Respiratory Disease and Pen Microenvironments in Calf Barns

Rebecca Brotzman, DVM
Ken Nordlund, DVM
Naturally ventilated calf barns
- Individual pens
- Solid or mesh sides
- +/- Pen covers
- Variable bedding
Respiratory Disease
“We don’t have much respiratory disease”

- Frequently overlooked because “appetite” is used as indicator of health
- Use of clinical calf scoring system increases diagnosis prevalence
  
  *Scoring system developed by Dr. Sheila McGuirk:*
  
  http://www.vetmed.wisc.edu/dms/fapm/fapmtools/calves.htm

- Use of ultrasound to identify lung lesions shows an even greater prevalence

  *T. Ollivett, PhD studies at University of Guelph*
Importance of growth rate pre-weaning

• Weight gain during first 50 days of life has huge effect on adult milk yield

• Difference of 1 kg (2.2 lb) Average Daily Gain during days 1-50 yields an additional 850 kg (1,800 lb) of milk in first lactation
  • Soberon et al, J. Dairy Sci., 2012

• Calves “treated” for respiratory disease showed major reduction in adult milk yield
Field trial to examine risk factors

Selection criteria for barns:

- Natural ventilation
- Single calf pens
- Minimum of 15 calves on milk
- Current health status “typical” for barn
- Trial conducted Jan-Mar 2004
Data collected

- Respiratory scores -15 or more nursing calves
- Airborne bacterial counts (Total cfu & coliform) in pens and alleys
- Ammonia in pens
- Temperature & humidity – inside and outside
- Bedding depth and dry matter
- Building and inlet dimensions
- Animal counts
- Outdoor wind speed & direction, etc…..
## Calf Respiratory Scoring Criteria

<table>
<thead>
<tr>
<th>Rectal temperature</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
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<tbody>
<tr>
<td>100-100.9</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>101-101.9</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>102-102.9</td>
<td>2</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>≥103</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>3</td>
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</table>

<table>
<thead>
<tr>
<th>Cough</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
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<tbody>
<tr>
<td>None</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Induce single cough</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Induced repeated</td>
<td>2</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>spontaneous cough</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>3</td>
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<tr>
<td>Repeated</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>spontaneous coughs</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>3</td>
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<table>
<thead>
<tr>
<th>Nasal discharge</th>
<th>0</th>
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<tbody>
<tr>
<td>Normal serous</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>discharge</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Small amount of</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>unilateral cloudy</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>discharge</td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>Bilateral, cloudy</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>or excessive mucus</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>discharge</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Copious bilateral</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>mucopurulent</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>discharge</td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

Scoring system developed by Dr. Sheila McGuirk - [http://www.vetmed.wisc.edu/dms/fapm/fapmtools/calves.htm](http://www.vetmed.wisc.edu/dms/fapm/fapmtools/calves.htm)
## Calf Respiratory Scoring Criteria

<table>
<thead>
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<th></th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
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</thead>
<tbody>
<tr>
<td><strong>Eye scores</strong></td>
<td><em>Normal</em></td>
<td>Small amount of ocular discharge</td>
<td>Moderate amount of bilateral discharge</td>
<td>Heavy ocular discharge</td>
</tr>
<tr>
<td>Eye droop score</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Slight unilateral droop</td>
<td></td>
<td>Head tilt or bilateral droop</td>
<td></td>
</tr>
</tbody>
</table>

A cumulative score of 5 or more points is considered to be a case of respiratory disease

Scoring system developed by Dr. Sheila McGuirk - [http://www.vetmed.wisc.edu/dms/fapm/fapmtools/calves.htm](http://www.vetmed.wisc.edu/dms/fapm/fapmtools/calves.htm)
Percentage of calves scored 5+

Lago et al., J Dairy Sci 89:4014, 2006
Data collected

- Respiratory scores - 15 or more nursing calves
- Airborne bacterial counts (Total cfu & coliform) in pens and alleys
- Ammonia in pens
- Temperature & humidity – inside and outside
- Bedding depth and dry matter
- Building and inlet dimensions
- Animal counts
- Outdoor wind speed & direction, etc…..
Typical values

- Outdoor air: 100 – 1,000 cfu/m$^3$
- Clean office air: 1,000 - 2,000 cfu/m$^3$
- Well-ventilated barn: 10-15,000 cfu/m$^3$
Ventilation Findings

- Median barn ventilation rate was 5.5 changes per hour (range 0-93 ach) *assistance of Brian Holmes & David Kammel
- Pen air NH3 avg 2 ppm (range 0-4 ppm)
- Alley cfu/m3 associated with barn ventilation rate $P<.0001$
- Pen cfu/m3 were NOT associated with barn ventilation rate
- Pens are microenvironments within the barn
Service alley cfu/m³ associated with barn ventilation rate

\[ P < 0.0001 \]

*Pen* cfu/m³ *NOT* associated with barn ventilation rate

This barn may be well ventilated, but that means nothing in this pen!

*My “Microenvironment”*

*Lago et al., J Dairy Sci 89:4014, 2006*
Total airborne bacterial cfu/m$^3$ in PEN associated with prevalence of respiratory disease \( P \leq 0.003 \)

*Association is not causation...*

_Lago et.al., J Dairy Sci 89:4014, 2006_
Airborne bacterial counts

- Potential marker for microbial cell wall agents
- Cause inflammation, suppress immunological defenses
- Bacterial source agents
  - Endotoxin in Gm-, peptidoglycan in Gm+, and enzymes
- Fungi & mold source agents
  - β-glucan, chitin, and enzymes
Factors to ↓ airborne bacteria in pens

1) Lower temperature  $P<0.003$

2) Larger pens  $P<0.02$
   > 30 square feet

3) Fewer solid sides  $P<0.006$

Lago et.al., J Dairy Sci 89:4014, 2006
Pen Size & No. Solid Sides

- Box factor 1, straw bedding
- Box factor 3, straw bedding

Pen area, ft²

0 to 2 solid panels around calf
4 solid panels around calf
Key factors for respiratory health

1) Nesting in deep bedding \( P<0.002 \)

2) Low pen airborne bacteria counts \( P<0.003 \)
   \( \text{Total bacterial counts significant} \)
   \( \text{Coliforms (EMB) not significant} \)

3) Solid panel between calves \( P<0.003 \)

Lago et al., J Dairy Sci 89:4014, 2006
Thermoneutral zone

Newborn calf: 50-78°F (10 to 26°C)
Month old calf: 32-73°F (0 to 23°C)

Study conditions 19-54°F (-7 to 12°C)
Nesting score = 1

Legs entirely visible when lying down
Nesting score = 2

Legs *partially* visible when lying down
Nesting score = 3

Legs generally not visible when lying down
Bedding

Lago et al., J Dairy Sci 89:4014, 2006

No nesting

Deep nesting

Airborne bacteria cfu/m³ x 1000

Prevalence of respiratory disease

Nesting score 1, mesh sides
Nesting score 2
Nesting score 3
Key factors for respiratory health

1) Nesting in deep bedding  $P<0.002$

2) Low pen airborne bacteria counts  $P<0.003$
   
   Total bacterial counts significant
   Coliforms (EMB) not significant

3) Solid panel between calves  $P<0.003$

Lago et al., J Dairy Sci 89:4014, 2006
Mesh sides

Solid sides

Prevalence of respiratory disease

Airborne bacteria cfu/m$^3$ x 1000

Lago et al., J Dairy Sci 89:4014, 2006
Field Study Results Summary

(a.k.a. “The story of the tubes”)

- ↓ respiratory disease with lower airborne bacterial counts in pen

- Confounding finding:
  - Solid panels between calves ↑ airborne bacteria counts
  - Solid panels ↓ risk of respiratory disease

- Stimulated work to develop a “new generation” of positive pressure tubes to push fresh air between panels
“New Generation” Tubes

• Not the tubes of the 1980’s!
• Supplement natural ventilation, not recirculation
• Technical differences in tube design
  – Entirely fresh air without recirculation
  – Uniform discharge along the length
  – “Throw” distance calculated to avoid drafts
• Accept the reality of cold air
Temperature Chart Outside and Inside Two Calf Barns Over 4 Days

Degrees F

1/19/11 12:00 PM
1/20/11 12:00 PM
1/21/11 12:00 PM
1/22/11 12:00 PM
1/23/11 12:00 PM
1/24/11 12:00 PM
1/25/11 12:00 PM

-15
-10
-5
0
5
10
15
20
25
30
35

Natural ventilation only
Natural ventilation plus PP tube
Outside the barns
## Temperature data

<table>
<thead>
<tr>
<th></th>
<th>North Barn - With Tube</th>
<th>South Barn</th>
<th>Outside</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temp. (F), Min.</td>
<td>2.0</td>
<td>2.3</td>
<td>-10.1</td>
</tr>
<tr>
<td>Temp. (F), Max.</td>
<td>47.7</td>
<td>50.3</td>
<td>49.4</td>
</tr>
<tr>
<td>Temp. (F), Ave.</td>
<td>23.1</td>
<td>23.0</td>
<td>17.0</td>
</tr>
</tbody>
</table>
Natural ventilation with curtain sidewalls and open ridge

Supplemental positive pressure ventilation tube

Very healthy calves!
It looks somewhat like a calf barn, but I can’t spot the tube!
Group pen, automatic feeder calf barns
Tubes in old stall barn retrofitted for calves
Tube in open-front weaned heifer barn
Tube in dead-ended “BANK” barn
The Guide to Welfare Friendly Dairy Cattle Housing

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Upcoming Events

- **2014 PDPW Business Conference**
  - **Home Sweet Home for Heifers and Post-weaned Calves**
    Dr. Rebecca Brotzman, Associate Outreach Specialist for the Dairyland Initiative, will discuss the important components of heifer housing such as facility size, feed and resting space, ventilation method, and grouping strategy for the transitioning, post-weaned calf through springing heifer.
  - **Finding and Targeting High Risk Fresh Cows**
    Dr. Gary Oetzel, Associate Professor in the Food Animal Production Section of the School of Veterinary Medicine at UW-Madison, will discuss approaches to detecting and managing healthy cows during the days leading up to calving.

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