Injury Prevention in Pig Barns

Catherine Trask  November 13 2012
Thank you to collaborators:

Julia Wellman, University of Regina Kinesiology
Overview

• What is ergonomics?
• How does workplace injury impact the pork industry?
• What causes injury?
• What are the main risks of pig farming tasks?
• What are the best practices for controls?
Introduction to Ergonomics
What is Ergonomics?

The scientific discipline concerned with the understanding of interactions among humans and other elements of a system, and the profession that applies theory, principles, data and methods to design in order to optimize human well-being and overall system performance.

-International Ergonomics Association
History of Ergonomics

• Started with the ‘efficiency movement’ and ‘scientific management’
• Efficiency of different shovel sizes on coal shoveling
• Focussed on maximum output with minimum cost
• ‘Time and motion’ studies on production lines led to work specialization and setting speeds for assembly lines
• Great for production, originally not so good for health
What is ergonomics?

• The study of humans doing work
• Real-world, applied, problem-solving
• Interdisciplinary: engineering, biomechanics, design, psychology, physiology, sociology/anthropology, economics
• Answers the questions:
  • Is this task (workstation, tools) ok?
  • How much is too much?
  • What causes injury, how can we prevent it?
Injury rates as a business performance indicator
How is injury relevant to the pork industry?

Profit = Revenue – Loss

- Loss can come from:
  - Elevated Workers’ Compensation rates
  - Sick leave and absenteeism
  - Worker turnover
  - ‘Presenteesim’ (low productivity)
- Musculoskeletal injury increases all of these
- Lots of attention is spent on production performance, but less on OH&S
Is injury a big problem?

- Musculoskeletal disorders in Sask:
  - 30% of all $228 million in WCB claims cost
  - $68 million in 2010
  - 34% of MSD claims costs are for the back
  - 20% for the shoulder
  - WCB claims rate in ‘Light Agricultural Operations’ is about **twice** the provincial average
Scientific studies on pig barn injuries

- Danish swine workers: most common body parts were back (60%), neck (32%), and shoulders (20%) (Denmark, Christensen et al. 1992).

- Swedish swine workers: ‘any MSD’ was 78%, most commonly in the upper extremities (62%) and the back (57%) (Sweden, Kolstrup, Stal et al. 2006)

How does this compare to Saskatchewan rates?

- Conducted a survey in 5 Saskatchewan pig barns to find out...
Worker-reported MSD (last 12 months)

- Neck: 55%
- One or both shoulders: 55%
- One or both elbows: 33%
- One or both hands: 57%
- Upper back: 43%
- Lower back: 79%
- One or both hips/thighs: 46%
- One or both knees: 52%
- One or both ankles: 29%
- Any body area: 92%
- Multiple body areas: 73%
### What kind of impact on work? (last 12 months)

<table>
<thead>
<tr>
<th>Body Area</th>
<th>Impact %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neck</td>
<td>14%</td>
</tr>
<tr>
<td>One or both shoulders</td>
<td>38%</td>
</tr>
<tr>
<td>One or both elbows</td>
<td>19%</td>
</tr>
<tr>
<td>One or both Hands</td>
<td>29%</td>
</tr>
<tr>
<td>Upper Back</td>
<td>25%</td>
</tr>
<tr>
<td>Lower Back</td>
<td>52%</td>
</tr>
<tr>
<td>One or both hips/thighs</td>
<td>20%</td>
</tr>
<tr>
<td>One or both knees</td>
<td>23%</td>
</tr>
<tr>
<td>One or both ankles</td>
<td>20%</td>
</tr>
<tr>
<td>Any body area</td>
<td>58%</td>
</tr>
<tr>
<td>Multiple body areas</td>
<td>46%</td>
</tr>
</tbody>
</table>
WCB Claims - type

- Shoulder: 23%
- Back: 15%
- Hand: 11%
- Foot: 5%
- Glasses: 3%
- Finger: 2%
- Ankle: 1%
- Leg: 2%
- Knee: 13%
- Multiple: 2%
WCB claims by months of service

More than half the claims occur in the first 18 months

Opportunity for training and supervising new workers
WCB Rates by barn type

WCB claim rates (per FTE per yr) by Barn type

- Breed/farrow and grow/finish are significantly higher than nursery and integrated.
Managing injury

Profit = Revenue – Loss

• At the end of the day, profits increase when:
  • Revenue increases
  • Loss decreases

• Safety should factor into performance evaluations of a barn or unit
• This requires systematic and consistent record keeping
• Propose an industry-wide standard for injury log records
**Pig Farm Incident Logbook Entry Form**

<table>
<thead>
<tr>
<th>Name</th>
<th>Sex</th>
<th>Date</th>
<th>Job title</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>D</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>F</td>
<td>D</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Barn facility**

<table>
<thead>
<tr>
<th>Time of incident</th>
</tr>
</thead>
<tbody>
<tr>
<td>________<strong>:</strong>____</td>
</tr>
</tbody>
</table>

**Department**

<table>
<thead>
<tr>
<th>Body part injured (check all that apply)</th>
</tr>
</thead>
<tbody>
<tr>
<td>□ Hand</td>
</tr>
<tr>
<td>□ Shoulder</td>
</tr>
<tr>
<td>□ Leg (includes ankle)</td>
</tr>
<tr>
<td>□ Eye</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Nature of Injury (check all that apply)</th>
</tr>
</thead>
<tbody>
<tr>
<td>□ Sprain or strain</td>
</tr>
<tr>
<td>□ Needlestick</td>
</tr>
<tr>
<td>□ Burn</td>
</tr>
<tr>
<td>□ Other: ____________________________</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Location at that facility</th>
</tr>
</thead>
<tbody>
<tr>
<td>□ Yard</td>
</tr>
<tr>
<td>□ Laundry</td>
</tr>
<tr>
<td>□ Mill</td>
</tr>
<tr>
<td>□ Medication room</td>
</tr>
<tr>
<td>□ Pig Room</td>
</tr>
<tr>
<td>□ Load in or hallway</td>
</tr>
<tr>
<td>□ Coffee room</td>
</tr>
<tr>
<td>□ Bin</td>
</tr>
<tr>
<td>□ Vehicle</td>
</tr>
<tr>
<td>□ Office</td>
</tr>
<tr>
<td>□ Utilities room</td>
</tr>
<tr>
<td>□ Crate or Pen</td>
</tr>
<tr>
<td>□ Dead room</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Task being performed at the time of incident</th>
</tr>
</thead>
<tbody>
<tr>
<td>□ Moving pigs</td>
</tr>
<tr>
<td>□ Pressure washing</td>
</tr>
<tr>
<td>□ Pulling pits</td>
</tr>
<tr>
<td>□ Treatments/vet care</td>
</tr>
<tr>
<td>□ Culling/handling deads</td>
</tr>
<tr>
<td>□ Getting in/out of pens</td>
</tr>
<tr>
<td>□ Marketing/tattooing</td>
</tr>
<tr>
<td>□ Semen collection</td>
</tr>
<tr>
<td>□ Maintenance with tools</td>
</tr>
<tr>
<td>□ Shower/laundry</td>
</tr>
<tr>
<td>□ Processing piglets</td>
</tr>
<tr>
<td>□ Breeding</td>
</tr>
<tr>
<td>□ Working with feed</td>
</tr>
<tr>
<td>□ Birthing/C-section</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Was tool or equipment used</th>
</tr>
</thead>
<tbody>
<tr>
<td>□ Yes</td>
</tr>
<tr>
<td>□ No</td>
</tr>
</tbody>
</table>
Injury Mechanisms
What causes Injury?

From Sask OH&S Regs...
81(1) In this section, “musculoskeletal injury” means an injury or disorder of the muscles, tendons, ligaments, nerves, joints, bones or supporting vasculature that may be caused or aggravated by any of the following:

(a) repetitive motions;
(b) forceful exertions;
(c) vibration;
(d) mechanical compression;
(e) sustained or awkward postures;
(f) limitations on motion or action;
(g) other ergonomic stressors.

Demands vs Capacity

A single exposure that does not exceed tissue tolerance
Demands vs Capacity

A single exposure that does exceed tissue tolerance

Worker’s tissue tolerance level
Demands vs Capacity

exposure over time

Worker’s tissue tolerance level

Repeated exposures that decrease tissue tolerance
Demands vs Capacity

Complicated series of exposures mixed with recovery, varying tissue tolerance
Spinal Compression Limits

- Strict limits are rare in ergonomics
  - Exception: Spinal compression
- Can estimate using biomechanical software
- Action Limit: 3400 Newtons (762lbs)
  - Safe for 99% men and 75% women
- Maximum Limit: 6800 Newtons (1524lbs)
  - Safe for 25% of men and 1% of women
Pig Barn Tasks: Risk factors and ideas for prevention
Biomechanical Methods

- 19 workers were filmed for 30-120 minutes each during different tasks
- Object weights and push/pull forces were assessed using a Shimpo force gauge
- Pig weights were estimated
Video Review Methods

- Analyze the video for each task
  - Time the work cycles
  - Quantify key movements and postures
    - Back bends $>45^\circ$
    - Shoulder lifts $>90^\circ$
    - Lifts, pushes, pulls
    - Hand grips

- Take snapshots of heavy events
  - Use software to estimate forces and strength requirements
Breeding

- 7 days per week, 3.5 hours per day
- Average 8 min per sow
- 0.24 shoulder lifts/min
- 2.3 back bends/min
- 7.1 hand grips/min

Risk of Interest
- Static back bending – 50% of the time is bent forward

**3DSSPP - Status - breeding - Frame 1**

- Hand Forces (N)
  - Hand Locations (cm)
    - Horizontal: 68.4 64.9
    - Vertical: 70.6 71.9
    - Lateral: -6.4 8.0

- 3D Low back Compression (N)
  - L4/L5: 1945 N

- Strength Percent Capable (%)
  - Wrist: 99
  - Elbow: 100
  - Shoulder: 100
  - Torso: 97
  - Hip: 86
  - Knee: 98
  - Ankle: 88

Balance: Unacceptable
Coef. of Friction: ...
Feeding

- 4-5 times per day, 15-20 minutes
- 1 shoulder lifts/min
- 10 back bends/min
- 13 hand grips/min

Risk of Interest
- Repetitive back bending
- Repetitive hand gripping
Treatments and vaccination

- 6 times per week, 2 hrs each day
- 3 shoulder lifts/min
- 1.6 back bends/min
- 12 hand grips/min

Risk of Interest
- Static back bending
- Repetitive hand gripping

1968 N
1869 N
Pressure washing

- 6 times per week, 4hrs each day
- 1 shoulder lifts/min – but sustained
- <1 back bends/min
- 3 hand grips/min

**Risk of Interest**
- Static shoulder lifting
- Static hand gripping

2114 N
Sorting piglets

- 5 times per week for 2 hrs
- Sorting 2 pigs /min
- 3.5 shoulder lifts/min
- 8.2 back bends/min
- 15 hand grips/min

**Risk of Interest**
- Repetitive back bending
- Repetitive gripping

![Image showing anthropometry and forces](image.png)

**Hand Forces (N)**
- Left: 54.9
- Right: 54.9

**Hand Locations (cm)**
- Horizontal: 14.1, 30.2
- Vertical: 70.6, 79.7
- Lateral: -17.4, 16.2

**3D Low back Compression (N)**
- L4/L5: 2166N

**Strength Percent Capable (%)**
- Wrist: 96
- Elbow: 98
- Shoulder: 98
- Torso: 92
- Hip: 51
- Knee: 70
- Ankle: 83
Processing piglets

- 6 times per week for 4 hrs
- About 8 minutes per piglet
- 3 shoulder lifts/min
- 2.5 back bends/min
- 28 hand grips/min

Risk of Interest
- VERY Repetitive gripping

Potential solutions
- Keeping processing tools sharp and clean to minimize cut force
- Collaborate with workers to update cart – minimize reaching and re-gripping
Moving Deads

- 2 times per week for ~30 min
- About 5 min/pig to load out
- 0.5 shoulder lifts/min – but sustained
- 3.5 back bends/min
- 11 hand grips/min

Risk of Interest
• HEAVY loading on the back and shoulders

Potential solutions
- A winch over the dead room door to assist with load out
- Electric winch on the deads cart
- Develop safe lifting policy (compare to health care industry)
Designing Ergonomic Controls
Why don’t all new safety practices work?

- Odd duck
  - new equipment shows up without any supporting training, policy, introduction, or worker input

- Inconsistent reinforcement
  - 2 hour training cannot overshadow the peer-reinforcement of supervisor and peers

- Poor buy-in
  - lots of reasons – need to motivate change

- Habit and memory
  - need to learn and remember the new process
Hierarchy of Controls

- Pragmatic: What can we change?
- Example control: train baggage handlers in safe lifting techniques

- The flight loading environment includes tight spaces where ‘lifting with the knees’ isn’t possible...
  - consider the work conditions and process
Hierarchy of Controls

What is the best way to limit exposure to a hazard?

1. Eliminate the hazard
2. Substitute the hazard
3. Engineering controls
4. Administrative controls
5. PPE- personal protective equipment
Hierarchy of Controls in Ergonomics

- **Engineering**
  - Requires planning and investment for the employer
  - Requires very little from the worker
  - Often improves productivity

- **Administrative**
  - Can be integrated into work process, but often rely on workers following the right procedure

- **PPE**
  - Not really an option for ergonomics
  - (back belts are not PPE)
Questions and comments?

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Biomechanical Modeling Software

- Biomechanical modeling software (3DSSPP from University of Michigan)
- Worker inputs
  - Sex, height, weight
- Task inputs
  - Measured force
  - Posture from the image
Scientific reports on pig barn tasks

- Pinzke et al 2003 cite catching and lifting piglets as the worst job
  - Repetitive bending and lifting
- Kolstrup et al 2006 report cleaning, piglet processing, and sorting piglets have the highest reported exertion levels
  - Repetitive hand gripping, lifting and bending
- Christensen et al 1992 measured duration of back bending and found most tasks had >40% bent >20 degrees
  - Long duration in awkward posture