

Advancing swine welfare practices to empower your industry:

What the Chair in Swine Welfare is doing for you

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Western College of Veterinary Medicine, University of Saskatchewan

Prairie Swine Centre Producer Meetings, April – May 2024



**NSERC
CRSNG**



BE WHAT THE WORLD NEEDS

Need for practical & science-driven solutions to swine welfare challenges

Past & current pressures facing Canadian Swine industry

- Move to group housing
 - Canada: 2014 Code of Practice
 - US, California: Prop 12, 2022
- Long distance transport
 - Requirements to offload pigs:
Expensive & effect on welfare unknown

- Requirements:
Not always informed by science
- Can be unworkable
- Influence market access

Chair in Swine Welfare: A strategic initiative

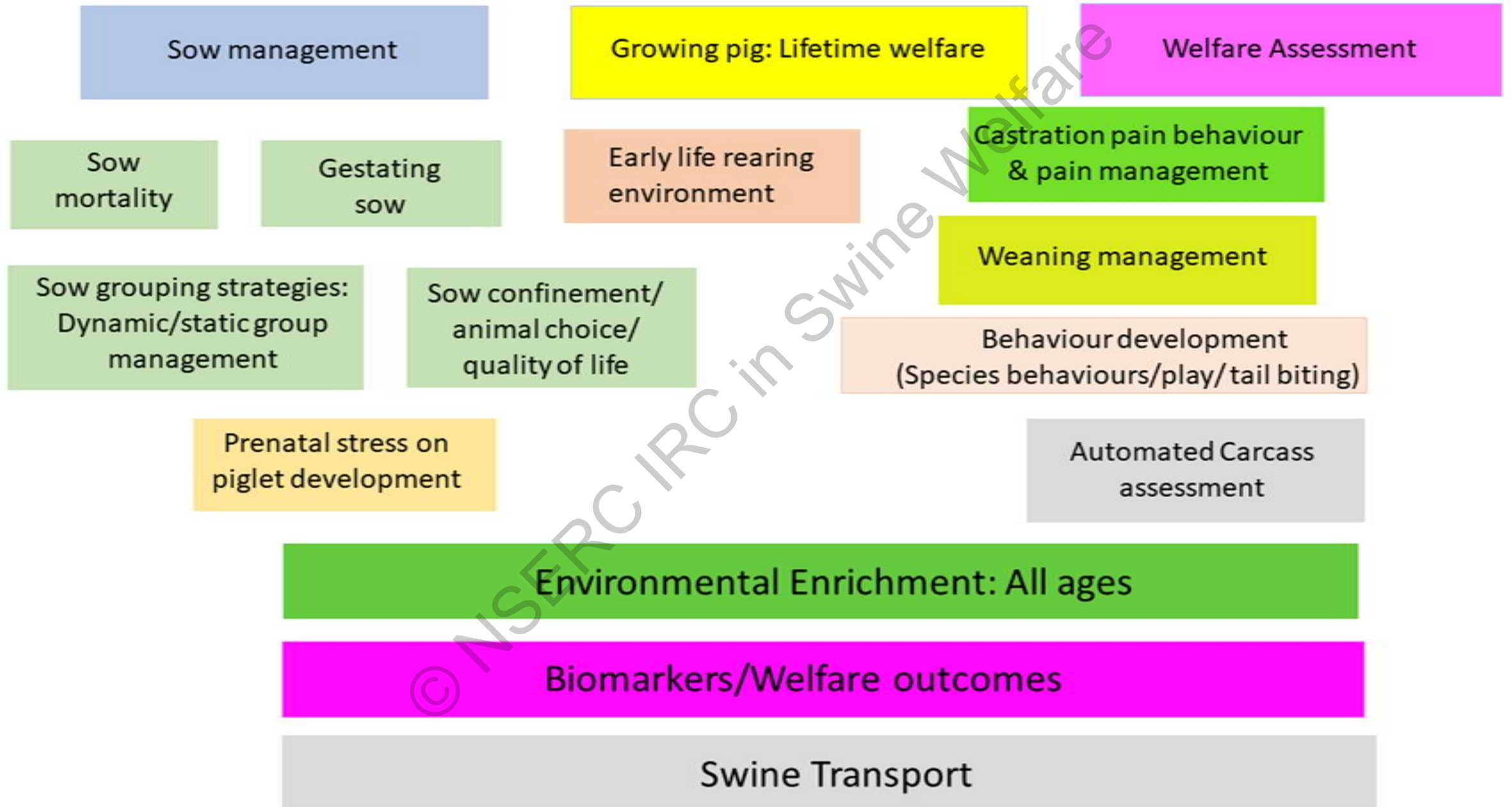
1. Strategic initiative: **Proactive approach** to swine welfare, not reactive
2. **Forward facing research**
3. Increase resources for swine welfare research in Canada
 - Working on industry challenges: **Developing solutions**
 - Increase the training of highly qualified personnel

- Established 2018
- Total funds \$2 million

- Industry partners x 14
- Federal government
- University of Saskatchewan



Research areas covered: 2018 - 2023



Program objectives

Beneficial pathways to support the pig in fully slatted systems

Goal 1: Understand how early life management contributes to pig robustness, sociability, and welfare outcomes in the growing pig

Goal 2: Identify if promotion of play can increase physiological and psychological robustness

Tools to monitor/measure/provide feedback/transparent reporting

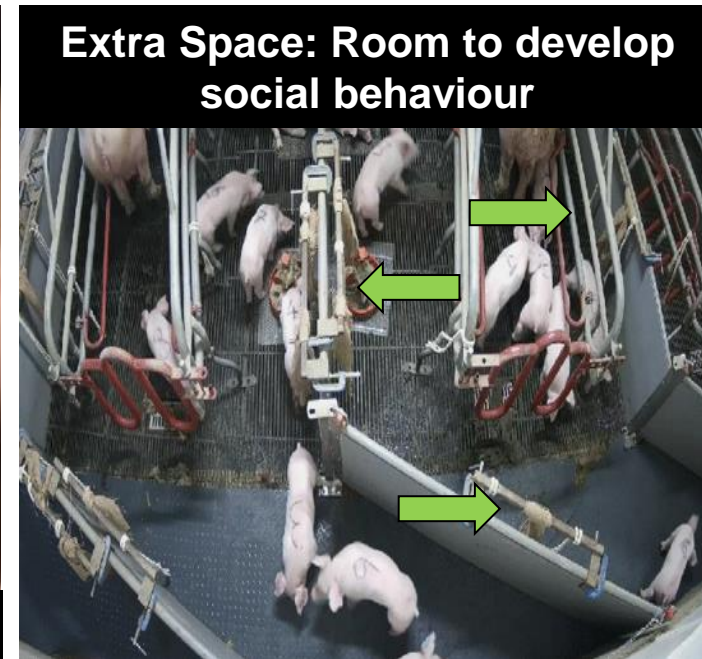
Goal 3: Identify and validate biological markers indicative of welfare states in swine

Goal 4: Understand the value of animal-based post-mortem indicators of welfare

**Provide scientific evidence for mechanisms
& Evaluate practicality for industry at commercial level**

Goal 1: Early life management contribution to pig robustness, sociability & welfare in growing pigs

- Optimize welfare in fully slatted systems early in life = lifelong effect
- Provision of a combination of treatments in **farrowing & nursery**



Benefits to pig welfare & industry: improved robustness & sociability?

Goal 1: Results

– Treatments in farrowing & nursery

- Improved average daily gain in **nursery & lifelong**

Table: Predicted mean and 95% CI of **average daily gain** at various life stages of growing pigs

	EE	EC	CE	CC	χ^2	P
Pre-weaning	0.25 (0.24, 0.26)		0.25 (0.24, 0.25)		0.42	0.52
Nursery	0.47 (0.45,0.48) ^a	0.40 (0.39,0.42) ^b	0.42 (0.40,0.43) ^{ab}	0.39 (0.38,0.40) ^b	8.07	0.04
Grower	1.08 (1.05,1.11)	1.08 (1.05, 1.11)	1.07 (1.04, 1.11)	1.08 (1.05, 1.11)	0.27	0.97
Finisher	1.37 (1.26, 1.42)	1.31 (1.20, 1.42)	1.34 (1.23, 1.45)	1.28 (1.17, 1.39)	0.77	0.86
Lifelong	0.87 (0.84,0.89) ^a	0.84 (0.82,0.87) ^b	0.85 (0.82,0.88) ^{ab}	0.82 (0.80,0.85) ^b	12.28	0.01

- Reduced skin lesions upon mixing
- Improved handleability in late nursery stage: less reactive pigs

Goal 1: Results

↓ Proportion of bitten tails observed (n = 312)

Treatment	Control only	CE	EC	Enhanced only	X2	P
End nursery	0.27 ^a	0.11 ^b	0.25 ^a	0.02 ^b	11.22	0.01
Finisher	0.11	0.09	0.10	0.10	0.08	0.99

- Gut inflammation: cytokines, calprotectin – in progress, Murcia University, Spain
- Carcass traits: coming by summer 2024

Goal 2: Supporting positive welfare through play

The negatives

Castration



Tail docking



Diseases



The positives

Animal-human interaction



Play opportunities



Social bonds



Goal 2: Supporting positive animal welfare through play



Determine: Can play be supported in intensive production systems?

1. What conditions can trigger play
2. Benefits of play on resilience & productivity

Provide positive events:
Enrichment materials &
extra space allowance

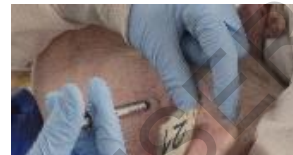
Methods

- PLY reared with play opportunities from birth
- Weaning: pigs selected for disease challenge & transported to biosecurity level 2

PLY in BSL2 (n=14)



CON in BSL2 (n=14)



Weaning

$D26 \pm 2$
mean \pm SD

Infection with
PRRSV

Play opportunities every second day

Respiration observed daily

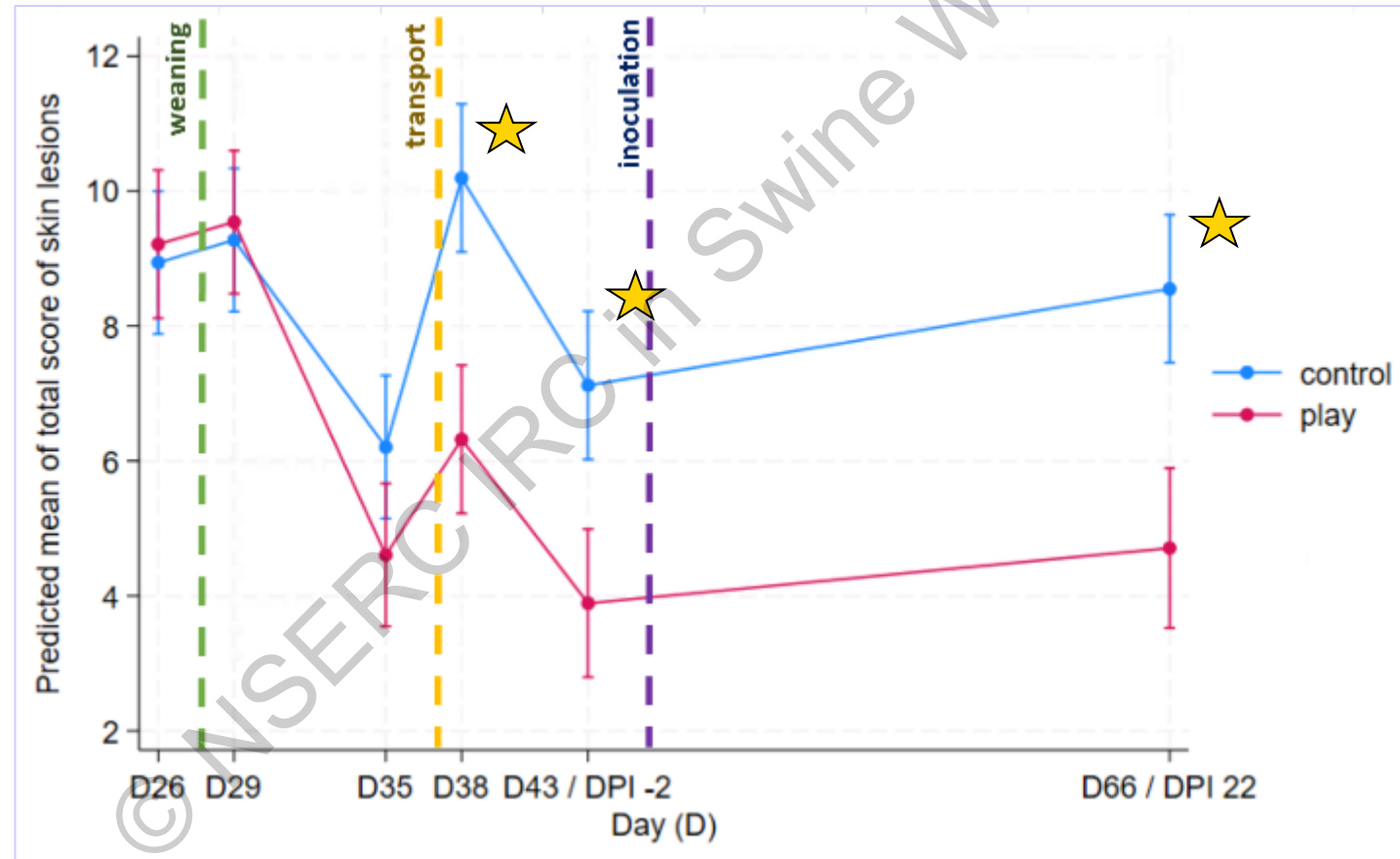
Euthanasia
(Pentobarbital)

$D65 \pm 2$
mean \pm SD
22 DPI

Goal 2: Skin lesions (measure of aggression)

Play pigs

- ↓ Skin lesions during transport & levels low until end of trial

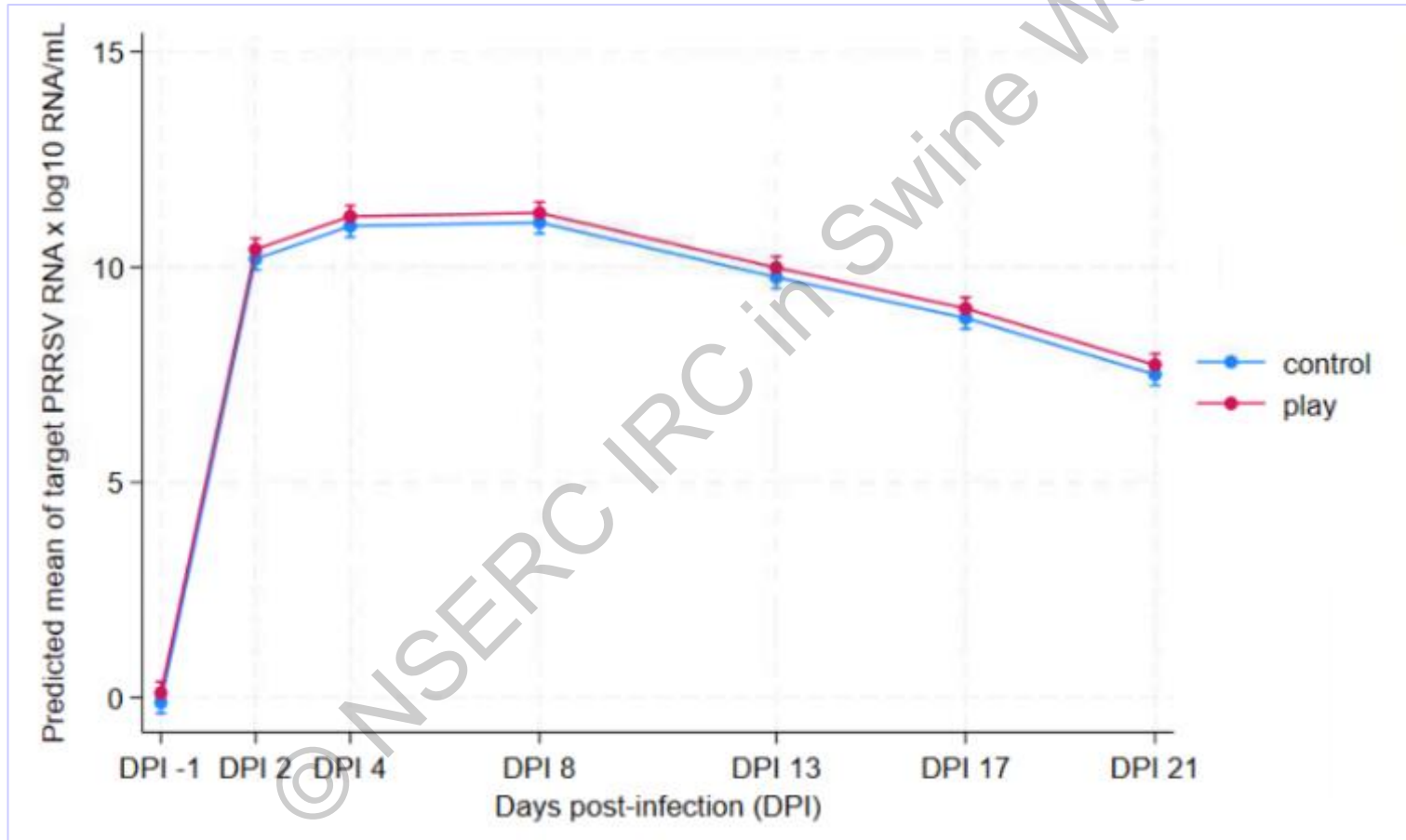


Data are presented as predicted mean and 95% CIs. Star indicates significant difference between treatments.

Goal 2: PRRS viral load

Play pigs

- ↑ PRRS viral load (tendency: $P=0.075$)

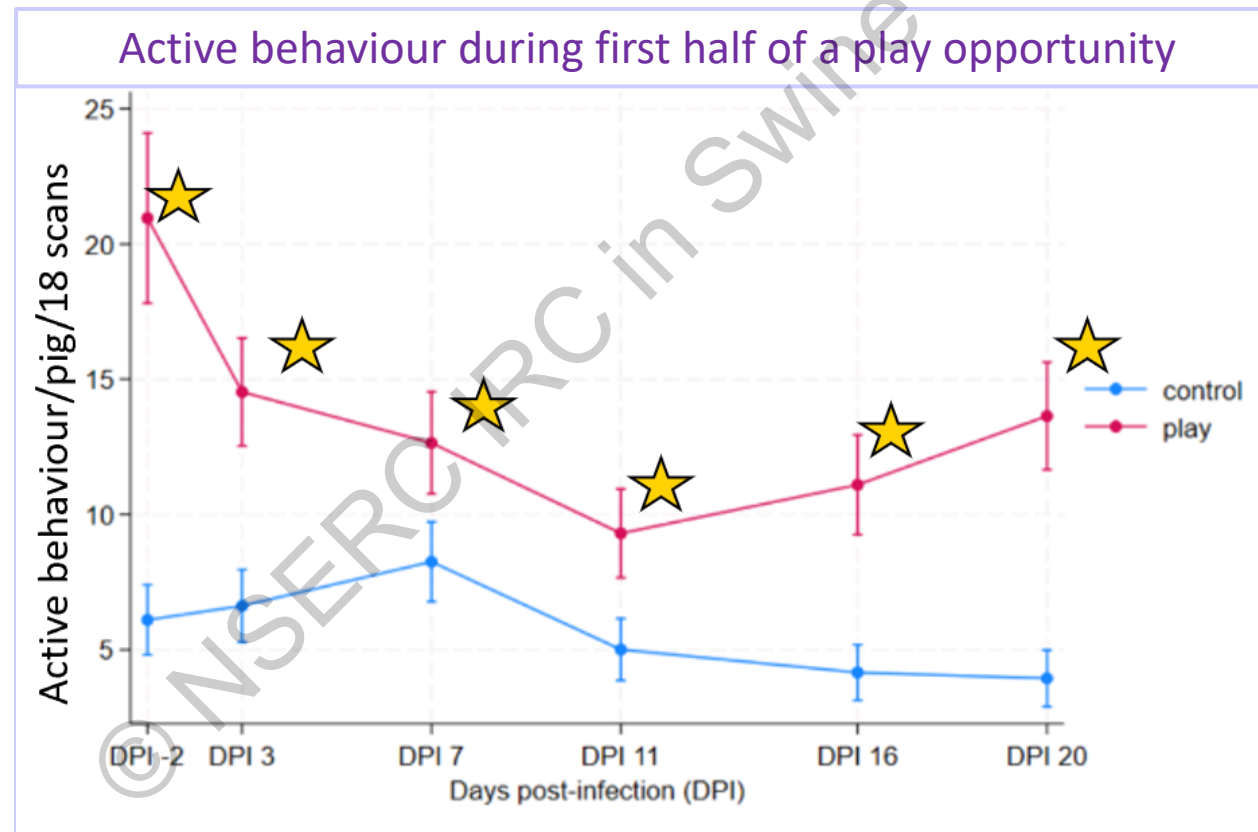


Data are presented as predicted mean and 95% CIs. Star indicates significant difference between treatments.

Goal 2: Sickness behaviour

Play pigs

- ↑ Active before infection & remained active during acute infection period, until recovery



Data are presented as predicted mean and 95% CIs. Star indicates significant difference between treatments.

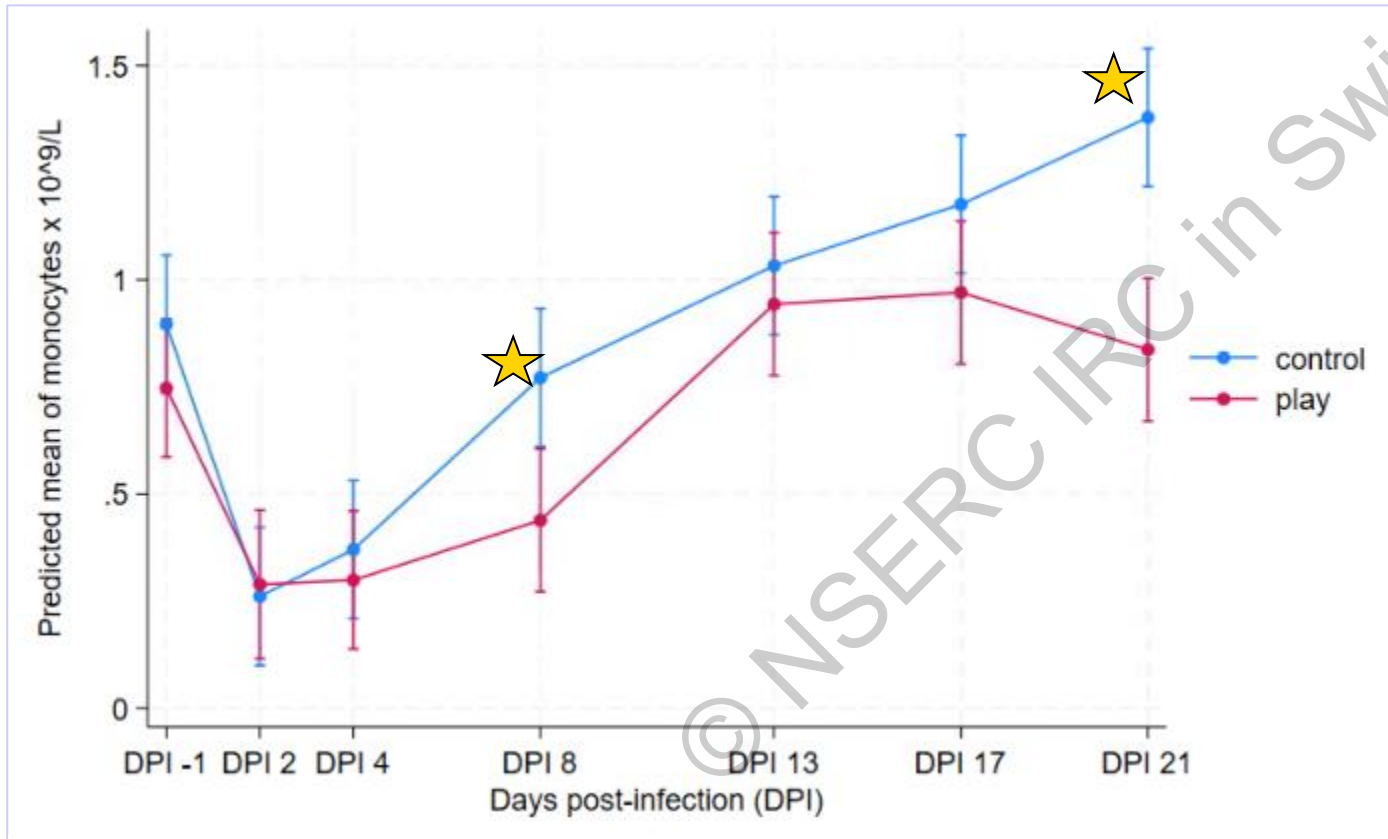
Goal 2: Monocytes (measure of immune response)

Play pigs

Lower monocytes (inflammatory response)

=

Lower immune response, but just as effective



Clinical symptoms

- Respiratory distress (PRRS symptom)

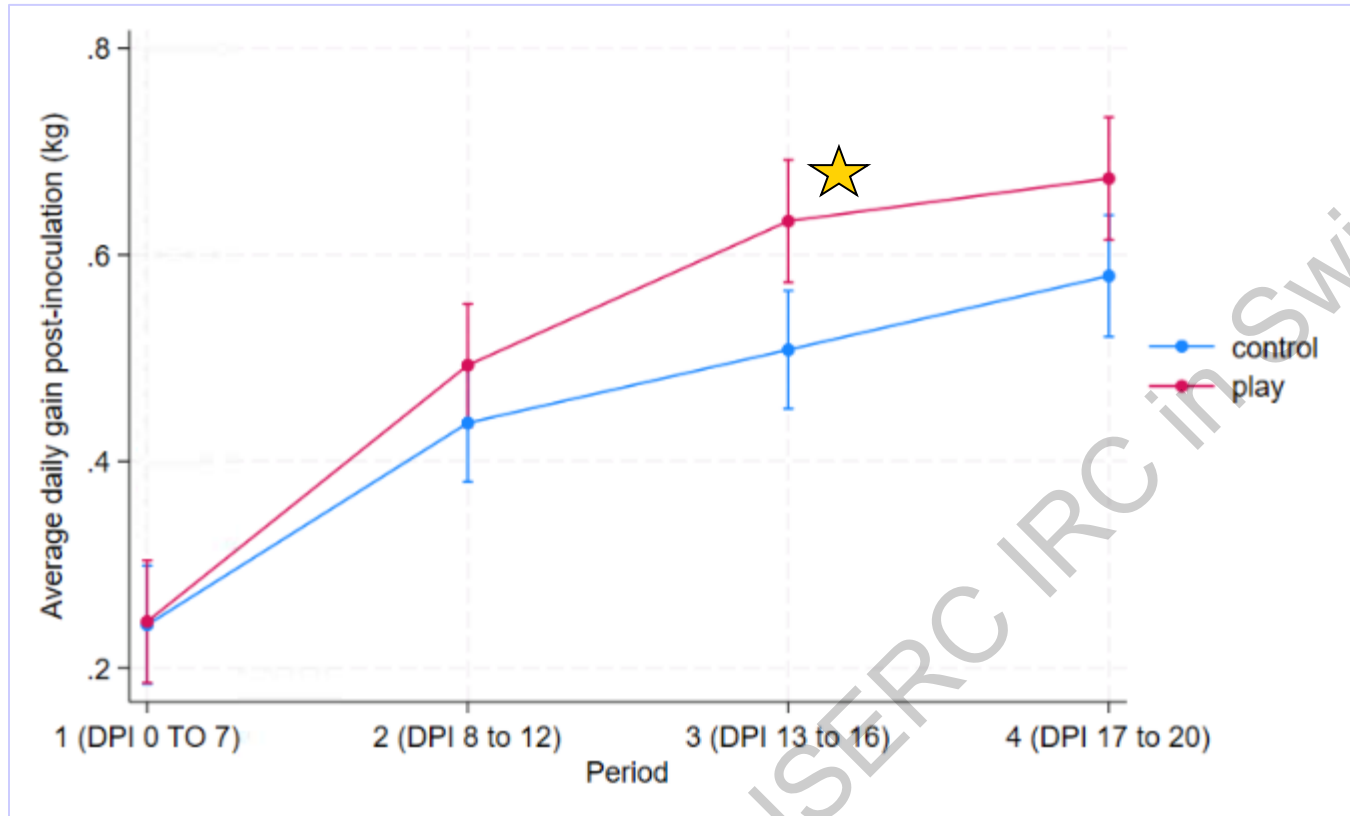
Play pigs (n=14)	Control pigs (n=14)
35%	91%

P < 0.05

Data are presented as predicted mean and 95% CIs. Star indicates significant difference between treatments.

Goal 2: Results

- **Play pigs had \uparrow ADG in the second half of infection**



Data are presented as predicted mean and 95% CIs. Star indicates significant difference between treatments.

*Deceased PLY pig was excluded from this analysis.

Pen level gain to feed during infection

Gain to feed	Mean	S.D.
Play	0.72	0.06
Control	0.57	0.11

Goal 2: Implications for science & industry

Play behaviour

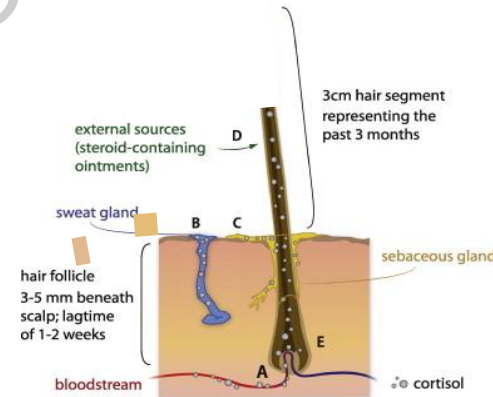
- Can be promoted in intensive production systems
- A positive experience = Measure of positive welfare
 - Code of Practice
- Important tool to support good welfare & maintain positive image of pork production



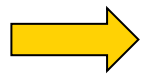
Goal 3: Validate biomarkers of welfare state in swine

- Biomarkers: objective measures & indicate biological states
- Measurement tool
 - Welfare
 - Different production systems
 - Individual welfare of animals
 - Tool for genetic selection

Stall or group housed sows?



Mechanisms of cortisol incorporation into the hair (Stalder et al. 2012)

- Hormones in hair
- Chronic measure of stress
 - Cortisol
 - DHEA
 - **Cortisol:DHEA ratio**  Superior measure?

Genetics of stress hormone concentrations in hair of healthy nursery pigs and their relationship with back-test responses

Fazhir Kayondo, Hayder Al-Shanoon, Yolande Seddon, David Janz, Dylan Carette, Carmen Cole, Frederic Fortin, John C. S. Harding, Michael K. Dyck, Graham Plastow, Pig Gen Canada, and Jack C. M. Dekkers

2023 ASAS-CSAS-WSASAS Annual Meeting

Animal
Breeding
&
Genetics

Current conclusions

- Cortisol & DHEA-S
 - Heritable phenotype in young pigs
 - Potential biomarker to select pigs better able to cope with stress

Goal 3: Use of hair hormones to evaluate welfare

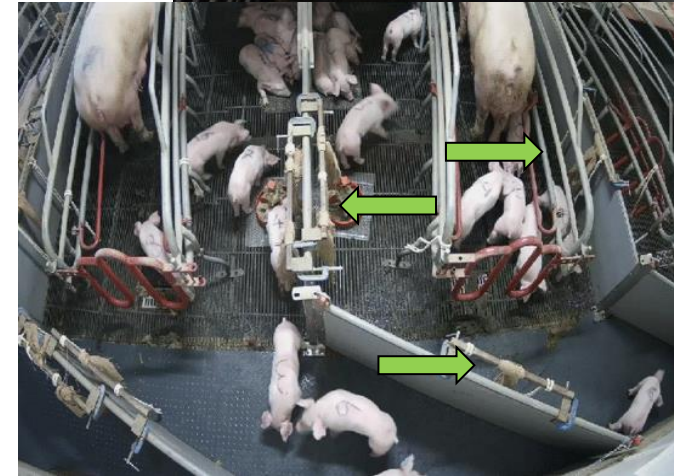
- Pigs reared in environments designed to improve welfare, modulate stress & improve resilience long-term (Goal 1)
 - Straw enrichment
 - Management modifications early in life

No system difference in hair cortisol & DHEA levels

Individual level differences:

Lame pigs in conventional systems: \uparrow hair cortisol:DHEA ratio

- Better able to cope with stress
- Better tool for individual pig welfare assessment



Conventional reared VS Multi-suckling reared: enriched and larger pens

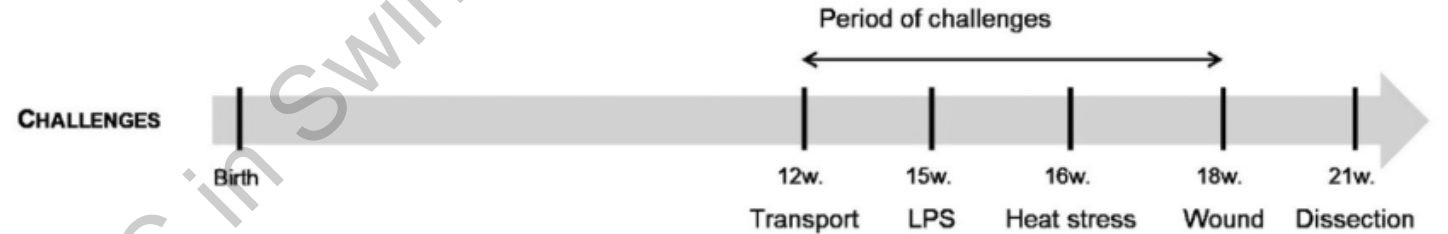
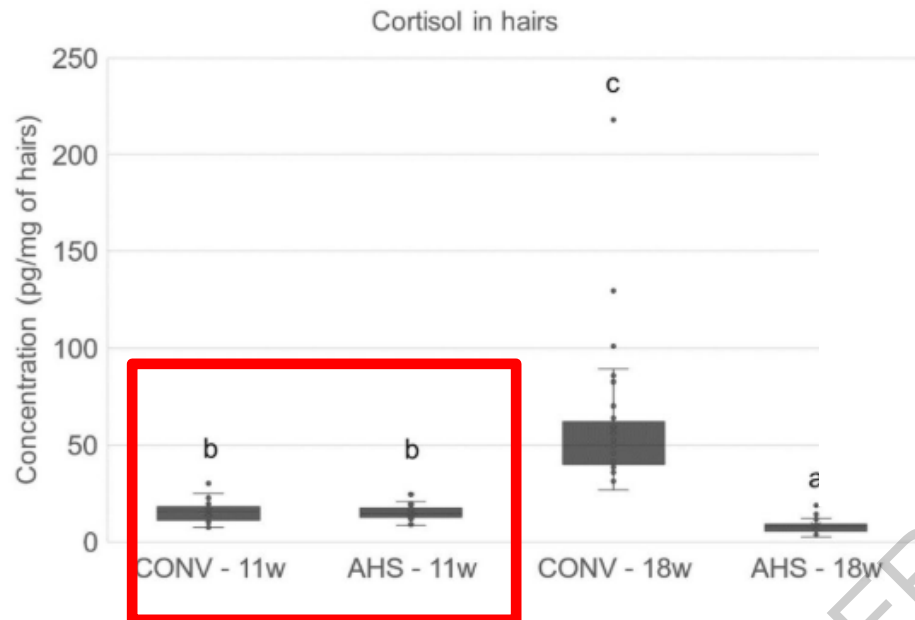


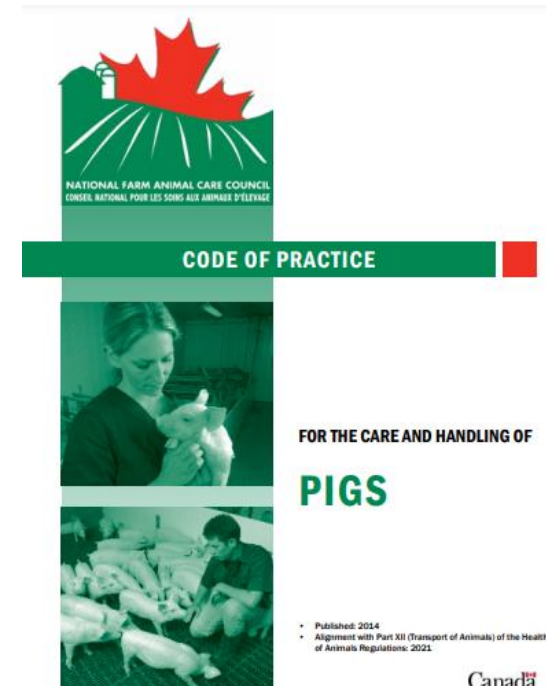
Figure 1. Schematic view of the experiment from birth till dissection of pigs housed in an alternative (AHS) or conventional (CONV) system.

Figure 7. Cortisol concentration in hairs measured before (11 weeks of age) and at the end (18 weeks of age) of the period of challenges in pigs housed in an alternative (AHS) or conventional (CONV) system. Letters were attributed for significantly different values $a < b < c$; $p < 0.0001$.

Goal 4: Evaluation of animal-based indicators of welfare on swine carcasses

Importance of welfare assessments & high-quality welfare data

1. ↑ Transparency in reporting & public trust in Canadian pork
 - Tracking of on-farm management practices
 - Benchmarking
 - Verified standards → Valid programs: PigCARE
2. Importance of welfare & quality globally
 - Prop 12 – US
 - Demand for high quality produce – Japan



A new approach – At slaughter



Carcass-based indicators



Automated (Artificial Intelligence) welfare assessment

- Unbiased & no threat to biosecurity
- Adoption: large scale, commercial level
- Cost-effective, regular, efficient & continuous data collection
- Feedback mechanism

Objectives

1. Identify relationships between animal-based welfare indicators on carcasses, and animal- & resource-based measures on-farm and in pre-slaughter handling

→ **Herd diagnostic tool**

2. Automation of a welfare lesion scoring system, using computer vision (AI)

Methods: Carcass images

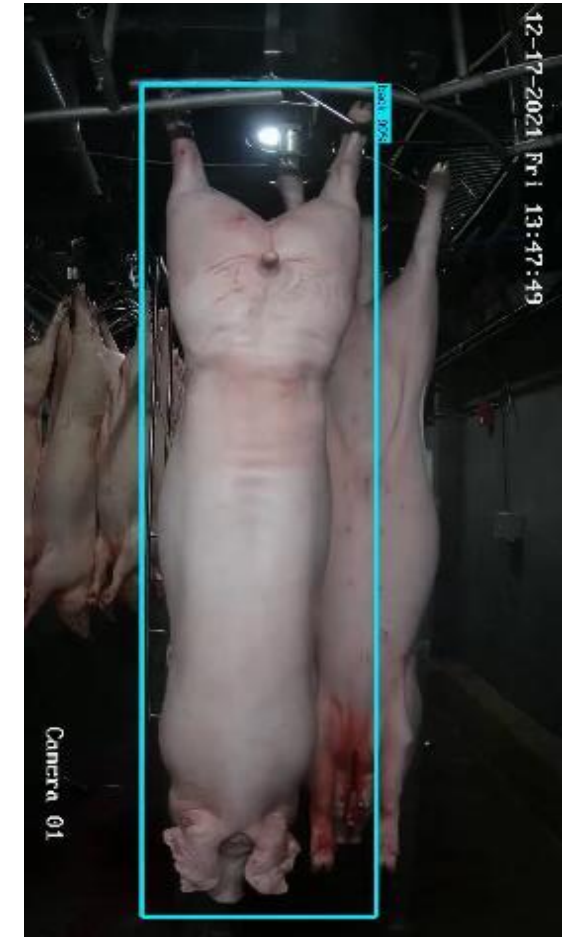
- Camera
 - Post scalding & dehairing
 - Turn in the line
- Footage collected
- Carcass-based indicators scored by 2 observers



Lateral



Dorsal



Methods: Carcass-based indicators

Fresh skin lesions

(lateral: shoulder, middle, rump)



Score 0 = up to 1 visible lesions



Score 1 = from 2 to 5 visible lesions



Score 2 = from 5 to 10 visible lesions



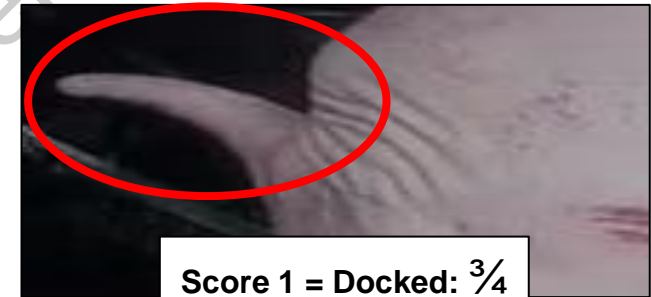
Score 3 = more than 11 visible lesions

Tail length

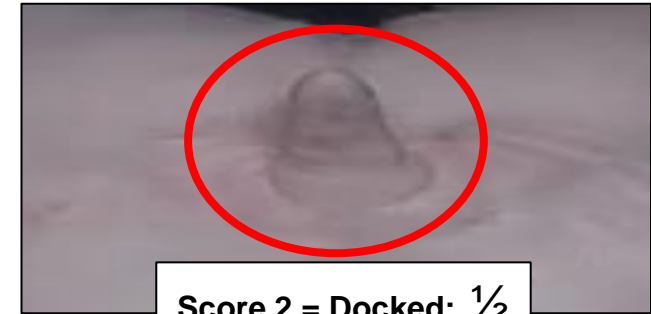


Picture: Valros et al., 2020

Score 0 = Undocked



Score 1 = Docked: $\frac{3}{4}$



Score 2 = Docked: $\frac{1}{2}$



Score 3 = Docked: $< \frac{1}{4}$

Methods: Carcass-based indicators

Tail biting lesions



Score 1 = Mild



Score 3 = Severe

Ear lesions



Score 3 = Severe

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Methods: Carcass-based indicators

Hernia



Score 1 =
Small bump



Score 3 = Bump
larger than an orange

Frostbite



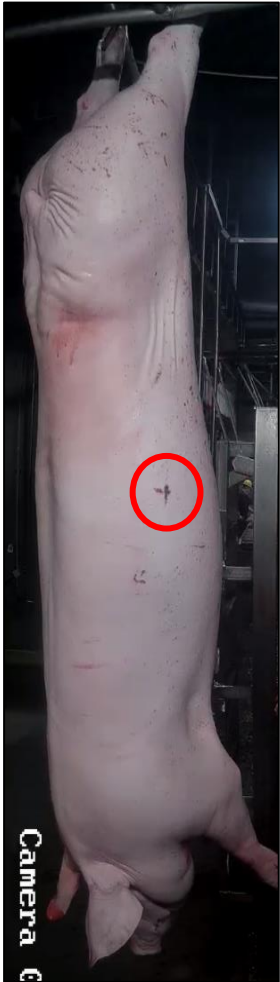
Score 1 = 20% of
lateral side affected



Score 3 = > 20% of
lateral side affected

Methods: Carcass-based indicators

Old skin lesions



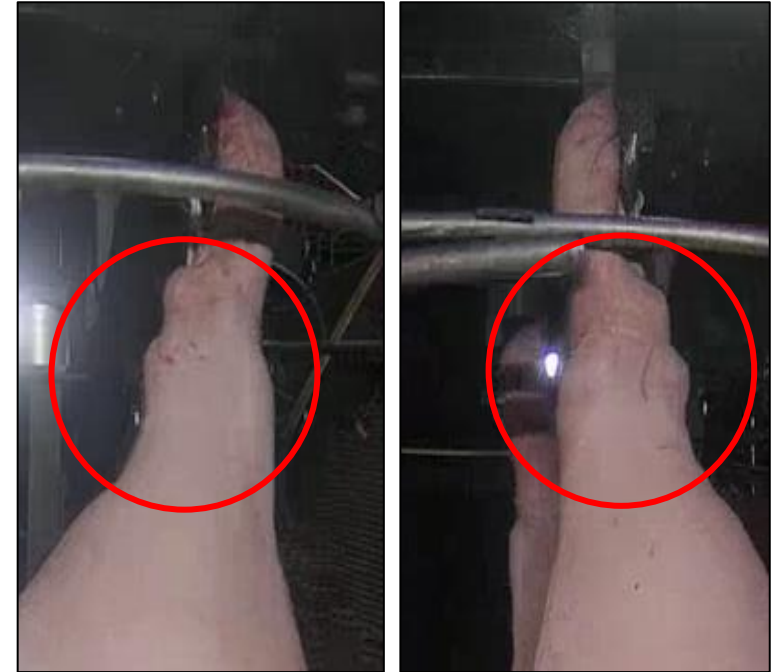
Human handling lesions



Loin bruise



Bursitis



Development of automated scoring of welfare lesions

Electrical & Computer Engineering, Biomedical Sciences, USASK



Stage 1: Carcass identification:

Detect pig carcasses on video

Stage 2: Tracking:

Track the same pig carcass & provide ID

Stage 3: Lateral and dorsal:

Identify and extract lateral and dorsal sides from same pig carcass

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Welfare

AI system evaluation

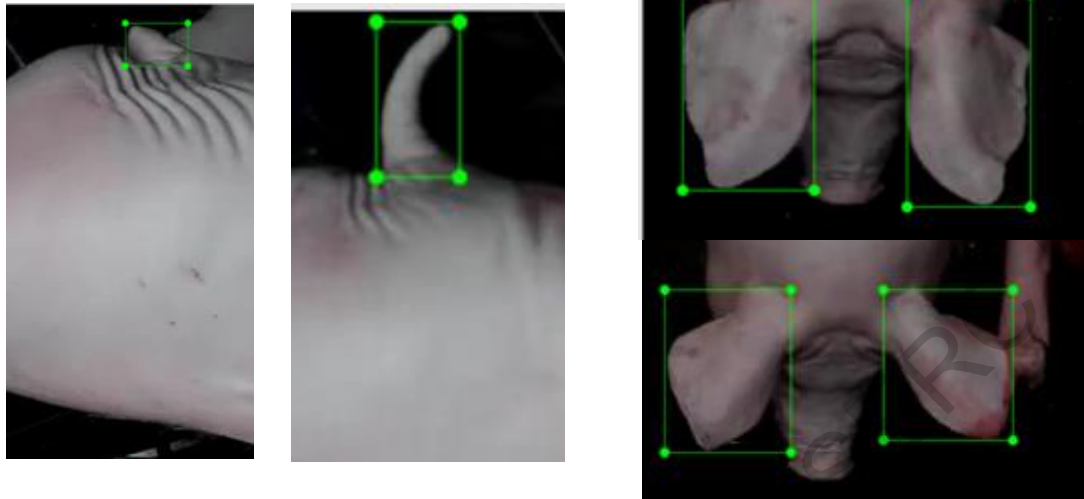
System name	Classifier	Queue System	Accuracy	Precision	Recall	F1-score
Tail (Body Det. / Tail Det.)	x	x	0.81	0.83	0.93	0.88
Tail and queue (Body Det. / Tail Det. with queues)	x	✓	0.86	0.96	0.84	0.90
Proposed system (Body Det. / Tail & Head Det./ Head Clf. with queues)	✓	✓	0.92	0.98	0.91	0.94
Tail & head no classifier (Body Det. / Tail & Head Det with queues)	x	✓	0.58	0.96	0.45	0.62

Development of automated scoring of welfare lesions

Stage 4: Automated detection of carcass sections:

Ears, tail, shoulder, mid-section, rump

- Computer learns to detect
 - Tail: location & length
 - Ears



Model successfully trained to recognize

- Carcass position & body parts
- Accuracy >99% - All body parts



```
*****  
back      AP      0.99605  
dorsal    AP      0.99012  
front     AP      1.0  
left-ear  AP      1.0  
middle    AP      0.99247  
...  
*****
```


Development of automated scoring of welfare lesions

Stage 5 & 6: Carcass lesions: Identify lesions of significance to animal welfare within carcass sections

- Identify lesion
- Quantify lesion

Red Box: Tail

- Length : categorise length -
Relates to docking practices
- Tail biting damage present
- Tail damage biting severity

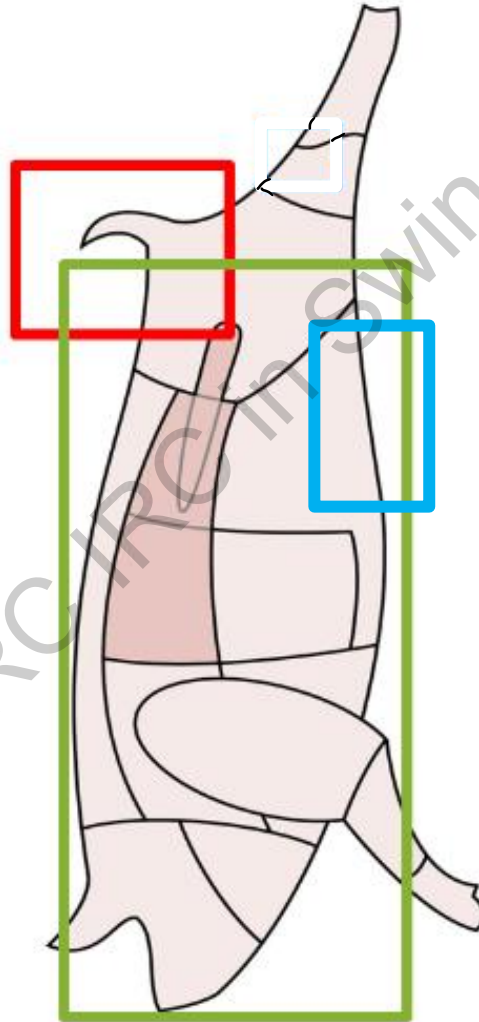
Green box: Skin lesions –
3 classifications

- Swine aggression
- Human handler inflicted
- Environmental

For each measure:
absence/presence & severity is
the goal

Hernia

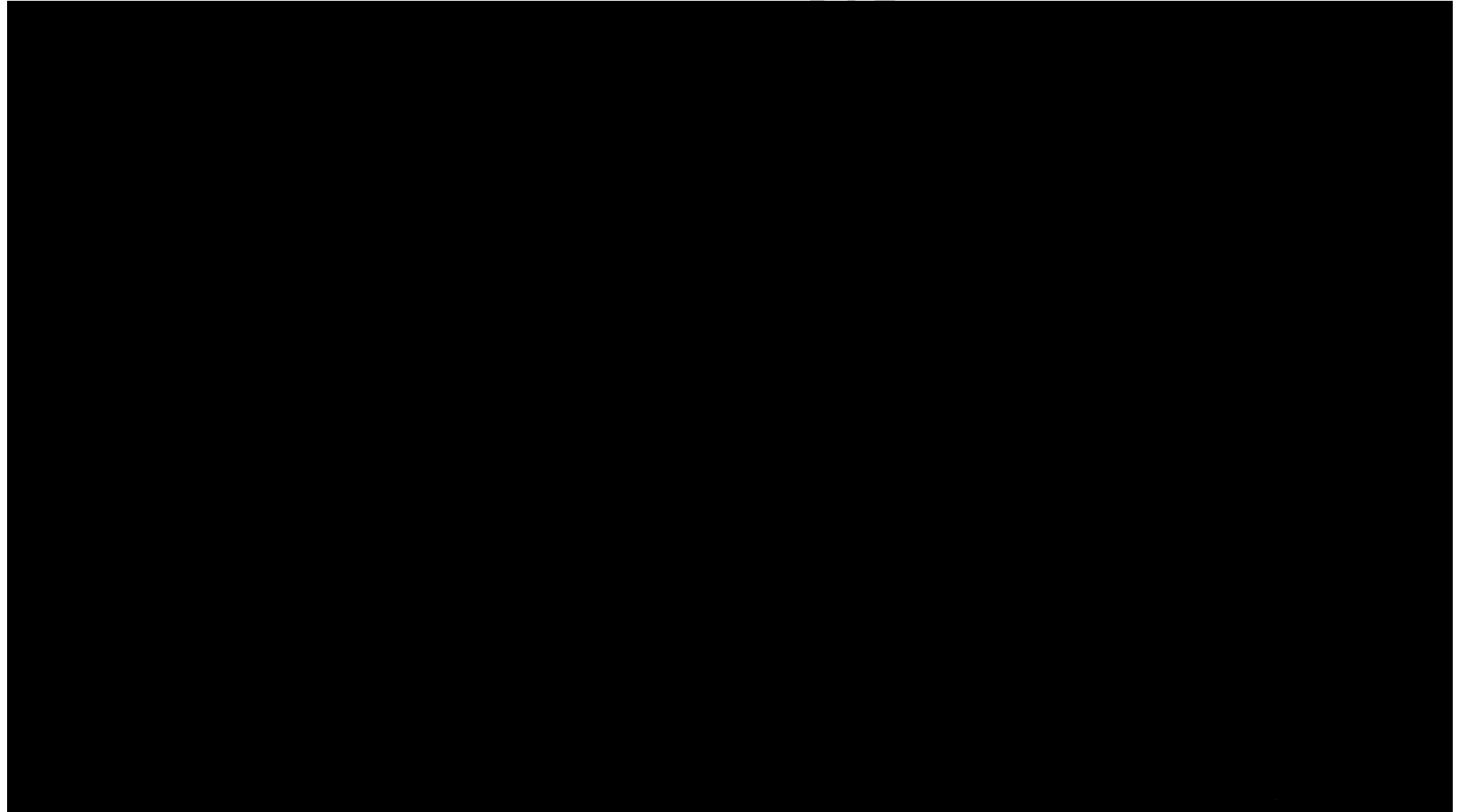
**Model training:
in progress**



Development of automated scoring of welfare lesions

Stage 5 & 6: Carcass lesions: Identify lesions of significance to animal welfare within carcass sections

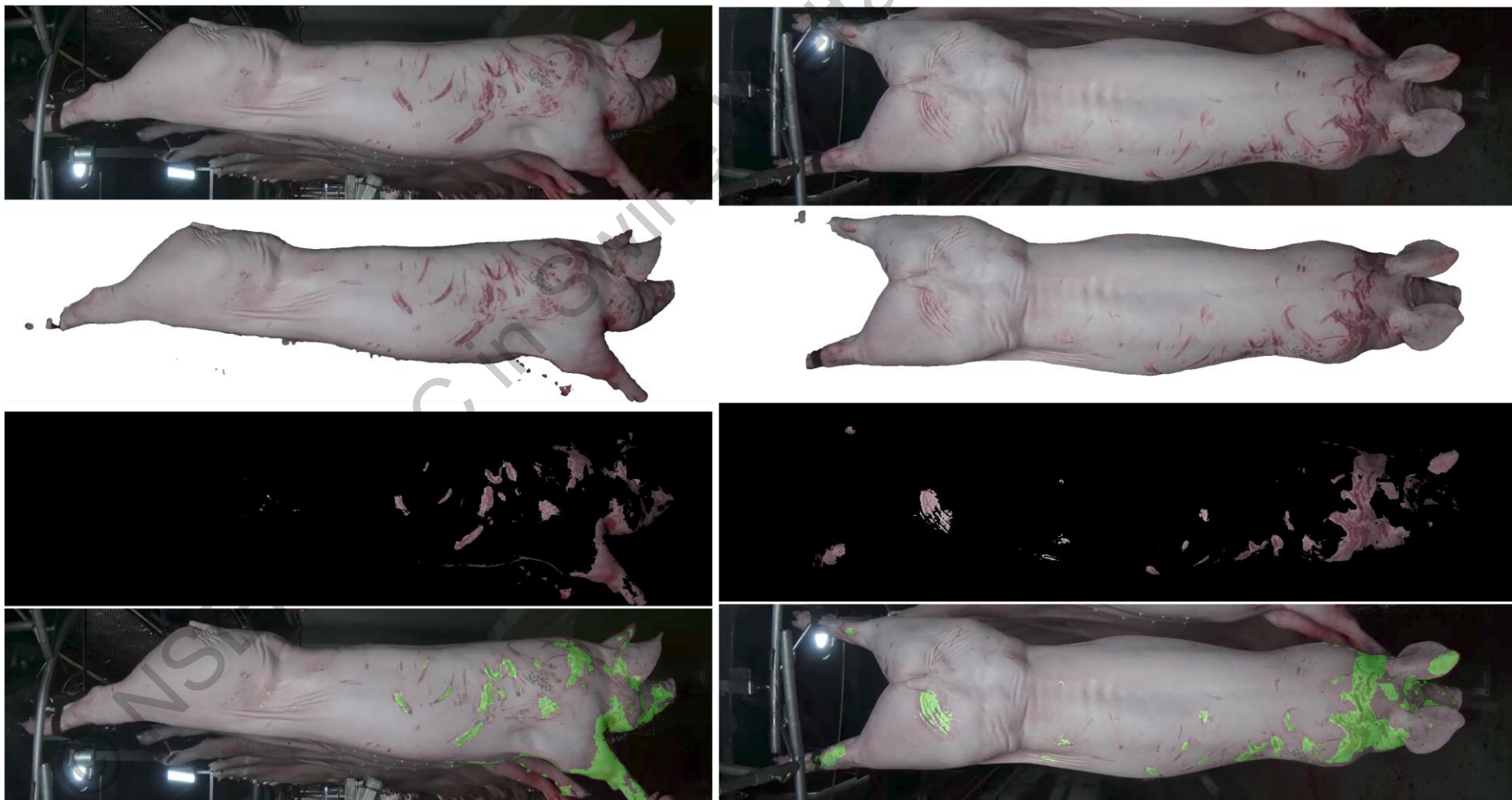
**Hernia
detection**



Development of automated scoring of welfare lesions

Stage 5 & 6: Carcass lesions: Identify lesions of importance to animal welfare within carcass sections

**Skin lesion
detection**



Successful automation → Potential for commercial level uptake

NSERC IRC in Swine Welfare: Results

What the Chair is doing for you

- Information & tools that the industry can employ to their advantage
- Receiving international recognition
 - Supports promotion of Canada as leader in pork production & quality
- Ability to elevate Canada's options & conversations on animal care
- Strong team: adaptable & responsive
 - Tech transfer (dissemination, workshops)
 - Presence at meetings, conferences
 - Consultancy
 - Social media – increase access to information resources

Research team and results active on social media now!

Fly over to our website

www.swinewelfare.ca

or scan the QR code



Swine Welfare Chair



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@swinewelfare_SK



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Information about current and past projects.

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Resources

Helping producers enhance their operations.

Learn more >

Renewal: NSERC IRC in Swine Welfare

- Interest in renewal: Demonstrates swine industry's commitment to welfare
- Conversations now happening
- Swine Welfare Chair committed to continue delivery of practical solutions for the Industry

Input on research areas of interest – Continue to let us know your needs

NSERC IRC in Swine Welfare: Supporting adoption

- Moving work forward:
Support adoption of concepts & technologies developed at commercial level

**Calling for producers & abattoirs to come forward to
participate in adoption**

- **Implementation in commercial production systems:**

- Goal 1 – Strategic management modifications in early life
- Goal 2 – Support play behaviour
- Goal 4 – Test AI technology in different abattoirs (install cameras)



**Summer
2024**

Beyond: NSERC IRC in Swine Welfare

Address sow mortality:

Identify risk factors & provide advice on mitigation

To start in summer 2024

Thank you to program funders



© MRC in Swine Welfare

Thank you for listening!



Research team and results active on social media now!

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