Vaccination to Prevent Respiratory & Reproductive Disease in Dairy Cattle

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Bovine Respiratory Disease Complex

Reduced feeding efficiency & performance, high treatment costs & high mortality

The most at-risk cattle: young, newly received & highly stressed calves
## Dairy Heifers

### USDA, 2011

<table>
<thead>
<tr>
<th>Disease or disorder</th>
<th>Pct.</th>
<th>Std. error</th>
<th>Pct.</th>
<th>Std. error</th>
<th>Pct.</th>
<th>Std. error</th>
<th>Pct.</th>
<th>Std. error</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diarrhea, bloat (digestive)</td>
<td>25.3</td>
<td>(8.3)</td>
<td>18.2</td>
<td>(5.9)</td>
<td>71.8</td>
<td>(11.1)</td>
<td>0.8</td>
<td>(0.1)</td>
</tr>
<tr>
<td>Pneumonia (respiratory)</td>
<td>18.1</td>
<td>(5.9)</td>
<td>16.4</td>
<td>(5.7)</td>
<td>90.2</td>
<td>(6.5)</td>
<td>11.2</td>
<td>(2.5)</td>
</tr>
<tr>
<td>Navel infection</td>
<td>1.5</td>
<td>(0.5)</td>
<td>1.3</td>
<td>(0.5)</td>
<td>87.4</td>
<td>(8.0)</td>
<td>0.1</td>
<td>(0.1)</td>
</tr>
<tr>
<td>Lameness/injury</td>
<td>0.7</td>
<td>(0.3)</td>
<td>0.5</td>
<td>(0.2)</td>
<td>74.0</td>
<td>(12.7)</td>
<td>0.9</td>
<td>(0.3)</td>
</tr>
</tbody>
</table>

### Percentage of heifers that died as a result of the following disease/disorder during 2010, by heifer class

- Diarrhea, bloat, etc. (digestive): 1.4%
- Pneumonia (respiratory): 2.3%
- Navel infection: 0.4%
- Lameness/injury: 0.4%
- Mastitis: 0.0%

Heifer class:
- Preweaned heifers
- Weaned heifers
- Pregnant heifers

USDA, 2011
Bovine Viral Diarrhea Virus (BVDV)

Respiratory & Reproductive disease

Embryonic losses

Abortion

Congenital defects

Stillbirth
Bovine Viral Diarrhea Virus (BVDV)

Infection with NC BVDV ≤ 125 days of gestation

BVDV can cause the development of a Persistently Infected Calf
Bovine Herpes Virus 1. IBR

- Latent infection. Animals become carriers with no clinical disease.
- During stress virus reactivates (Infertility, abortion & respiratory disease).
- Infectious Bovine Rhinotracheitis, Pneumonia, brain inflammation.
- Abortion > 4 months, embryonic death and infertilty

Lesions in vagina & penis
Strategies to Prevent & Control Respiratory and Reproductive Disease

Biosecurity

Diagnosis

Vaccination
Vaccination is a powerful tool to prevent respiratory disease & reduce the use of antibiotics

**Vaccines are not 100% Effective !!!**

Many factors affect the immune response to vaccines
Antibodies coat the free virus particles

The virus cannot bind and infect the calves’ cells
1. T-cell receptor binds to peptide on MHC protein, becomes activated.

2. Activated T cells multiply, differentiate, and enter blood.
Modified-live vs Killed virus Vaccines

- Efficacy
- Safety
Respiratory Virus vaccines in the USA:

<table>
<thead>
<tr>
<th>MLV Vaccines</th>
<th>Killed Vaccines</th>
</tr>
</thead>
<tbody>
<tr>
<td>Replicate in the animal</td>
<td>Do not replicate. Need booster 21 d later</td>
</tr>
<tr>
<td>Stimulate cell mediated Immunity (CMI)</td>
<td>limited cell mediated immunity</td>
</tr>
<tr>
<td>Stronger and longer antibody response</td>
<td>Weaker and shorter antibody response</td>
</tr>
<tr>
<td>Could revert to virulence</td>
<td>Safe</td>
</tr>
<tr>
<td>Risk of contamination during production</td>
<td>Low risk of contamination</td>
</tr>
<tr>
<td>Can suppress the immune response</td>
<td>No suppression</td>
</tr>
<tr>
<td>Risk of abortion in pregnant animals</td>
<td>No risk of abortion</td>
</tr>
</tbody>
</table>
Vaccination of Dairy Calves

• Depends on management & colostrum consumed (quality & quant)

• Level of maternally derived antibodies (consumption & absorption).
Transfer of Maternal Antibodies through Colostrum

- Colostrum should contain at least 50 g IgG/L.
- 4 quarts (3.78 L) should be fed within 1-2 h of birth.
- Nurse bottle or esophageal feeder.
- Mal-absorption syndrome might also occur.
n=1989 dairy calves  
Mean: 27.6 OD  
SD: 20.7  
CV: 75.06%  

BHV-1 Antibody level  
>45% low antibody level

High proportion of calves (>40%) with low antibody levels

BVDV-1 Antibody  
>42% low antibody level (<32 OD)

n=1966 dairy calves  
Mean: 45.2 OD  
SD: 33.9  
CV: 75.01%
Neutralizing Antibody titer to BVDV-1 in dairy calves was around 1:16 at 3.5 months.
Vaccination of Dairy Calves

- High % neonatal dairy calves have failure of passive transfer (FPT)
- Dairy calves should be vaccinated ≤ 3 months of age.
Vaccination of young calves

- Newborn calves have a functional immune system able to respond to vaccines
- If calves are at high risk of disease due to FPT, priming vaccination during the first weeks of life is required.
However...

IM or SQ vaccination in dairy calves with Maternal Antibodies (MA)

Limited immune response due to interference by circulating antibodies.

Ellis et al., 2014: “No protection from clinical disease in calves vaccinated at 3-9 days of age and challenged with BRSV 11 weeks later”
Intranasal vaccines (IN):

- Development of Antibodies on the respiratory mucosa.
- Antiviral substances at the mucosa (e.g., interferons)
- Local protection against respiratory pathogens
Vaccination Protocol in high risk herds

**Priming IN MLV Vaccine**
(BoHV1, PI3 & BRSV) @ 2 weeks of age

**Booster SQ MLV vaccine**
(BVDV, BoHV1, PI3, and BRSV) @ 60-90 d after priming vaccination.
2 Vaccination of replacement heifers

- Should be vaccinated at least twice with MLV before breeding.
- Isolated from pregnant cows during and after vaccination.
- At least 3 weeks before synchronization and breeding.
Vaccination Protocol in Dairy Heifers

SQ MLV vaccine  SQ MLV vaccine  SQ MLV vaccine

1  2  3  6  12

Months
Vaccination of Dairy cows

- To achieve protection & induce increased antibodies in colostrum
- Cows at various reproductive stages. This limits vaccine selection
Vaccination of Dairy cows

- Maximal protection during the critical first 4 months of gestation
- Maximize duration of immunity & fetal protection.
- Revaccinate annually (before breeding & at Dry off).

https://www.munters.com
Vaccination Protocol in Dairy Cows

- **30 days post-partum**: SQ MLV vaccine
- **60 days pre-partum**: SQ MLV vaccine
How to optimize the response to vaccines?
Biosecurity

• Isolate new introductions for at least 2 weeks.
• Older calves can amplify infection & spread it to younger animals.
• Avoid crowding animals into large groups (<8 animals/group)
Biosecurity

- Isolate aborting cows and sick animals.
- Dispose fetus and placenta.
- Avoid standing water
- Ensure good air quality
Diagnosis: Prevalence & Infectious Pressure

2. Lab Diagnosis in dead & sick animals.
3. Systematic Diagnosis Program (pooled or individual samples)

“Diagnosis helps to define the type of vaccine & protocol”
Provide adequate nutrition

• Prevent Nutritional deficiency
  • Protein, Energy
  • Copper, Zinc, Selenium
  • Vitamin E, B vitamins
Trace Mineral Supplementation concurrently with vaccination

Effect on immune response

- 30 male Holstein calves (3 months of age)
- Vaccines:
  - 2mL of MLV vaccine (BHV1, BVDV1 & 2, BRSV, and PI3V) SQ
  - 2mL of attenuated-live (M. haemolytica & P. multocida) bacterin SQ
Randomly assigned to 1 of 2 groups:

1. **ITM (n=15)** received a SQ injection of ITM containing 15, 60, 10 and 5 mg/mL of Cu, Zn, Mn and Se at 1mL/100lb (**Multimin® 90**, Fort Collins, CO)

2. **Control (n=15)** received a SQ injection of sterile saline at 1mL/100lb

• 21 days after prime vaccination, calves received a booster of the same vaccines and a second injection of ITM or saline according to group
“ITM concurrently with MLV vaccination resulted in higher antibody titer to BVDV-1 on day 28 compared to the control group.”

“Higher proportion of calves in the ITM group (80.0%) showed sero-conversion to BVDV-1 on day 28 post vaccination compared to the control group (53.3%)."
BVDV-2 (strain 890) 5 mL with 1X10^5 CCID_{50}/mL
**Rectal temperature**

- **ITM & Vac**
- **Sal & Vac**
- **Control & NoVac**

* Statistical difference (P< 0.05)

**Health score**

- **ITM & Vac**
- **Sal & Vac**
- **Control & NoVac**

**Mean NASAL score at Day 5**

ITM&Vac lower than Sal&Vac P< 0.05

**Mean FECAL score at Day 8**

ITM&Vac lower than Sal&Vac P< 0.05
Live body weight & ADG

Average daily gain (ADG)

- ITM & Vac
- Sal & Vac
- Control & NoVac

*xy* differs between groups for each interval (P< 0.05 unless specified)
Vaccine handling

- Keep the vaccine cold
- Avoid contaminating the vaccine (keep clean needle in)
- Avoid using old product previously reconstituted
- Avoid disinfectants in multi-dose syringes
- Do not mix different vaccines or products in the same syringe.
Some other considerations...

- Do not vaccinate stressed or sick animals
- Vaccinate against agents involved in the disease (e.g. Pasteurella and Mannheimia or BVDV-1 and 2).
- Vaccination program will depend on infectious pressure.
- Administer vaccines using good hygiene.
- Pay attention to label instructions (route, booster, etc)
Thanks !!!