Making decisions about new technologies on the dairy

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Bewildering number of choices/potential decisions in all aspects of managing a dairy

Larger capital investments

Modest capital investments
Adoption of management practices

- Increased milking frequency
  - 2X vs 3X vs 4X
  - 4X/2X or 4X/3X

- Adjusting dry period length
  - 40 days
  - No dry period?

- Calf management
  - Colostrum and early life feeding strategies

Nutritional management decisions

- Dry and transition cow programs
  - Controlled energy diets
  - Anion supplementation or use of a calcium binder
  - MP and AA formulation approaches

- Strategic supplementation of specific nutrients for transition cows
  - Rumen-protected choline
  - Chromium
  - Specific fatty acids

- Using improved forms of nutrients
  - Improved trace minerals

How can one sort through the decisionmaking process?

- Type 1 and Type 2 error in decisionmaking (Galligan)
  - Type 1 – “rejecting the null hypothesis when it is true”
    - Translation – making a decision to implement something and having it not work out
  - Type 2 – “accepting the null hypothesis when it is false”
    - Translation – failing to implement something that you should have implemented
Type 1 vs Type 2 error – which is the bigger risk?

It probably depends upon the size of investment / magnitude of commitment

What is the potential economic return and how will you monitor that?

- Partial budget
  - Changes in revenue or other benefits
    - What are the assumptions?
    - How soft are the numbers?
    - What is the sensitivity of economic outcome to the projected changes?

- Changes in investment
  - What are the assumptions?
  - How soft are the numbers?
  - What is the sensitivity of economic outcome to level of investment?

What do we need to think about when considering adoption of management practices or nutritional strategies and technologies?

- Biology and potential mode of action
  - Some things well-understood
    - Examples: milking frequency, rbST
  - Emerging or integrative areas less well-understood
    - Gut integrity/leaky gut
    - Oxidative metabolism
    - Immune/inflammatory mechanisms

- How well will it fit the management system?
  - Facilities, management style, people

- Projected economic returns, assumptions, and sensitivity (see previous)

- What is the “opportunity cost” for labor or management?

- Managing expectations – no silver bullets!!!
What is in the “constellation of evidence”?

• Biology and potential mode of action (see previous)

• Research and demonstration
  • Controlled, peer-reviewed University or Research Center work
  • Replicated (within dairy) commercial farm-based studies
  • Replicated (across dairies) commercial farm-based studies/demonstration
  • Meta-analytic approaches

• Practicality of implementation

• Experience

A few “watch out’s” with controlled work

• Cow removal

• How well did the controls perform?

• Replication/statistical power
  • Biologically significant/economically important vs. statistical significance

• Internal consistency of data within individual studies

• Are all of the available results across multiple studies being presented/shared in some form?
  • Patterns of response – recognize heterogeneity of response
  • Meta-analysis helps to formalize
  • Helps to manage expectations?

How well did the controls perform?

Two examples –

Increased milking frequency (IMF) of fresh cows

Monitoring/treatment protocols for hyperketonemia

Increased milking frequency during early lactation only

- Most readily implemented on farms where early lactation cows can be separated from rest of herd
- 7% increase in milking capacity and labor for 4X/2X compared to 30% increase for 3X compared with 2X
  - McFadden and Wall (2007)
- Two major IMF schemes
  - 6X/3X
  - 4X/2X (beginning and end of each milking)
- Other variations exist (e.g., 4X/3X)
- Minimal economic investment (low downside risk)

<table>
<thead>
<tr>
<th>Author</th>
<th>Milking scheme</th>
<th>Length of IMF (DIM)</th>
<th>Milk yield response (Kg/d)</th>
<th>Fat yield response (Kg/d)</th>
<th>Prot. Yield response (Kg/d)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bar-Peled et al., 1985</td>
<td>6x-3x</td>
<td>1-42 d</td>
<td>8.4</td>
<td>0.03</td>
<td>0.2</td>
</tr>
<tr>
<td>Hale et al., 2003</td>
<td>4x-2x</td>
<td>1-21 d</td>
<td>3.5</td>
<td>0.02</td>
<td>0.15</td>
</tr>
<tr>
<td>Fernandez, 2004</td>
<td>4x-2x</td>
<td>1-46 d</td>
<td>3.5</td>
<td>0.02</td>
<td>0.15</td>
</tr>
<tr>
<td>Dahl et al., 2006</td>
<td>6x-3x</td>
<td>1-21 d</td>
<td>3.6</td>
<td>0.02</td>
<td>0.15</td>
</tr>
<tr>
<td>VanBaale et al., 2005</td>
<td>6x-3x</td>
<td>1-63 d</td>
<td>-1.7</td>
<td>-0.12</td>
<td>-0.02</td>
</tr>
<tr>
<td></td>
<td>63-308 d</td>
<td>-0.2</td>
<td>0.01</td>
<td>0.01</td>
<td></td>
</tr>
</tbody>
</table>

| Wall and McFadden, 2007 | 4x-2x | 1-21 d | 3.5 | nr | nr |
| Unilateral | 21-305 d | 1.8 | nr | nr |

Table 1. Milk production and composition of cows milked three times daily or six times daily during the first 6 weeks of lactation (Bar-Peled et al., 1985).

<table>
<thead>
<tr>
<th>Treatments</th>
<th>3X</th>
<th>6X</th>
<th>SEM</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Week 1-6 Postpartum</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Milk Production, kg/d</td>
<td>35.3</td>
<td>42.6</td>
<td>1.3</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Fat, %</td>
<td>3.28</td>
<td>3.16</td>
<td>0.09</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>Protein, %</td>
<td>3.13</td>
<td>3.07</td>
<td>0.07</td>
<td>NS</td>
</tr>
<tr>
<td>Week 7-18 Postpartum</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Milk Production, kg/d</td>
<td>37.4</td>
<td>42.5</td>
<td>0.5</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Fat, %</td>
<td>2.89</td>
<td>2.81</td>
<td>0.03</td>
<td>NS</td>
</tr>
<tr>
<td>Protein, %</td>
<td>2.76</td>
<td>2.79</td>
<td>0.03</td>
<td>NS</td>
</tr>
</tbody>
</table>

Total lactational yield increased by ~ 1,500 kg for cows milked 6X/3X.
### Impact of Facility

<table>
<thead>
<tr>
<th>Parameter</th>
<th>3X</th>
<th>6X</th>
</tr>
</thead>
<tbody>
<tr>
<td># Cows in Pen</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average</td>
<td>39</td>
<td>44</td>
</tr>
<tr>
<td>Range</td>
<td>20−70</td>
<td>1−70</td>
</tr>
<tr>
<td>Walking Distance (meters)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>One way</td>
<td>51</td>
<td>123</td>
</tr>
<tr>
<td>Per day</td>
<td>307</td>
<td>1480</td>
</tr>
<tr>
<td>Time out of Pen (minutes)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average</td>
<td>195</td>
<td>390</td>
</tr>
<tr>
<td>Range</td>
<td>180−225</td>
<td>270−450</td>
</tr>
<tr>
<td>Time Milking (minutes)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Range</td>
<td>60−75</td>
<td>45−75</td>
</tr>
</tbody>
</table>

VanBaale et al., 2005

### Summary – Cornell research

- Early lactation IMF for the first 21 d postpartum increased yields of milk and milk components (~ 3.5 lb/d of component corrected milk) over first 210 DIM
- Four dairy farms varying in management schemes
- Minimum milking intervals ranging from 3.5 to 6 h
- All four farms responded with increased milk yield
- Early lactation IMF did not affect udder health as assessed by linear score
- Early lactation IMF did not appear to affect BCS during early lactation and had minimal effects on serum NEFA
- Serum BHBA concentrations were increased by early lactation IMF, but the proportion of cows categorized as subclinically ketotic (BHBA > 14 mg/dL) was not affected by treatment

Soberon et al., 2011. J. Dairy Sci. 94:4398–4405

### Bar napkin partial budget

- Assume:
  - 3.5 lb/d component-corrected milk response, 305-d lactation
  - $16/100 lb milk, $0.12/lb of feed DM; 2.25 lb of milk/lb of DM
  - 10 min/cow/day increased labor for 21 d @ $10/h
- Increased revenue
  - 1067 lb of milk -- $170 per cow
- Increased cost
  - Labor -- $35 per cow
  - Feed -- 474 lb DM -- $57 per cow
- Net -- $78 per cow

Despite this, very little adoption of 4X/2X across 2X dairies.....
What about opportunity cost for labor and management?

Testing & Treatment Strategy

• No testing
  • All fresh cows given 5 days oral PG

• Test 3 times per week from 3 to 16 DIM
• Test 2 times per week from 3 to 9 DIM
• Test 1 time per week from 3 to 16 DIM
• Positive cows treated with Propylene Glycol
  • 300mL for 5 days

Assumptions

- Fresh cows
- Number days of treatment: 5
- Feed ($/lb dry matter): $0.11
- Price of milk ($/lb): $0.13
- BHBA strip cost: $1.53
- Propylene Glycol ($/dose): $1.00
- Treatment (cow/hr): 60
- Testing (cow/hr): 45
- Labor ($/hr): $13.50
- DA % (1st 30 DIM): 3.58%
- Risk Ratio DA (SCK vs non-ketotic): 17.56
- Cost of a DA: $583.74
- Cull % (1st 30 DIM): 8.45%
- Risk Ratio cull (SCK vs non-ketotic): 3.11
- Risk Ratio cull (PG vs control): 1.74
- Exchange cost for a replacement cow: $660.63
- lb milk/day (PG vs control): 2.0
- SCK incidence: 40%

McCart et al., 2014
### Partial Budget (average outcomes per 100 fresh cows)

<table>
<thead>
<tr>
<th>SCK Incidence</th>
<th>10%</th>
<th>20%</th>
<th>40%</th>
<th>60%</th>
<th>80%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treat all fresh cows 5d PG</td>
<td>($241)</td>
<td>$130</td>
<td>$873</td>
<td>$1,616</td>
<td>$2,359</td>
</tr>
<tr>
<td>Testing 2 x per week (3-9 DIM)</td>
<td>$(47)</td>
<td>$272</td>
<td>$909</td>
<td>$1,600</td>
<td>$2,185</td>
</tr>
<tr>
<td>Testing 3 x per week (3-16 DIM)</td>
<td>$(131)</td>
<td>$(297)</td>
<td>$504</td>
<td>$1,305</td>
<td>$2,107</td>
</tr>
</tbody>
</table>

McCart et al., 2014

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### Summary and conclusions

- Have a process and strive to be systematic
- Weigh the Reward-Risk
  - Type 1 vs Type 2 errors
  - Don’t let skepticism/fear of Type 1 error get in the way
- Determine the potential economic returns, assumptions, sensitivity
  - Be realistic about expectations and ability to monitor
  - No silver bullets – many responses that are biologically and economically meaningful may be difficult to measure
- Develop a “constellation of evidence”
- Be conscious of management system/practicality/opportunity cost

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