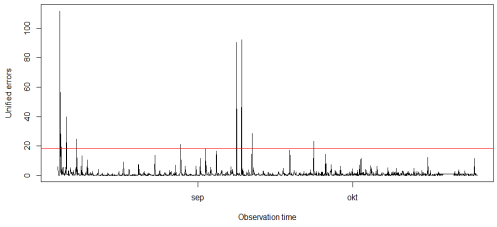
1. **Features:**
   - Dynamic, *i.e.* Adaptive
   - Provides one-step-ahead forecasts
   - Multivariate: co-variances are considered!

2. **Usefulness:**
   - Monitoring of (production) systems over time

3. **Multiple variables → multiple forecast errors:**
   - Forecast error unification (Cholesky decomposition/transformation)
     - I call it the ***DLM/Cholesky method***

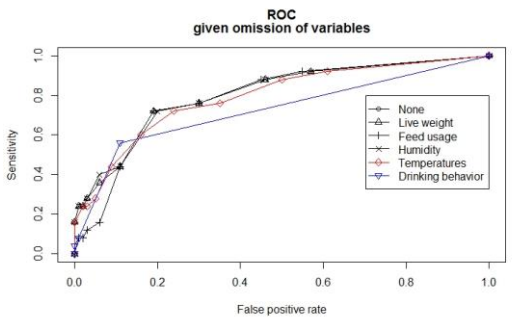
Results:
Unified forecast errors

Healthy batch
Unified forecast errors



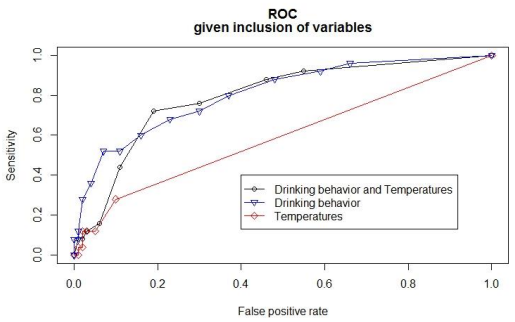
Adjusting SE and SP:
How many consecutive alarms for one full alarm?

Results:
Performance evaluation



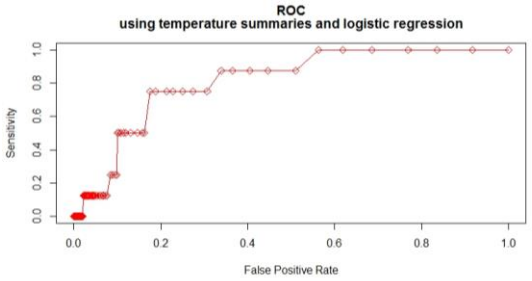
Prediction window:
-3/+1 days

Results:
Performance evaluation



Prediction window:
-3/+1 days

Results:
Performance evaluation - previously



Temperature alone, Summaries/logistic reg.: AUC = 0.80

Temperature alone, DLM/Cholesky: AUC = 0.55

In Conclusion

Take Home Messages

1. ***Automatic detection*** and early warnings can help the farmers ***focus their attention*** on high risk pens

2. ***Drinking behavior*** and ***Temperature*** hold the most useful information for predicting diarrhea and pen fouling

3. ***Different data*** types might be best exploited in ***different ways*** (*e.g.* summaries vs. modeling)

Acknowledgements:
Council for Strategic Research
Pig Research Center (VSP)
The technical staff at Aarhus University

Osteomyelitis in Danish slaugther pigs

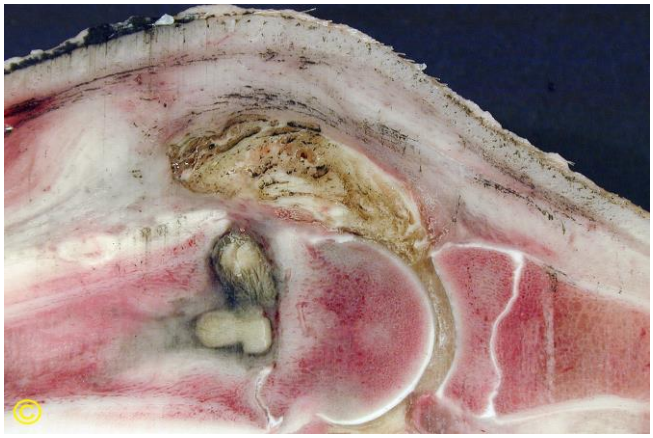
By Louise Kruse Jensen, Assistant Professor, Department of Veterinary Disease Biology, University of Copenhagen

Osteomyelitis in Danish slaugther pigs

Louise Kruse Jensen, DVM, PhD
Assistant professor in Veterinary Pathology
Louise-k@sund.ku.dk

Osteomyelitis is a common finding in Danish slaughter pigs.

– Welfare problem for the indiviual pig.
– Economic problem

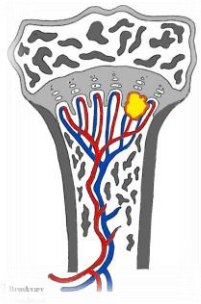


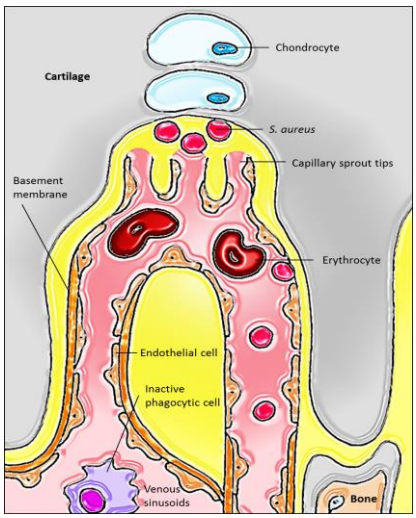
Inflammation of the bone and bone marrow = osteomyelitis

Pathogenesis

- **Systemic haematogenous**
  - Metaphysis – long bones
    - Vertebrae
    - Ribs
- **Local lymphatic/haematogenous**
  - Vertebrae, caudally from *os sacrum*
    - Tail biting
- **Traumatic**
  - Shoulder ulcerations

Concomitant tail biting and vertebral osteomyelitis in and caudally from *os sacrum* = local rejection of the pelvic bloc

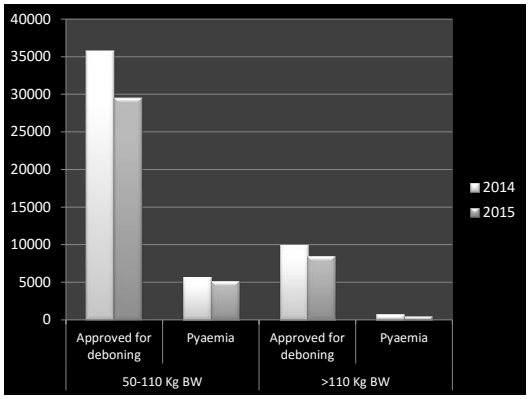




Sequelae of osteomyelitis

- Pathological fracture
- Arthritis
- Soft tissue/muscular abscess
- Sequestra formation
- Retained grow
- Malformations of the bone

Incidence of osteomyelitis



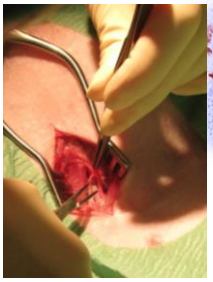
Why is these data a problem?

- Economic

Animal welfare

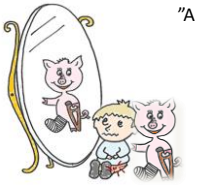
My research

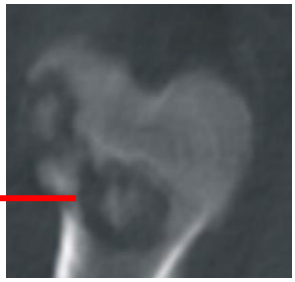
PhD title: ”Development, charaterization and application of a porcine model for haematogenous osteomyelitis in children”



The fingerprint of osteomyelit

”A model is a lie that helps you see the truth”





Analysis of bone tissue and blod samples for specific biomarkers of osteomyelitis (Immunohistochemistry, microRNA, mRNA)

Benefit of my research
for the Danish pig industry

Finding of biomarkers for osteomyelitis can result in a futher diagnostic tool

Increased focus on individual welfare

Monitoring growth in finishers by weighing selected groups of pigs

By Anna Helena Stygar, Post doc., Department of Large Animal Sciences, University of Copenhagen

Monitoring growth in finishers by weighing selected groups of pigs

Anna Helena Stygar

Department of Large Animal Sciences
University of Copenhagen

as@sund.ku.dk

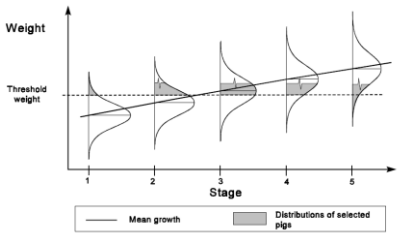
Data on body weight

- Knowledge about the herd (previous growth records)
- Insertion body weight (at batch, pen and animal level)
- Monitoring selected group of pigs (at pen and animal level)

Why to monitor body weight?

Production control

Delivery strategy



From Kure, 1997

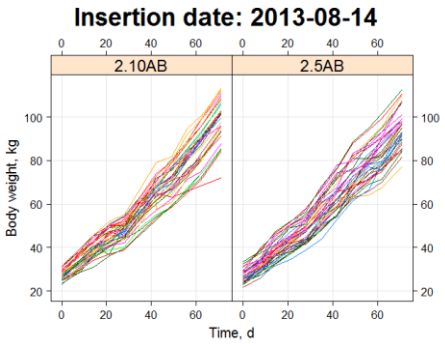
Objectives of this study

- Develop a monitoring and decision support tool
  - Production control
  - Marketing decisions (forecasting number of pigs above a body weight threshold)
- Quantify the value of information in finishers (including or excluding the information on body weight)

Material and methods – data from the herd

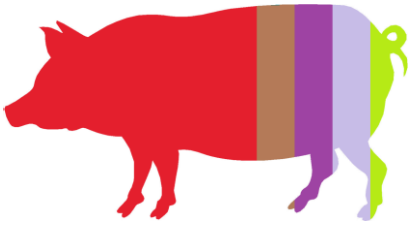
- Batches: **9**
- Data collected between: **2012-2015**
- BW observations at insertion and first delivery (all pigs)
- BW observations of selected group (every week of 2 double pens)
- Total number of observations: **9,800**
- Number of observations used for setting model parameters:**7,918**
- Number of observations used for testing: **1,882**
- Number of observed pens in a batch: **14**
- Number of pigs inserted: ~**480**

Material and methods – data from the herd



Material and methods – parameter estimation

$$y_{i,j,k,t} = \beta_0 + B_{0,k} + b_{0,j,k} + (\beta_1 + B_{1,k} + b_{1,j,k})t + (\beta_2 + B_{2,k} + b_{2,j,k})t^2 + A_{i,j,k,t} + \varepsilon_{i,j,k,t}$$



Material and methods –Multivariate Dynamic Linear model and Kalman filter

Observation equation: $Y_t = F_t'\theta_t + v_t, \quad v_t \sim N(\underline{0}, I\tau^2)$

System equation: $\theta_t = G_t\theta_{t-1} + W_t, \quad W_t \sim N(\underline{0}, W_t)$

$Y_7 = (30, 32, 29, 31)'$

$\theta_t = (\beta_t, B_t, b_t, A_t)$

$$v_t = \begin{pmatrix} \sigma_t^2 & 0 & 0 & 0 \\ 0 & \sigma_t^2 & 0 & 0 \\ 0 & 0 & \sigma_t^2 & 0 \\ 0 & 0 & 0 & \sigma_t^2 \end{pmatrix}$$

Material and methods –Multivariate Dynamic Linear model and Kalman filter

Prior: $\theta_t|D_{t-1}$

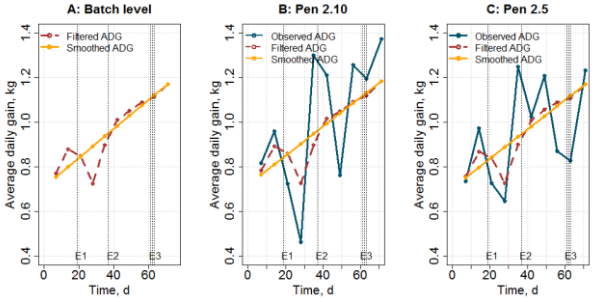
One step forecast: $Y_t|D_{t-1}$

Posterior: $\theta_t|D_t$

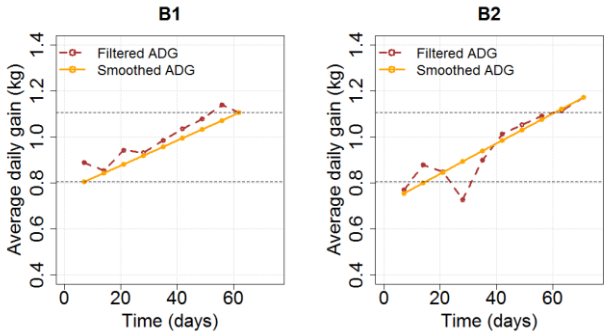
Sequential forecast for k steps ahead for j=1,…,k: $\theta_{t+j}|D_{t-1}$

Forecast distribution: $Y_{t+j}|D_t$

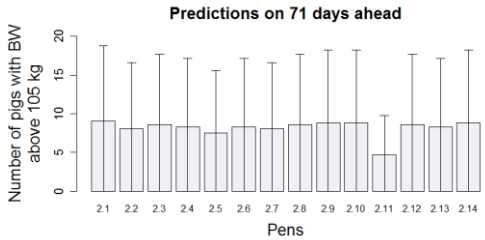
Results: production control at batch and pen leve



Results: production control – batch comparison

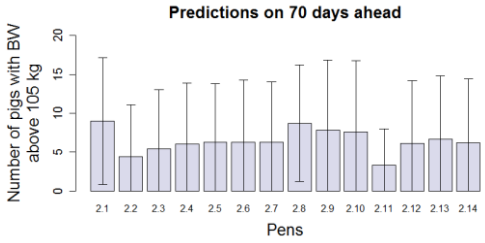


Results: predicting the number of pigs ready for marketing



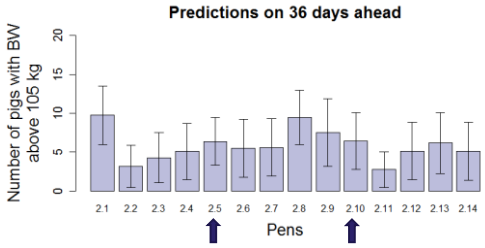
Input: Initial herd information
Number of BW measurements: 0

Results: predicting the number of pigs ready for marketing



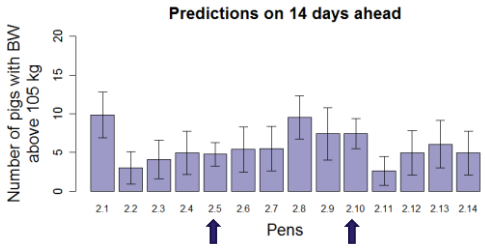
Input: Initial herd information and insertion BW of all pigs
Number of BW measurements: 486

Results: predicting the number of pigs ready for marketing



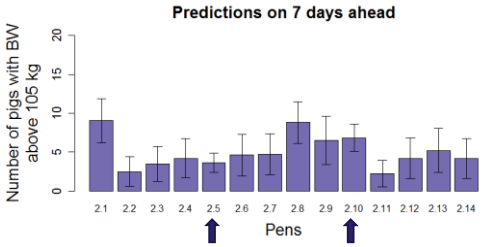
Input: Initial herd information, insertion BW of all pigs and selected group monitoring (15%)
Number of BW measurements: 486+72

Results: predicting the number of pigs ready for marketing



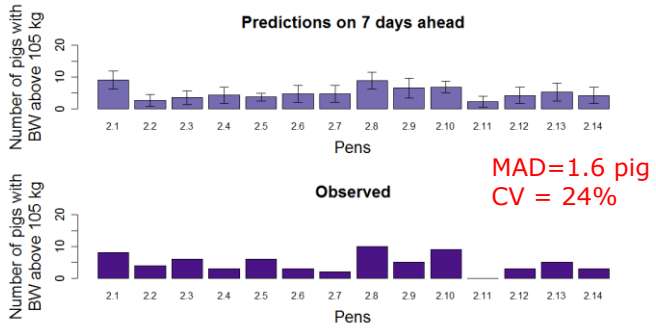
Input: Initial herd information, insertion BW of all pigs and selected group monitoring (15%)
Number of BW measurements: 486+288

Results: predicting the number of pigs ready for marketing



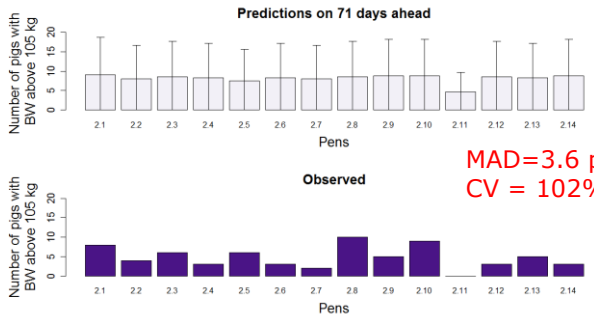
Input: Initial herd information, insertion BW of all pigs and selected group monitoring (15%)
Number of BW measurements: ~486+648

Results: predicting the number of pigs ready for marketing



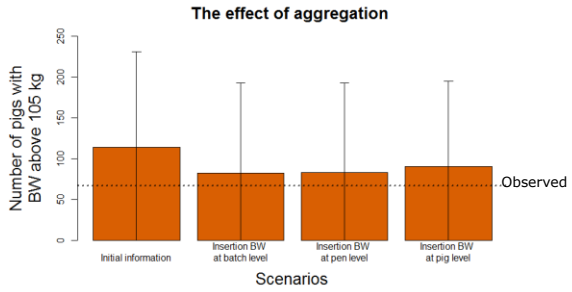
MAD=1.6 pig
CV = 24%

Results: predicting the number of pigs ready for marketing

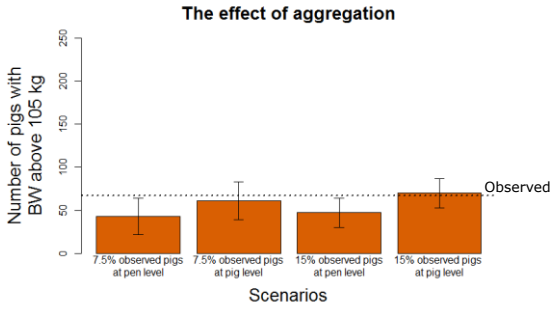


MAD=3.6 pig
CV = 102%

Results: predicting the number of pigs ready for marketing

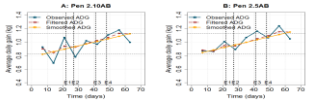


Results: predicting the number of pigs ready for marketing



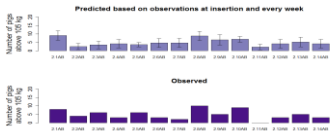
Conclusions

- We have a tool (production control, delivery strategy).
- The tool was able to combine information from different sources (BW information from different pens and pigs) and to increase the precision of knowledge.
- When a detailed level of information was provided, the forecasts on number of pigs above given threshold were given with high accuracy and precision.
- Aggregation (to pen level) only slightly reduced the accuracy of predictions.
- Data on initial BW had high value for the prediction procedure.



Conclusions – practical application

- Model can be used for production control.
- Model can be used to inform a farmer about the starting week of the delivery as well as number of pigs ready to market from a given pen.
- Further economic evaluation is necessary !!



Acknowledgments:

The Danish Council for Strategic Research

Pig Research Centre

This research was supported by the Danish Council for Strategic Research (The PigIT project, Grant number 11-116191)

Project manager: Professor Anders Ringgaard Kristensen

Session 2: Sows and Piglets

Monitoring PRRS using laboratory data

By Ana Carolina Antunes, PhD student, DTU National Veterinary Institute

Monitoring PRRS using laboratory data

Ana Carolina Antunes*, Fernanda Dorea, Dan Jensen, Tariq Halasa and Nils Toft

*email: aclan@vet.dtu.dk

DTU Vet
National Veterinary Institute

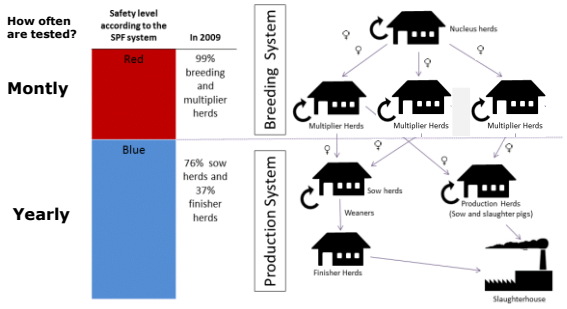
What is Porcine Reproductive and Respiratory Syndrome (PRRS)?

Some general information…

- Caused by a virus
- Clinical symptoms: it varies a lot!
- Endemic in Denmark
- Serology tests performed on regular basis (SPF system)

Just a quick overview of the data

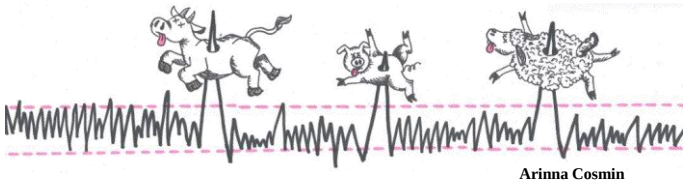
Danish pig production



What are the objective?

Monitor PRRSV in Danish swine herds

- PRRS seroprevalence
- Univariate process control algorithms
- Dynamic generalized linear models

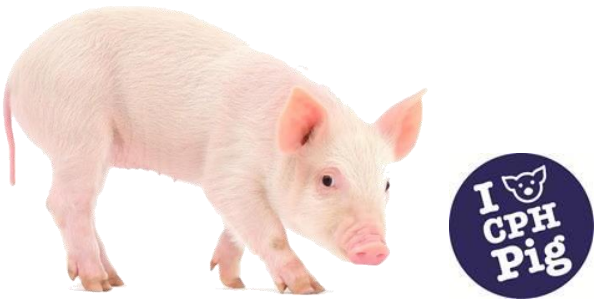


Arinna Cosmin

How can this be used?

- Set up a monitoring system
- Disease outbreaks detection
- Evaluate control and eradication programs
- Extended to other diseases and animals species
- Extended to other databases
- Combined with coordinates (spatiotemporal analysis)

Thank you for your attention



Impact of feeding regime on growth in prepubertal gilts

By Sophie Van Vliet, PhD student, Aarhus University

IMPACT OF FEEDING REGIME ON GROWTH IN PREPUBERTAL GILTS

Sophie van Vliet[1], Thomas S. Bruun[2], Janni Hales Pedersen[3], Christian Fink Hansen[3], Peter K. Theil[1]

[1] Aarhus University
[2] SEGES Pig Research Centre
[3] University of Copenhagen

Sophie.vanvliet@au.dk

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BACKGROUND

Currently most gilts are not fed according to their requirements

Overall aim:

Reduce feed consumption in gilts/ sows without negatively affecting production and longevity, by increasing body fat retention and reducing body protein retention in growing gilts prior to mating

Objectives:

- Manipulate growth and body composition in gilts
- (Long term consequences of altered body composition - colostrum and milk yield)

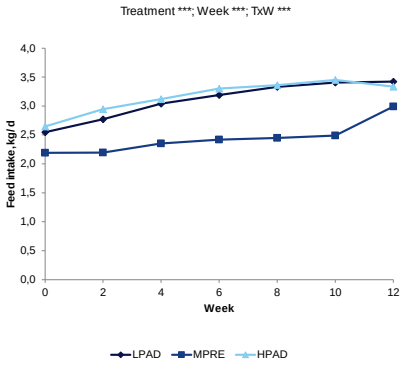
EXPERIMENT

- 3 treatments
- 48 gilts
  - 3 littermates from 16 litters
  - 60 kg LW (~15 weeks old)
- Fed according to bodyweight
- Measurements
  - Weight and backfat every second week
  - Blood samples in week 0, 4, 8 and 12
  - D_2O enrichment in week 0 (n=9) and at first heat after 25 weeks of age (all)

TREATMENTS

- LPAD – low protein ad libitum (4.1/ 3.3 g SID Lys/ FU ~ diet for pregnant sows)
  - High fat deposition – intermediate protein deposition
- MPRE – moderate protein restricted (5.0/ 4.1 g SID Lys/ FU)
  - Low fat deposition – low protein deposition
- HPAD – high protein ad libitum (6.6/ 5.0 g SID Lys/ FU ~ diet for slaughter pigs)
  - Intermediate fat deposition – high protein deposition

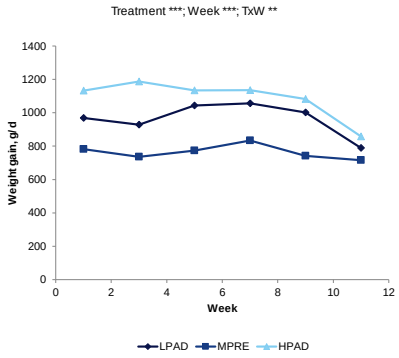
FEED INTAKE



THREE LITTERMATES

Week 12

WEIGHT GAIN



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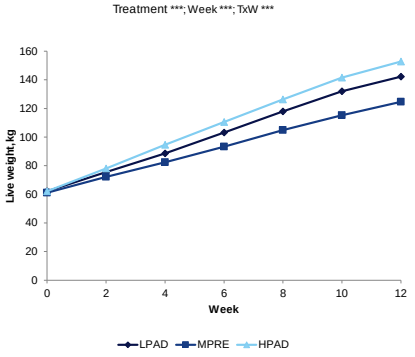
LIVE WEIGHT



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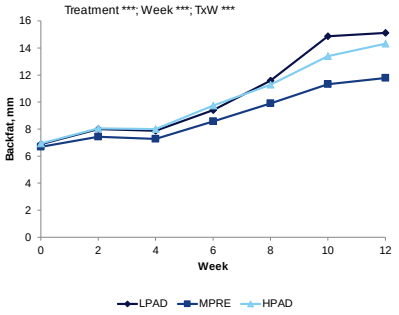
BACKFAT



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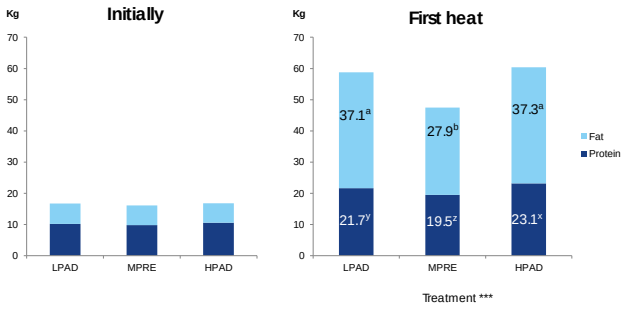
BODY FAT AND PROTEIN POOLS



PLASMA METABOLITES

	Treatment			
	LPAD	MPRE	HPAD	*P*-value
Glucose, mM	5.57	5.46	5.57	0.30
Lactate, mM	3.01^{a}	3.02^{a}	2.34^{b}	0.03
Urea, mM	3.91^{a}	3.40^{b}	3.50^{b}	<.001
NEFA, µM	27.7^{b}	28.0^{b}	34.1^{a}	0.004
Triglycerides, mM	0.31^{b}	0.33^{b}	0.37^{a}	<.001
Insulin, pM	26.0^{a}	17.8^{b}	31.2^{a}	<.001
IGF-1, ng/mL	147^{b}	144^{b}	168^{a}	0.002

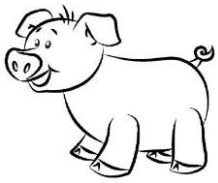
CONCLUSION

Body fat and protein retention can be altered by feeding regime

- LPAD – high fat retention and intermediate protein retention
- MPRE – low fat and protein retention
- HPAD – high protein retention and intermediate fat retention

Follow up study -> the effects of altered body composition on colostrum and milk yield

THANK YOU FOR YOUR ATTENTION



Increasing the dietary level of protein for lactating sows affects litter gain and sow weight loss

By Thomas Sønderby Bruun, Senior Specialist, SEGES Pig Research Centre

UNIVERSITY OF COPENHAGEN

Faculty of Health and Medical Sciences

Increasing the dietary level of protein for lactating sows affects litter gain and sow weight loss

Thomas Sønderby Bruun, SEGES Pig Research Centre
&
Anja V. Strathe, Department of Large Animal Sciences

Pig Research Centre

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Background

Sows are genetically different today
- Heavier when fully grown
- Larger litter size
- Less body fat content

Increased number of weaned piglets per weaning
- Possibly increased milk yield
- Reduce sow feed cost

Studies of protein requirement for lactating sows are needed

Aim
Finding optimal protein concentration in feed for lactating sows
- Maximize daily gain of the litter
- Moderate weight loss for the sow

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Materials and methods – Feed composition

Treatment	1	2	3	4	5	6
Energy FUsow per kg	1.06 1.06	1.06 1.06	1.06 1.06	1.06 1.06	1.06 1.06	1.06 1.06
SID lysine g per FUsow	5.5 5.6	6.1 6.2	6.6 6.7	7.1 7.1	7.8 7.8	8.5 8.5
SID crude protein g per FUsow	92 99⇧	101 108⇧	108 115⇧	116 122⇧	126 133⇧	136 143⇧

Black = planned
Pink = realized

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Materials and methods – 540 sow study

Placement
- Sow body weight
- Sow backfat

Day 2
- Litter equalisation 14 piglets/sow
- Litter weight
- Sow body weight
- Sow backfat

Weaning
- Litter weight
- Sow body weight
- Sow backfat

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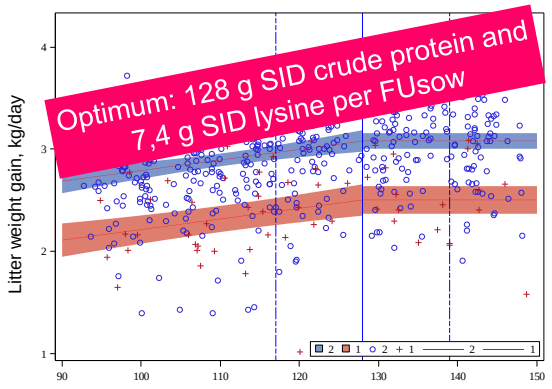
Results – Average daily litter gain



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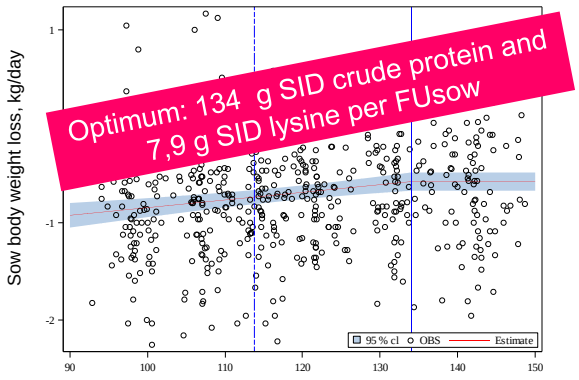
Results – Sow weight loss



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Results

Subsequent reproduction

- **No effect on the number of days to first mating**
- **No effect on farrowing rate**
- **Marginal effect on litter size**

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Materials and methods – 72 sow study

Day 3
- Milk
- Body composition

Day 10
- Milk
- Litter weight

Day 17
- Milk
- Litter weight
- Sow body weight
- Sow backfat

Day 24
- Body composition

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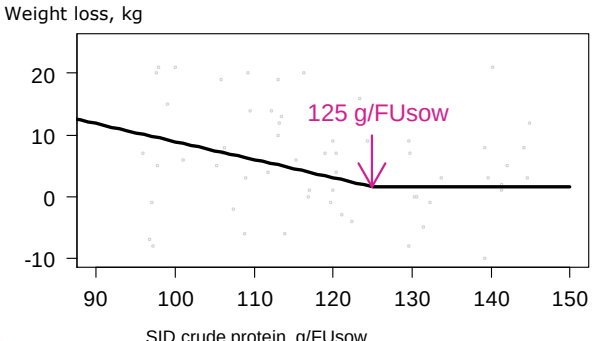
Results

- **Less weight loss in last week of lactation**



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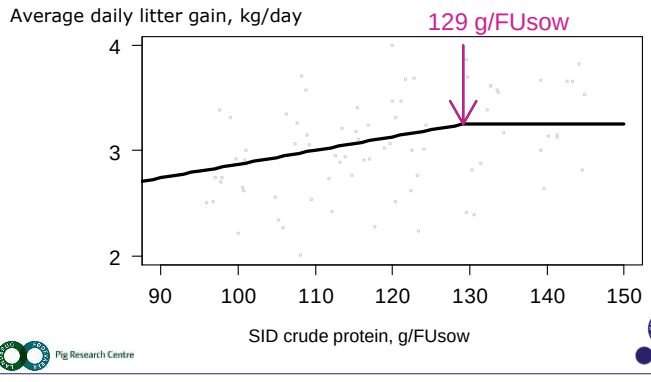
Results

- **Litter weight gain week 3**



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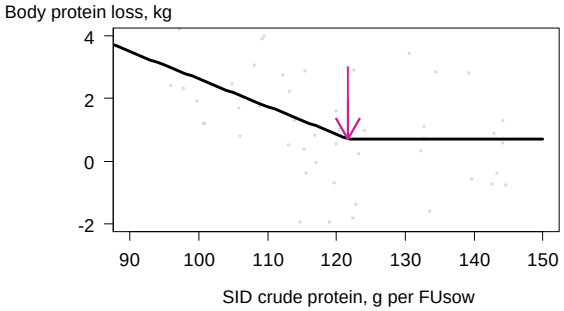
Results

Increase in protein → decrease in mobilization



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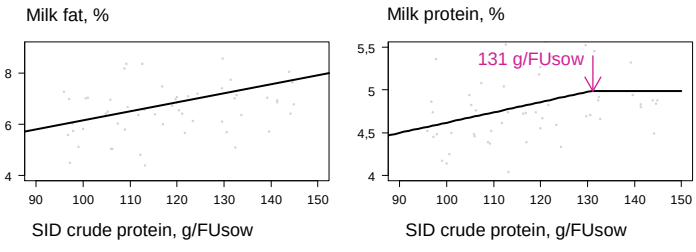
Results – Sow milk composition



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Conclusion

Increase protein during lactation

- Increased litter weight gain
- Reduced sow body weight loss
  - Limited mobilization of muscle protein
  - Increased mobilization of fat
- Increased nutritional content in milk
- (No influence on prevalence of piglet diarrhea)

Subsequent reproduction was not affected

- Minor positive effects of increased protein on subsequent litter size

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Thank you for your attention!

Pig Research Centre

Gastric emptying rate and blood values in newborn intra-uterine growth restricted piglets

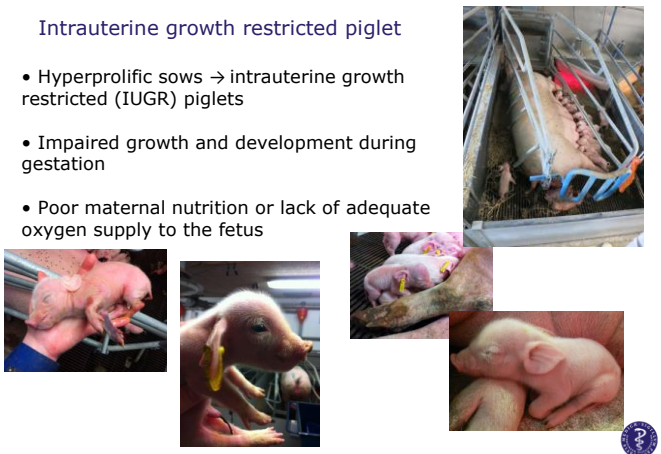
By Charlotte Amdi Williams, Post doc., Department of Large Animal Sciences, University of Copenhagen

Gastric emptying rate and blood values in newborn intra-uterine growth restricted piglets

Charlotte Amdi Williams Ph.d., Post doc, ca@sund.ku.dk
University of Copenhagen, Department of Large Animal Sciences

Intrauterine growth restricted piglet

- Hyperprolific sows → intrauterine growth restricted (IUGR) piglets
- Impaired growth and development during gestation
- Poor maternal nutrition or lack of adequate oxygen supply to the fetus

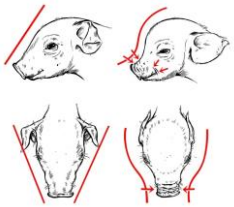


Intrauterine growth restricted piglet

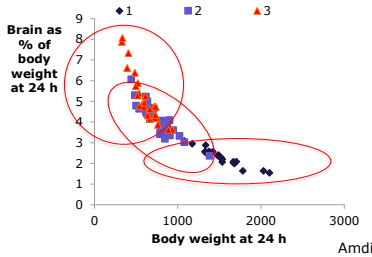
- More nutrients are redirected to brain and heart → fetal adaptive reaction (Roza *et al.,* 2008)
- 25 % to 30 % of newborn piglets in DK suffer from IUGR when defined on their headshape (Hales *et al.,* 2013, Amdi *et al.,* 2013)
- Higher mortality rate in IUGR piglets (Hales et al., 2013)

Intrauterine growth restricted piglet

Characteristics:
- Steep dolphin-like forehead
- Bulging eyes
- Hair with no direction of growth



Hales *et al.*, (2013), JAS



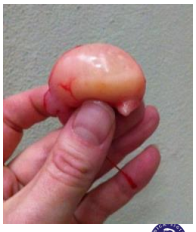
Amdi *et al.*, (2013), JAS

The IUGR piglet's problem?

- They can not digest the amount of recommended colostrum (Amdi et al., 2013)
- Up to 50 % of piglets that die within the first few days have empty stomachs (Hales et al., 2013)

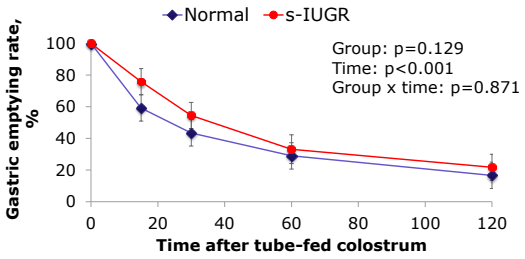
Therefore we investigated:

How quickly do the stomachs empty?

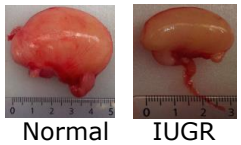


- 48 piglets – 24 IUGR, 24 Normal
- Tube-fed 12 mL/kg porcine colostrum at birth
- Euthanised after 15, 30, 60 and 120 min

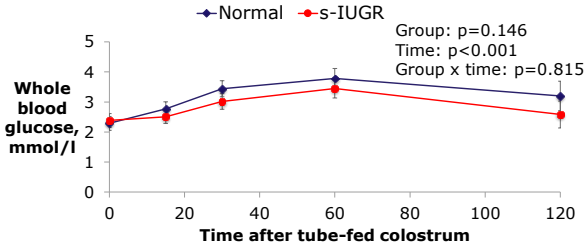
Gastric emptying rate



Preliminary results: Amdi, Klarlund et al., in manuscript preperation



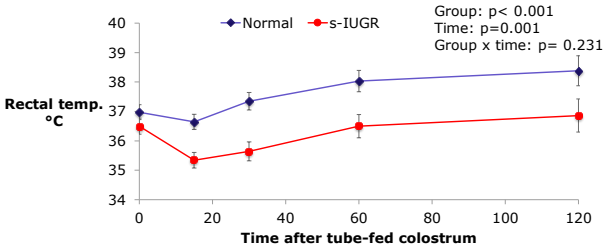
Blood values



No difference between groups
Difference over time

Preliminary results: Amdi, Klarlund et al., in manuscript preperation

Rectal temperatures (influences survival)



- Differences between groups and over time
- Drop in temp during the first 15 min.
- Difference of 1.3 °C in rectal temperatures

Preliminary results: Amdi, Klarlund et al., in manuscript preperation

The IUGR piglet's problem?

How often can we give IUGR piglets colostrum?

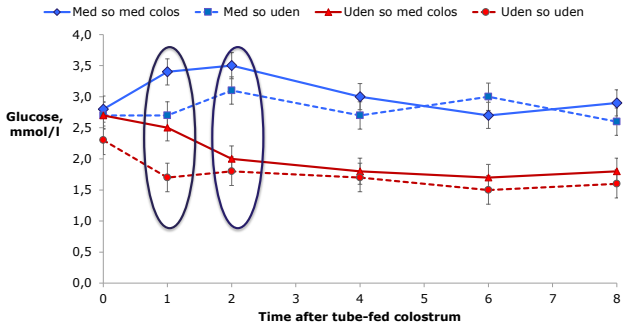
4 groups of IUGR piglets:

- With sow with colostrum
- With sow without colostrum
- Without sow with colostrum
- Without sow without colostrum

How much of an effect does the sow have?
Additional heat?
Additional colostrum?

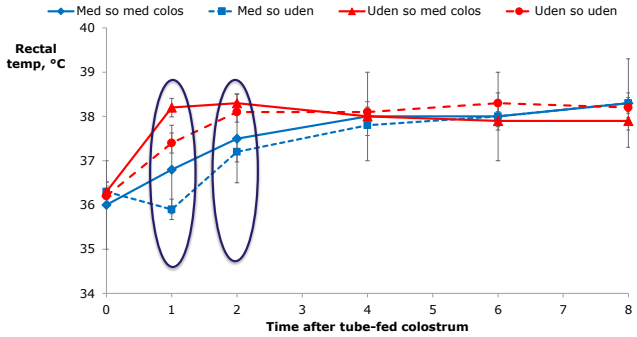
Tube-fed 12 mL/kg colostrum at birth
Weighed
Rectal temp

Glucose levels in IUGR piglets over 8 hours



Preliminary results – Jensen 2015

Rectal temperatures in IUGR piglets over 8 hours



Preliminary results – Jensen 2015

Take home message

- Gastric emptying rate is similar
- Stomachs are small and empty fast
- IUGR piglets might be more challenged in blood glucose
- Colostrum increases rectal temperatures with one degree
- However colostrum has to be given every hour…
- The sow has an effect


IUGR piglets after 2 weeks

Thank you:

Pig Levy Fund (Svineafgiftsfonden) for support and funding

The group at KU: Prof Christian Fink Hansen, Post doc Janni Hales, Phd stud Anja Strathe, speciale stud Mette Versner Klarlund, Laura Lundgaard Jensen and Camilla Højgaard

Thank you to Askelygaard for their IUGR piglets and help ☺

And a thank you to Julie Lynegaard and Maiken Engelsmann for letting us use some of their pictures ☺

Session 3: Welfare

The use of virtual herds in veterinary and agricultural education

By Karl Johan Møller Klit, PhD student, Department of Large Animal Sciences, University of Copenhagen

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The use of virtual herds in veterinary and agricultural education

Karl Johan Møller Klit DVM, Phd-Student, Camilla Kirketerp Nielsen DVM, PhD-Student
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Department of Large Animal Sciences

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Why virtual herd?

- Teaching environment

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Transfer

- The ability to use a skill beyond the present context
- To be value – any skill must be transferable to real life

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Farrowing unit

Aim/Purpose

- Increase Animal Welfare

- Piglet survival
  - Farrowing assistance
  - Farrowing fever
  - Piglet environment

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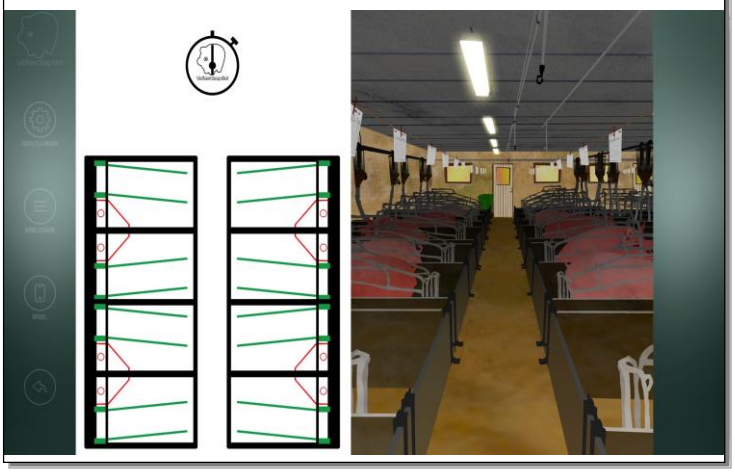

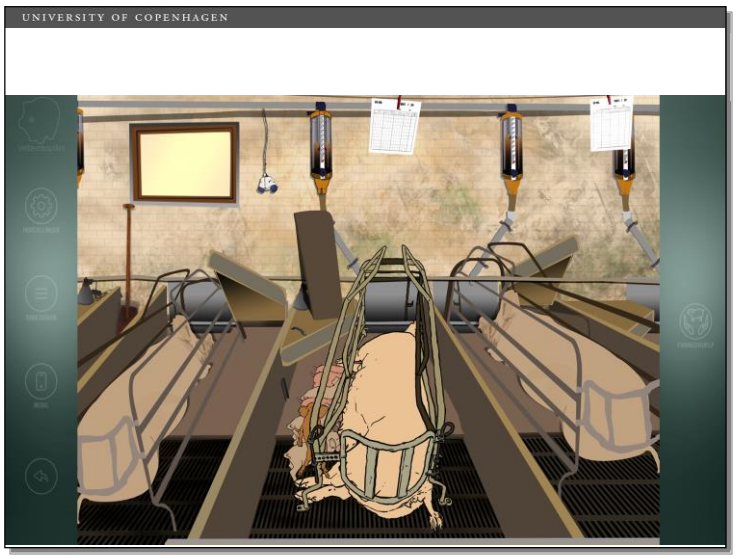
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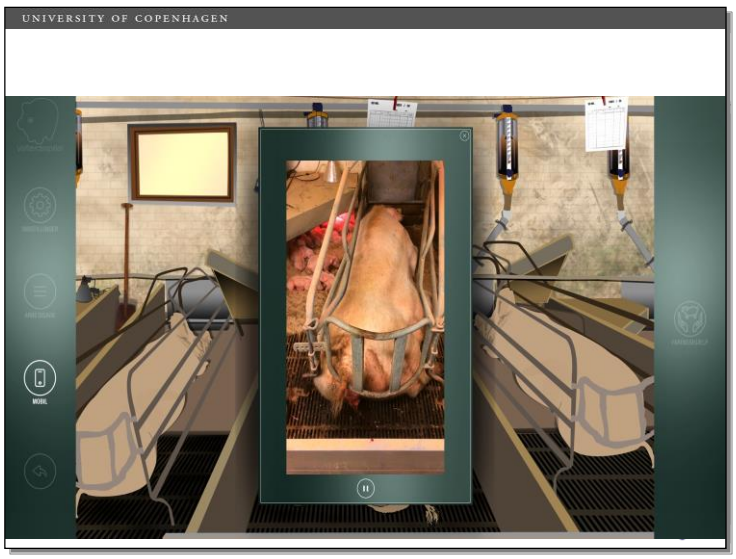
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Thank you

Svineafgiftsfonden

SEGES

PATTEGRISELIV FÆLLES FOKUS

ViD

Assessing farms with the Danish animal welfare index

By Marlene Kirchner, Assistant professor, Department of Large Animal Sciences, University of Copenhagen

Assessing farms with the Danish animal welfare index

Marlene Kirchner
Department of Large Animal Sciences

mk@sund.ku.dk

What is an animal welfare index?

An animal welfare assessment evaluates the welfare state of the animals at that specific point in time, representative for a period

The DAW- Index makes it possible to study the development of animal welfare over time, eg. several years.

The project

Project runs 2013-2016

- Farrowing sows & piglets, gilts and gestating sows, fattening pigs

- Index 1.
  - Based on existing registrations (meat control, use of antibiotics)
- Index 2.
  - Based on farm visits, preferred animal based measures
- Index 3.
  - Best combination of 1 & 2

The 'survival factors' for included indicators

- Hedonistic definition of animal welfare
- Validity – reliability – feasibility
- Experts round
- On-farm visits [90 Pig herds]
- Welfare Quality comparison
- Recording time max. 1hour

DUNCAN, 1996; KNIERIM & WINCKLER, 2009; WHAY ET AL., 2004; WELFARE QUALITY, 2009

Which aspects of Animal Welfare are covered by DAWIN?

4 Principles of Animal Welfare	Indicators
Good Feeding	Behavioural
Good Housing	Clinical
Good Health	Resources
Appropriate Behaviour	Records

The 'surviving' indicators included in DAWIN

27 for farrowing sows
22 for weaner and fattener
21 for piglets
28 gestating sows and gilts

Can change until the final version!

Farrowing sows – part 1

Principles (WQ)	Indicators	Type
Good Feeding	Body condition score (0/1)	Animal-based
	Roughage (No/Access to roughage)	Resource-based
	Feeding system (Non/competitive)	Resource-based
	Water supply (clean/sufficient)	Resource-based
Good Housing	Farrowing system	Resource-based
	Farrowing rails	Resource-based
	Space in farrowing system	Resource-based
	Resting area	Resource-based
	Ammonia	Resource-based
	Manure on the body	Animal-based
	Bursitis	Animal-based
	Panting	Animal-based
	Nursing sows	Animal-based

Farrowing sows – part 2

Principles (WQ)	Indicators	Type
Good health	Hampered respiration	Animal-based
	Shoulder wounds	Animal-based
	Integument alterations	Animal-based
	Vulva lesions	Animal-based
	Prolapse	Animal-based
	Hernia	Animal-based
	Nose ring	Animal-based
	Overgrown claws	Animal-based
	Proper euthanasia	Resource-based
	Hospital pens	Resource-based
	Mortality	Resource-based
Appropriate Behaviour	Stereotypies	Animal-based
	Rooting material	Resource-based
	Possibility to perform nest building behaviour	Resource-based

Weaner and fattener – part 1

Principles (WQ)	Indicators	Type
Good Feeding	Body condition score	Animal-based
	Feeding system	Resource-based
	Water supply	Resource-based
Good Housing	Stocking density	Animal-based
	Resting area	Resource-based
	Cooling	Resource-based
	Ammonia	Resource-based
	Slipperiness of the floor	Animal-based
	Manure on the body	Animal-based
	Panting	Animal-based

Weaner and fattener – part 2

Principles (WQ)	Indicators	Type
Good health	Lameness	Animal-based
	Integument alterations	Animal-based
	Tail bite	Animal-based
	Ear damage	Animal-based
	Rectal prolapse	Animal-based
	Hernia	Animal-based
	Twisted snout	Animal-based
	Neurological symptoms	Animal-based
	Proper euthanasia	Resource-based
	Hospital pens	Resource-based
	Mortality	Animal-based
Appropriate Behaviour	Rooting material	Resource-based

The future of the DAWIN project

2015
Visiting farms
Expert weightings of the measures

2016
Further shaping of the indicators
Aggregation of on farm measures
Constructing an index

COMING SOON !!!
DAW - Index 2016

Many thanks go to...

Danish Veterinary and Food Administration
Louise Holm
Ministeriet for Fødevarer, Landbrug og Fiskeri
Fødevarestyrelsen

Copenhagen University
Björn Forkman, Hans Houe,
Anne Marie Michelsen, Nina Otten,
Søren Saxmose Nielsen,
Matt Denwood, Henrik Elvang
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Aarhus University
Jan Tind Sørensen, Tine Rousing
AARHUS UNIVERSITY

Thank you for your attention!

mk@sund.ku.dk www.researchgate.net/Marlene_Kirchner

Tail biting: prevalence among docked and undocked pigs from weaning to slaughter

By Helle Pelant Lahrmann, Industrial PhD student, Department of Large Animal Sciences, University of Copenhagen & SEGES Pig Research Centre

TAIL BITING: PREVALENCE AMONG DOCKED AND UNDOCKED PIGS FROM WEANING TO SLAUGHTER

Helle Pelant Lahrmann, Industrial Ph.D. Student

February 3th 2016

INTRODUCTION

- EU directive bans routine tail docking
- More than 95% of European pigs are tail docked (EFSA 2007)
- Estimated 3.1% of Danish pigs tail bitten despite the tail docking procedure (D'Earth et al., 2014)
- The consequences of a cessation of tail docking in conventional Danish piggeries are not known

Study aim

Determine consequences of tail docking cessation on tail biting in a well-managed Danish conventional herd.

DEFINITION TAIL BITING & TAIL LESION

- Tail biting is a behaviour – damaging or non-damaging
- Definition damaging tail biting
  - Pig's chew on a pen mates tail resulting in a bloody wound on the tail (Munsterhjelm et al. 2013)
- Damaging tail biting
  - is painful to the pig
  - can develop to such an extent that the pig looses the majority of the tail
  - increases the risk of infections
  - increases the need for antibiotic treatments
  - may cause death or euthanasia (Kritas & Morrison 2004 & 2007)
- Tail lesion is a condition

Tail biting

Tail lesion

MATERIAL & METHODS


Bite Rite

- Two groups
  - +/- tail docking
- Housing
  - Same pen from weaning to slaughter (stable group)
  - Docked and undocked pigs in different pens
  - 20-22 pigs per pen, mixed gender
  - Daily provision of ~230 g straw on the floor until 70 kg + two vertical wooden sticks per pen
  - If tail biting occurred a Bite Rite was added and the amount of straw was doubled
- Animals
  - LYD – pigs, castrated males, individually earmarked

SEGES

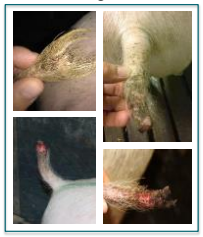
PEN DESIGN

SEGES

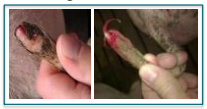
RECORDINGS

- Every second week all tails were inspected by a trained technician
- Recordings by stockperson
  - Date tail biting outbreak
  - Antibiotic treatments
  - Dead/euthanized pigs
  - Pigs removed from pen and cause
- Abattoir
  - Tail lesion comments/condemned

Part missing



Full length



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PRELIMINARY RESULTS

	Undocked	Docked
Pigs, n	963	964
Pens, n	47	48
Tail bitten, n	214	0
Infected tail injury, n	24	-
Dead pigs, n	30 (3 TB)	37
Hospital pen, n	38 (25 TB)	12

- On average 3.6 % of the pigs per scan had a tail injury
- In 19 % of the pens per scan there were pigs with tail injuries
- On average the first tail biting incidence was observed 45 days after weaning
- Gender tail bitten pigs: 77 gilts, 123 castrated males and 14 "unknown"

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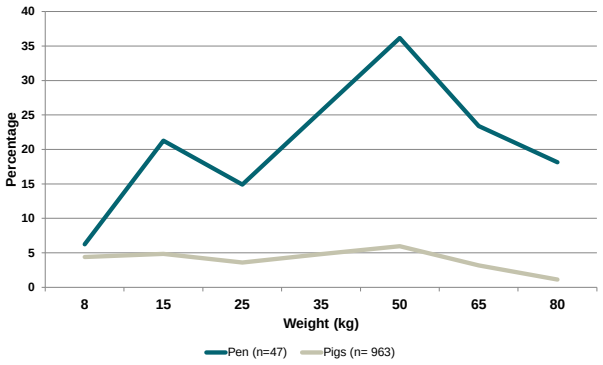
PRELIMINARY RESULTS TAIL BITING, 8-80 KG



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PRELIMINARY CONCLUSIONS

- Cessation of tail docking in a well managed herd with a high health status and low occurrence of tail biting among docked pigs:
  - Increased the risk of tail biting
    - despite low stocking density from 7-30 kg and straw
  - Increased the need for hospital pens
  - Did not increase number of dead pigs – if the tail biting could be stopped
  - Abattoir remarks underestimated the prevalence of tail bitten pigs

SEGES

THANK YOU FOR YOUR ATTENTION!!!

Challenging task!...

Finishers with intact curly tails

SEGES

Loose housed sows with low piglet mortality

By Janni Hales Pedersen, Post doc., Department of Large Animal Sciences, University of Copenhagen

UNIVERSITY OF COPENHAGEN

Faculty of Health and Medical Sciences

Loose housed sows with low piglet mortality

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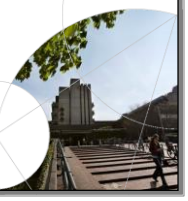
February 2016



Pig Research Centre

This project was founded by the Danish Centre for Animal Welfare

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Background

Danish industry

- 10 % loose housed lactating sows

Loose housed sows is a challenge

- Higher piglet mortality
- Temporary confinement for 4 days reduces mortality
- Not all sows have high mortality

Identify good sows

- Do they have a better farrowing process?
- Are they more active?
- Do they perform more pre-lying behaviour?

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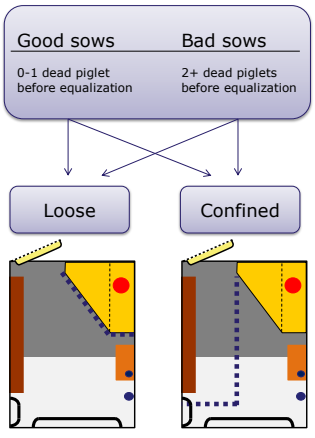
Experiment

Video recordings of 40 sows

- Parity 1 and 2
- Observation from end of farrowing to litter equalization

Registrations

- Farrowing duration
- Postural changes
- Pre-lying behaviour
- Piglet behaviour



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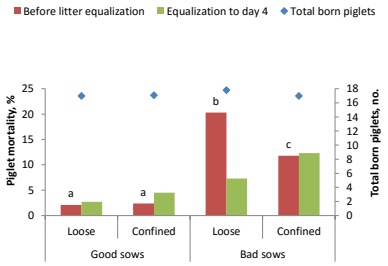
Piglet mortality



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Duration of farrowing and observational period

	Good sows		Bad sows		P-value	
	Loose	Confined	Loose	Confined	Housing	Mortality
Sows	8	8	8	4		
Farrowing duration, min	**241**	**204**	**261**	**273**	0.69	0.20
Time to litter equalization, h	**9**	**14**	**14**	**16**	0.18	0.21

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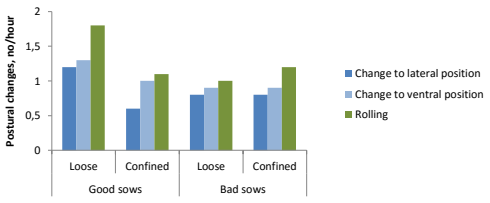
Sow behaviour – postural changes



	Good sows		Bad sows		P-value		
	Loose	Confined	Loose	Confined	Housing	Mortality	H x M
Lying lateral, min/event	**53**	**120**	**76**	**74**	0.11	0.54	0.09
Standing, min/event	**2**	**3**	**2**	**2**	0.13	0.43	0.74

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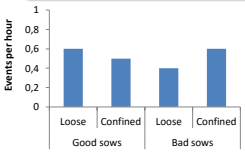
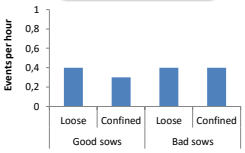
Sow behaviour – pre-lying behaviour

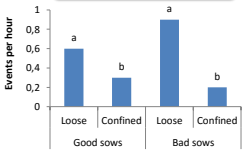
Lying down away from piglets



Rooting or pawing



Sow – piglet contact



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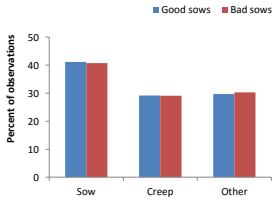
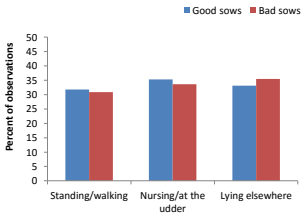
Piglet behaviour

Piglet location



Piglet activity



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Conclusions

Possible indicators of low piglet mortality

Sow related

- Duration of farrowing ÷
- Activity or inactivity ÷
- Performance of pre-lying behaviours ÷

Piglet related

- Location in per ÷
- Activity or inactivity ÷

Total born piglets and parity are still the best indicators of low or high piglet mortality.

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Thank you for your attention!!!

Pig Research Centre

Session 4: MRSA

Levels of MRSA on pigs and environmental samples

By Julie Elvekjær Hansen, PhD student, DTU National Veterinary Institute

Levels of MRSA on pigs and environmental samples

Julie Elvekjær Hansen
MSc. in Biology-Biotechnology, PhD student

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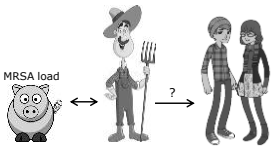
DTU Vet
National Veterinary Institute

LA-MRSA is a public health concern

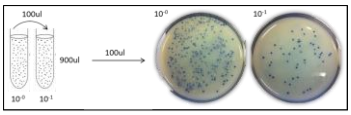
- Denmark: overall MRSA level is low
- Ambition of maintaining low levels of MRSA
- Increasing prevalence in livestock, especially in pig production – LA-MRSA load not known
- LA-MRSA reservoir – possibility of spread into the general population
- Control and prevention of increasing MRSA level in community
- Assessment of intervention strategies



Aims of the study

- To assess the possibilities of quantification of the animal MRSA load by nasal and skin swab samples
- To test two different active air samplers for quantification of airborne MRSA as a measure of environmental MRSA load

Quantification of animal load and air load



- Colony counts and determination of colony forming units →

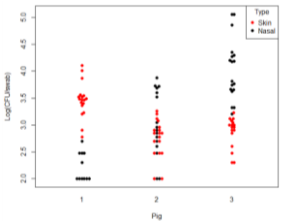
$$\text{CFU/ml(swab)} = \frac{\text{count x dilution factor}}{0.1\text{ml}}$$

Sampl'air:different volumes directly onto *Brilliance*™ MRSA 2
Sartorius:different volumes onto gelatine filter and incubated on *Brilliance*™ MRSA 2

- Determination of CFU/m³

Animal load - Biological and technical replicates

- Sampling : 3 pigs
- 4x3 swabs were obtained as: 3 nasal swabs + 3 skin swabs from each side of the pig
- Each of biological replicates were divided and analysed as three technical replicates in the lab, leading to 36 samples from each pig in total



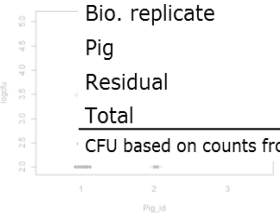
Source	Nasal swabs		Skin swabs	
	Variance	%	Variance	%
Bio. replicate	0.37	24	0.08	31
Pig	1.11	72	0.13	53
Residual	0.06	4	0.04	15
Total	1.54	100	0.25	100

CFU based on counts from 10^{-0}, where the 10^{-1} counts were zero

Nasal swabs seems to cause greater variation in the results than use of skin swabs. For nasal swabs a larger proportion of the variance can be explained by the difference between pigs.

Animal load - Biological and technical replicates

- Sampling : 3 pigs
- 4x3 swa
- Each of
  lab, lea



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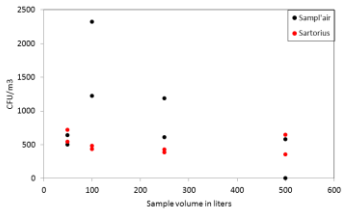
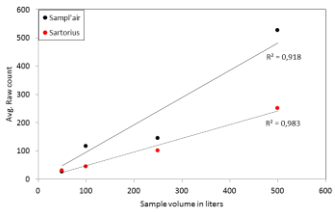
Environmental load - Airborne LA-MRSA

- Volumes: 50l, 100l, 250l, 500l
- Samples obtained in duplicates



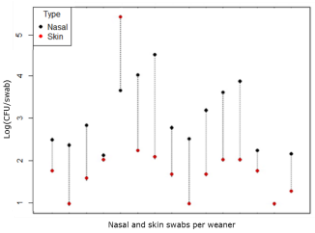


Sartorius yielded the most stable detection level of LA-MRSA from the different volumes and the increasing raw counts detected corresponds better with increasing air volumes.

7

Levels of nasal, skin and air load

	Ranges of LA-MRSA load
Nose	6.6×10^1 - 3.9×10^4 cfu/swab
Skin	1.1×10^1 - 2.6×10^5 cfu/swab
Sartorius	4.1×10^2 - 6.3×10^2 cfu/m³



MRSA load in nasal swabs are generally higher and more variable between pigs than MRSA load in skin swabs.

8

Animal loads – farm level

							Farm range			
	Sows	Gilts	Pregnant	Farrowing	Weaning	Slaughter	Lower	Upper	Farm avg.	Prevalance
Farm 1				1,42E+04	4,15E+04	1,89E+03	5,00E+00	7,00E+05	**1,79E+04**	62/64 (97%)
Farm 2		5,70E+01	5,51E+01	4,41E+02	4,48E+03		5,00E+00	2,80E+04	**1,34E+03**	60/62 (97%)
Farm 3				3,83E+03	4,33E+03		6,60E+01	3,00E+04	**4,13E+03**	25/25 (100%)
Farm 4				1,70E+02	2,90E+02	6,43E+00	5,00E+00	1,90E+03	**1,49E+02**	35/43 (83%)
Farm 5	1,00E+01	5,00E+00		7,50E+00	4,44E+02		5,00E+00	1,87E+03	**2,40E+02**	17/41 (41%)

9

Concluding remarks

- Quantification of animal LA-MRSA load is possible by direct plating
- Measurements of airborne LA-MRSA load are more stable from Sartorius MD8 air sampler than Sampl'air
- Limitations
  - Contaminant growth can interfere
  - Difficult to standardize
  - Air level as a time point measurement
- **Benefits**
  - Societal knowledge and demystification of "swine-MRSA"
  - We hope to be able to reduce or hinder the amount of LA-MRSA that escapes the farm
  - Provide knowledge for the authorities to base their decision-making on

Acknowledgement

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DTU Vet
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Margrethe Carlsen
Kári Karbech Mouritsen

SSI
Robert Leo Skov
Jesper Larsen
Øystein Angen

University of Copenhagen
Carmen Espinosa-Gongora

Can we reduce MRSA ST398 in positive farms by eliminating a few pig carriers?

By Carmen Espinosa Gongora, Post doc., Department of Veterinary Disease Biology, University of Copenhagen

UNIVERSITY OF COPENHAGEN

Faculty of Health and Medical Sciences

CAN WE REDUCE MRSA ST398 LEVELS IN THE FARM BY REDUCING A FEW PIG CARRIERS?

CPH PIG SYMPOSIUM Feb 2016

CARMEN ESPINOSA-GONGORA
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Department of Veterinary Disease Biology
Faculty of Health and Medical Sciences – University of Copenhagen

UNIVERSITY OF COPENHAGEN

Faculty of Health and Medical Sciences

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PIG STAPH

Animal Genetics, Bioinformatics and Breeding

Merete Fredholm
Claus B. Jørgensen
Per Skallerup

Veterinary Disease Biology

Luca Guardabassi
Carmen Espinosa-Gongora

UNIVERSITY OF COPENHAGEN

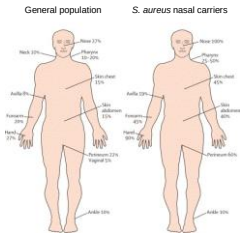
STAPHYLOCOCCUS AUREUS COLONIZATION

Commensal – Carriage/colonization

- 20% persistent carriers
- 30% intermittent carriers
- 50% non-carriers

Factors?

- Bacterial
- Host – Genetic – IR – Microbiota – Environment

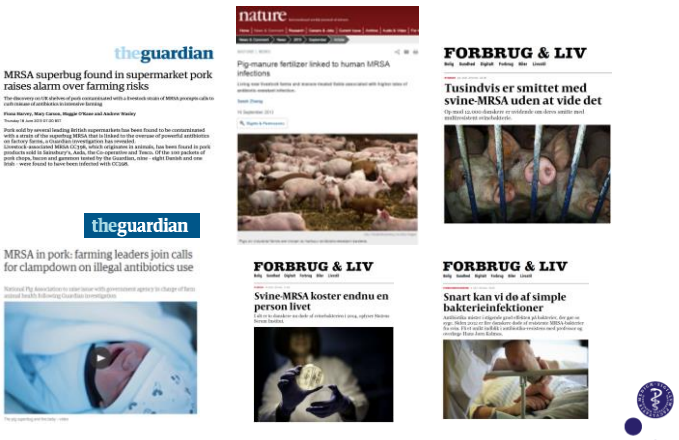


80% PEOPLE WITH SKIN INFECTIONS WERE CARRIERS

65% INFECTIONS caused by COLONIZING STRAIN

Wertheim et al, Lancet 2005

THE PROBLEM OF MRSA IN PIG FARMING I



THE PROBLEM C

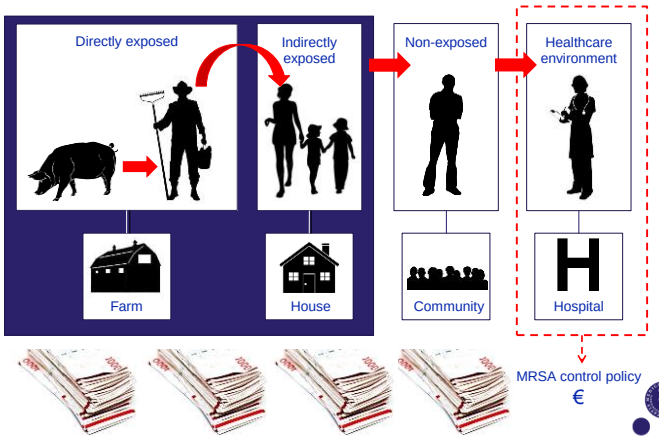
Table 8.4. The ten most pr

DANMAP 2014

spa type	CC	of cases	No. causing infections (%)
t127		990	179 (18)
t230		181	91 (50)
t002		180	36 (20)
t084		136	53 (39)
t012		119	86 (72)
t091		98	33 (34)
t015		79	37 (47)
t008		71	58 (82)
t701		70	31 (44)
t065		54	35 (65)

a) CC = Clonal complex.

THE PROBLEM OF MRSA IN PIG FARMING III



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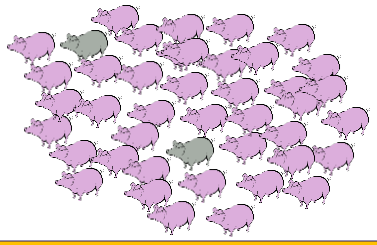
SUPERCARRIERS

PIG STAPH

SUPERCARRIER



A minority of the pigs (4-11%) are *"SUPERCARRIERS"* characterized by a high amounts and stable carriage of *S. aureus* in the nose

Espinosa-Gongora et al. 2015 *Appl. Env. Microbiol.*

ARE HOST GENETICS INVOLVED AS A CARRIAGE FACTOR?

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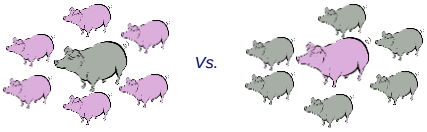
SUPERCARRIERS

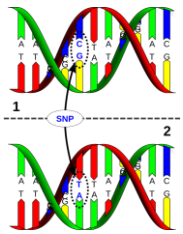
PIG STAPH

ARE HOST GENETICS INVOLVED AS A CARRIAGE FACTOR?



Vs.

Whole genome sequencing of the pigs



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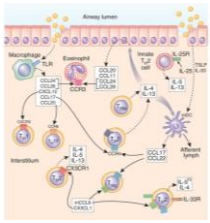
GENOME-WIDE ASSOCIATION STUDY (GWAS)

GWAS study using Illumina Porcine SNP60 beadchip (Ramos et al. PLoS one 2009)

- **Skallerup et al.,** Genome-wide association study reveals a locus for nasal carriage of *Staphylococcus aureus* in Danish crossbred pigs. **BMC Veterinary Research**

Chemokines
CCL1
CCL2
CCL8
CCL11

IMMUNE MEDIATORS



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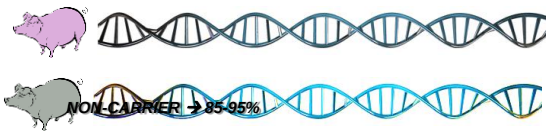

SUPERCARRIER → 5-15%

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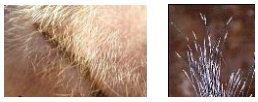
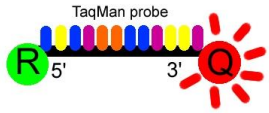
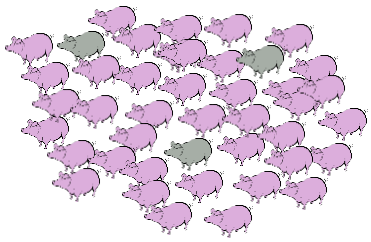
RAPID DIAGNOSTIC BY PCR

PIG STAPH







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CONCLUSIONS & FUTURE WORK

PIG STAPH

- Reducing MRSA levels in pig farms requires **MULTIPLE** measures
- **FARM TRIAL** to test the efficacy of eliminating the *supercarriers*
- **In combination** with more strategies (antimicrobial use? zinc? hygiene? probiotics? disinfection methods? etc…)
- Investigate **functional differences** in the immune response → possible new strategies

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PIG STAPH

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Faculty of Health and Medical Sciences – University of Copenhagen

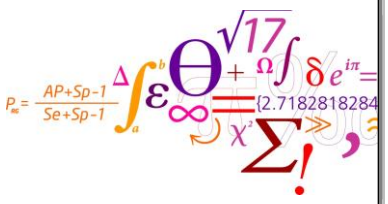
How to pool fecal samples in a cross-sectional study of antimicrobial resistance genes in Danish pig herds

By Anna Camilla Birkegård, PhD student, DTU National Veterinary Institute

How to pool fecal samples in a cross-sectional study of antimicrobial resistance genes in Danish pig herds

Julie Clasen, Anders Mellerup, John Elmerdahl Olsen,
Øystein Angen, Anders Folkesson, Tariq Halasa, Nils Toft,
Anna Camilla Birkegård

DTU Vet
National Veterinary Institute

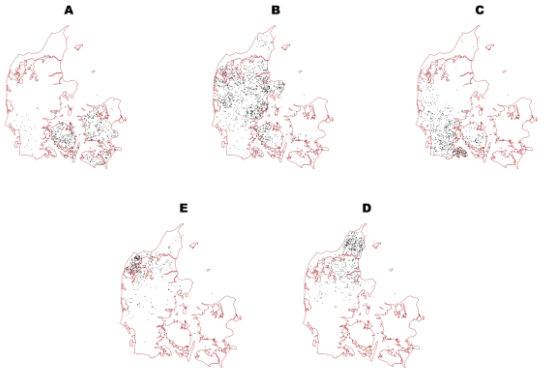


Why?

- Level of zoonotic antimicrobial resistance genes in Danish pig herds

- Cross-sectional study
  - 500-800 herds
  - Spatial randomness
  - Short sample period

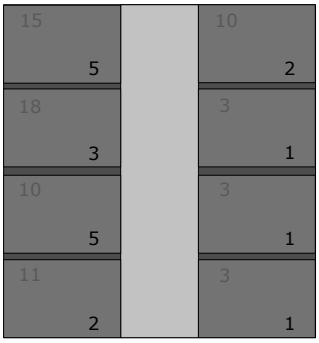
Where?



How many?

- Minimal number of samples
- Herd level of antimicrobial resistance

Farm



Creating the pools

20 fecal samples

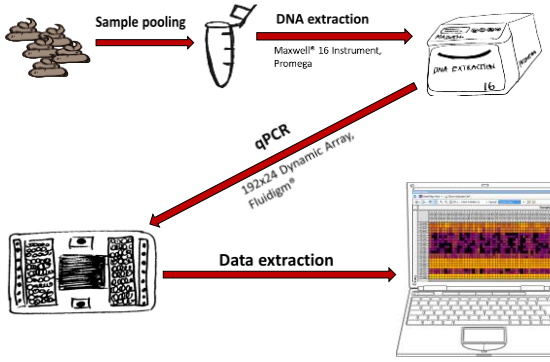
↓

20 individual samples

↓

48 pools
2
3
4
5
10
15
20

Analyzing the samples

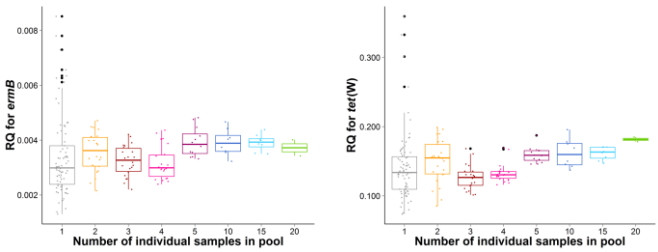


Level of antimicrobial resistance

$$RQ_{\text{primer set}} = 2^{-\Delta C_q}$$

$$\Delta C_{q,\text{primer set}} = C_{q,GOI} - C_{q,\text{reference gene}}$$

Results



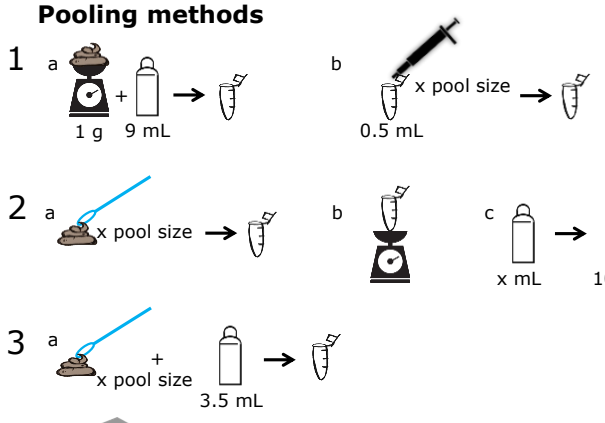
Optimizing the pooling method

- 5 herds
- 5 samples per herd

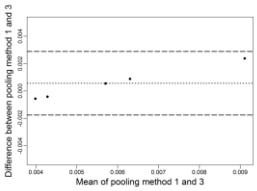
- 3 pooling methods

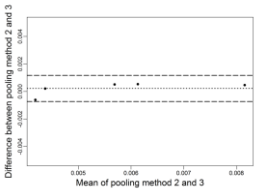
- 10 pools for method 1 and 2
- 5 pools for method 3

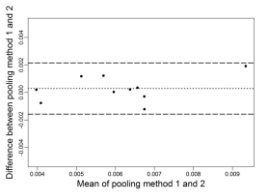
Pooling methods



Pooling methods







Conclusion

- Five samples per herd
- Pooling method 3

Can pooled faecal samples be used for resistance profiling? -Resistance in E. coli isolates from diarrhoeic nursery pigs

By Nicolai Weber, PhD student, Department of Large Animal Sciences, University of Copenhagen

UNIVERSITY OF COPENHAGEN Department of Large Animal Sciences

Faculty of Health and Medical Sciences

Can pooled faecal samples be used for resistance profiling?

-Resistance in *E. coli* isolates from diarrhoeic nursery pigs

Nicolai Weber
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Department of Large Animal Sciences, University of Copenhagen

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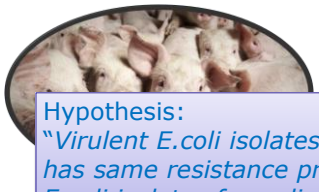
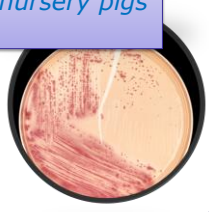
Dias 2

UNIVERSITY OF COPENHAGEN Department of Large Animal Sciences



Hypothesis:
"Virulent E.coli isolates from the pen floor has same resistance profile as virulent E.coli isolates from diarrheic nursery pigs contained in the pen"

Dias 3

Motivation

Development of diagnostic decision tool for selection of antibiotic classes for treatment of *E.coli* diarrhoea

Supervisors:

Jens Peter Nielsen (Professor, DVM, PhD, Dipl. ECPHM)
Christian Fink Hansen (Associated Professor, MSc Animal Science, PhD)
Ken Steen Pedersen (CEO OE-Vet A/S, DVM, PhD, Dipl. ECPHM)

DET SUNDHEDSVIDENSKABELIGE FAKULTET KØBENHAVNS UNIVERSITET | DTU Vet National Veterinary Institute | SEGES

Study design

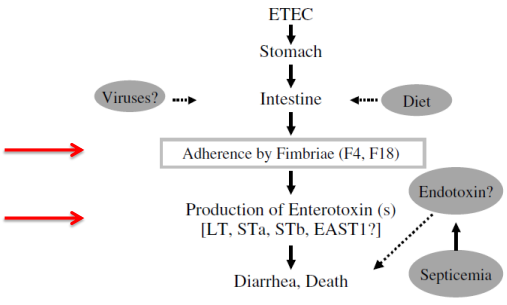
Pig samples

- 3 nursery facilities
- In pens with >25 % diarrhoea
- 3 diarrheic pigs per pen

Pen samples

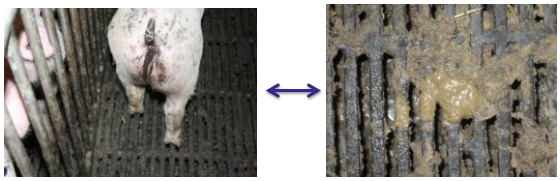
- 1 pen floor sample

Pathogenesis



Definition: Virulent *E.coli* = fibriae positive and toxin positive

Study design



Comparison of resistance status at pen level

Hypotheses: Res.Pen = Res.pig

Results

89 virulent isolates analysed – all F18 positive
87/89 hemolytic activity

22/86 sampled pigs

13/31 sampled pens

Results

	Overall resistance		
Antimicrobial class	**% resistant**	**DTU-VET 06-08***	**Clinical breakpoint (µg/ml)**
# Isolates	**89**	**55**	
Tetracycline	47.2	69.1	16
Ampicillin	60.7	34.5	32
Sulphamethoxazole	69.7	70.9	512
Trimethoprim	69.7	36.4	16
Streptomycin	34.8	83.6	32
Spectinomycin	18.0	56.4	128

Resistance profiles analysed by Sensititre system
* From the national guidelines of antibiotic use

Results

% Resistant by Herd

	Herd 1	Herd 2	Herd 3
Isolates analysed	**42**	**25**	**22**
Tetracycline	100	0	0
Ampicillin	33.3	84	86.4
Sulphamethoxazole	97.6	84	0
Trimethoprim	97.6	84	0
Streptomycin	43	52	0
Spectinomycin	38.1	0	0

Results

Agreement study:

Definitions:

Res.pig = 1 or more virulent E.coli isolates from 1 or more pigs for the pen

Res.pen = 1 or more virulent E.coli isolates from 1 pooled pen floor sample

Results

		Pig level		
		+ Virulent	- Virulent	Total
Pen level	+ Virulent	10	3	13
	- Virulent	2	16	18
	Total	12	19	31

Sensitivity = 83.3 %; Specificity= 84.2 %
PPV = 76.9 %; NPV = 88.9 %

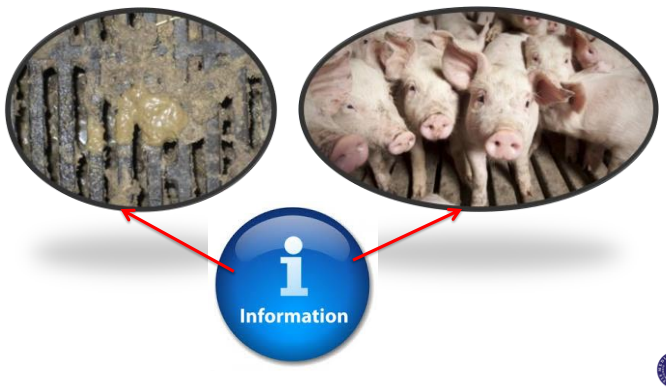
Results

Agreement of resistance	
Antimicrobial class	Agreement
Tetracycline	10/10
Ampicilline	10/10
Sulphamethoxazole	10/10
Trimethoprim	10/10
Streptomycin	10/10
Spectinomycin	8/10

Comparison of Res.pen and Res.pig was only possible i 10 pens

Conclusion

- 10 of 31 pens virulent *E.coli* isolated in pen and pig
- Highest prevalence of resistance to Sulpha, TMP and Tetra
- Herd specific resistance patterns
- Excellent agreement between pen resistance and pig resistance
- Low sample size
- Confirmation in larger study needed



CPH Pig is financially supported by the Pig Levy Fund (Svineaftgiftsfonden)

www.svineafgiftsfonden.dk

Thank you for participating
– see you next year!

www.cphpig.ku.dk