Goals in Calf Rearing

- Minimize health problems
- Rapid growth of frame size (skeleton and muscle)
- Develop the rumen and transition to functioning ruminant
- Smooth transitions between life stages
- Set up for optimal reproduction and high milk production later in life
Preweaning Gold Standards
Dairy Calf and Heifer Association

1. Mortality <3%
2. Morbidity (medical treatments)
   - Diarrhea <15%
   - Respiratory infections <10%
3. Double birth weight by 56 days
   Ex. 100 lbs (45.4 kg) → 200 lbs (90.7 kg)
   → 1.79 lbs/d (0.81 kg/d)

Newborn Management
Colostrum Management

• Quantifying transfer passive immunity (TPI)
• Quantity
• Quality
• Quickly
• sQueaky clean

Historical TPI Standards
Mortality and Morbidity in the US

NAHMS survey of farms raising heifers in the US
Lombard et al., 2020

New Transfer of Passive Immunity Standards

<table>
<thead>
<tr>
<th>TPI Category</th>
<th>Serum IgG (g/L)</th>
<th>Total Protein (g/dL)</th>
<th>Brix %</th>
<th>Target for herd (% of calves)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excellent</td>
<td>≥25.0</td>
<td>≥6.2</td>
<td>≥9.4</td>
<td>&gt;40</td>
</tr>
<tr>
<td>Good</td>
<td>18-24.9</td>
<td>5.8-6.1</td>
<td>8.9-9.3</td>
<td>~30</td>
</tr>
<tr>
<td>Fair</td>
<td>10.0-17.9</td>
<td>5.1-5.7</td>
<td>8.1-8.8</td>
<td>~20</td>
</tr>
<tr>
<td>Poor</td>
<td>&lt;10.0</td>
<td>&lt;5.1</td>
<td>&lt;8.1</td>
<td>&lt;10</td>
</tr>
</tbody>
</table>

32% of farms in NAHMS met this herd standard already
Serum collected 1-7 d after birth
Lombard et al., 2020
Probability of Survival

Lombard et al., 2020

Probability of Disease

Lombard et al., 2020
Measuring Transfer of Passive Immunity

- Use 12 clinically healthy 1-7 d old calves, or normal herd sampling
- Serum total protein refractometer or Brix refractometer
  **Colostrum replacer levels ~0.2 g/dL less for TP**

Feeding to Achieve Excellent Serum IgG

- >25 g/L or more of serum IgG
- **Single feeding**
  - 3.3 L colostrum by 2 h of age (286.7 g of IgG; ~87 g/L or 26% Brix)
  - Average serum IgG of 32.0 g/L
- **Multiple feedings**
  - 2.7 L by 2.8 h of age (226.6 g of IgG at the first feeding; 84 g/L)
  - Total amount of colostrum fed was 5.3 L
  - Total estimated IgG consumption of 421.2 g
  - Average serum IgG concentration was 33.9 g/L
Quantity

- 10% of calf body weight
- 3-4 qts (2.8-3.8 L) of high quality colostrum
- Additional colostrum and transition milk for next 3-4 feedings
- Colostrum or colostrum replacer should allow for 250-300 g of IgG consumption

Quality

Colostrometer
- Green > 50 g/L
- Good
- Poor

Brix Refractometer
- Good > 22% = 50 g/L

Mean colostrum quality for Holsteins averages ~74 g/L
(Morrill et al., 2012; Shivley et al., 2018)
Quickly

- Gut closure within 24 h
- Serum [IgG] ↓ by 0.32 mg/mL every hour following birth
- Apparent efficiency absorption (AEA) ↓ by 6 h
  - 0 h AEA ~ 51.8% vs. 6-12 h AEA ~35%
- < 2 h of life feed colostrum

***Goal: Get colostral antibodies to intestine before environmental bacteria get there!

Shivley et al., 2018; Fischer et al., 2018

No Difference in Method of Delivery

Desjardins-Morrissette et al., 2018
sQueaky Clean

Calving environment and colostrum collection procedures

• Bacteria double every 20 mins
  • Colostrum is a great food source for proliferation!
• Within 30 mins chill to < 60°F (15.5°C) before storage
• Storage type
  • Fresh
    • Use within 48 h
    • 33.8-35.6°F (1-2°C)
  • Frozen
    • Stored up to 1 year in frost-free freezer
    • One-time-use storage container
**Colostrum Replacer**

- Commercial replacers viable alternative
  - Do not use a supplement by itself!
- >150-200 g IgG at first feeding
  - Colostrum derived replacer
  - May require > 1 bag depending on brand
  - Read the label or ask for supporting info
- Have on hand in case fresh high quality colostrum not available
- If evaluating total proteins ~0.2 g/dL difference expected vs. maternal colostrum

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**Colostrum Effect on Calf Performance**

- Maternal vs. serum-derived colostrum
  - Similar IgG provided and passive transfer status
  - Calves fed MC↑ feed efficiency 1st 7 d life
- Maternal colostrum provided 2.1 vs. 4.2 qt
  - Increased ADG under similar management (1.8 vs 2.3 lbs)
- Interaction of colostrum (2.1 vs. 4.2 qt) and MR (limited vs ad lib)
  - 4.2 qt colostrum had ↑ pre- and postweaning ADG and ↑ feed intake postweaning

Jones et al., 2004; Faber et al., 2005; Soberon and Van Amburgh, 2011
Colostrum Provides More than IgG

<table>
<thead>
<tr>
<th></th>
<th>Unit</th>
<th>Colostrum</th>
<th>Milk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gross energy</td>
<td>MJ/L</td>
<td>6</td>
<td>2.8</td>
</tr>
<tr>
<td>Crude protein</td>
<td>%</td>
<td>14.0</td>
<td>3.0</td>
</tr>
<tr>
<td>Fat</td>
<td>%</td>
<td>6.7</td>
<td>3.8</td>
</tr>
<tr>
<td>Immunoglobulin G</td>
<td>g/L</td>
<td>81</td>
<td>&lt;2</td>
</tr>
<tr>
<td>Lactoferrin</td>
<td>g/L</td>
<td>1.84</td>
<td>Undetectable</td>
</tr>
<tr>
<td>Insulin</td>
<td>µg/L</td>
<td>65</td>
<td>1</td>
</tr>
<tr>
<td>Glucagon</td>
<td>µg/L</td>
<td>0.16</td>
<td>0.001</td>
</tr>
<tr>
<td>Prolactin</td>
<td>µg/dL</td>
<td>280</td>
<td>15</td>
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<tr>
<td>Growth hormone</td>
<td>µg/dL</td>
<td>1.4</td>
<td>&lt;1</td>
</tr>
<tr>
<td>IGF-1</td>
<td>µg/dL</td>
<td>310</td>
<td>&lt;1</td>
</tr>
</tbody>
</table>

Summarized by Van Amburgh, 2017; Odle et al., 1996; Blum and Hammon, 2000; Baumrucker and Blum, 2008; Bonnet et al., 2002; Farke et al., 2011

Maternal Colostrum “Jump-Start”

- Hormones
- Growth factors
- Bioactive factors

- Protein & energy utilization
  → Anabolic
- Development of GIT
  ↑ uptake nutrients
Feeding Transition Milk

Transition milk = Milking 2-6 after calving
• Provides ↑ nutrients, IgG, hormones, growth and bioactive factors vs. milk
  • Lower odds of health scores → associated with disease and infection
  • Increased villi height and SI surface area

Conneeley et al., 2014; Pyo et al., 2018; Fischer et al., 2019