BRD is one of the most costly cattle diseases

BRD causes a significant % of pre-weaning calf deaths

<table>
<thead>
<tr>
<th>Cause</th>
<th>Beef</th>
<th>Dairy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calving Problems</td>
<td>33%</td>
<td>14%</td>
</tr>
<tr>
<td>Scours</td>
<td>17%</td>
<td>60%</td>
</tr>
<tr>
<td>Pneumonia</td>
<td>10%</td>
<td>24%</td>
</tr>
</tbody>
</table>

BRD causes a higher % of post-weaning calf deaths (USDA NAHMS)

<table>
<thead>
<tr>
<th></th>
<th>Beef Feedlot</th>
<th>Beef Replacement</th>
<th>Dairy Replacement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Digestive</td>
<td>13%</td>
<td>7%</td>
<td>14%</td>
</tr>
<tr>
<td>Respiratory</td>
<td>64%</td>
<td>7%</td>
<td>45%</td>
</tr>
</tbody>
</table>

BRD is caused by a sequence of events

- Interaction between pathogens, environment and the bovine host
  - Complex set of causal factors (ammonia, dust, stress, …)
- Final stage:
  - Pneumonia – acute, severe lung bacterial infection
  - Normal host flora in the wrong place

A disease of Man(agement) with clinical signs in the bovine
Clinical BRD cases are the “tip of the iceberg” red flags

The performance loss from subclinical disease is the same as that of clinical disease

469 steers followed from birth to feedlot to slaughter
• 35% (164) treated for BRD
• Pulmonary lesions at slaughter:
  – 78% (128) of treated steers
  – 68% (207) of untreated steers (subclinical)
  – 0.2 lb ADG reduction
  – 46 lb slaughter weight reduction
• Prevention is key to preventing production loss!

Due to the “iceberg phenomenon”, the ratio of subclinical to clinical cases is >10:1

BRD involves three major body locations

Five steps lead to BRD occurrence:

1. Stress and upper respiratory ciliary damage
2. Growth of normal bacteria in upper airways
3. Failure of the mucociliary protection mechanism to clear the ventral lung (gravity)
4. Proliferation of normal nasal bacterial flora (Mannheimia hemolytica A1) out of place in ventral lung
5. Vicious cycle of infectious inflammation in the dependent ventral lung

Stress + virus + bacteria = BRD
Bronchopneumonia involves a wide range of infectious agents, some primary and many secondary.

**Bacteria**
- Mannheimia (Pasteurella) hemolytica A1
- Pasteurella multocida
- H. Sommim
- Mycoplasma spp.
- Salmonella spp.
- A. pyrogenes
- Bacteroides spp.
- S. aureus
- Streptococcus spp.
- E. coli
- Klebsiella
- Chlamydia spp.
- Ureaplasma spp.

**Virus**
- BHV-1 (IBR)
- BRSV
- PI3
- BVD
- Adenovirus
- BHV-4
- Rhinovirus
- Reovirus
- Enterovirus

**Parasite**
- Dictyocaulus viviparus

*Mannheimia hemolytica* is the most common BRD pathogen.

**Bacteria Mannheimia (Pasteurella) hemolytica** serotype A1
- Normal bacterial flora in tonsillar crypts
- Spreads easily between calves
- Proliferates when:
  - Animal is stressed
  - Viral upper respiratory infection occurs
  - When certain feeds (silage) are fed

The mucociliary clearance mechanism removes particles from lungs.

**Based on Cilia waves:**
- Moves mucus from respiratory tract to throat
  - swallowed
- Moves at 1.5 cm / min with 1,500 waves / min
- Clears 90% of bacteria in 4 hrs
- Damaged by infectious agents, dust and fumes
  - diesel smoke, ammonia, corral dust

Ciliary damage slows or stops the clearance mechanism.

**Normal Cilia (Electron Micrograph)**

**IBR “Sewer pipe” Trachea**
In BRD normal bacteria proliferate, move to lung, are not cleared, and cause inflammation.

Bacteria are inhaled

Bacteria release toxins, attracting WBCs

Normal bacteria proliferate in Nasal Cavity

Lungs

Bacteria are inhaled

BRD lung damage is due to a vicious inflammatory cycle

M. hemolytica attracts white cells from bloodstream

M. hemolytica grows in the accumulating tissue fluid

M. hemolytica leukotoxin kills the white cells

White cell components cause lung damage, releasing tissue fluid and attracting more white cells

Animal’s natural response causes the lung damage!

Old whole antigen bacterins make the problem worse by attracting more white cells

What does classic BRD look like in the dead animal?

Necropsies are important for diagnosis

Pneumonia is in the ventral lung due to mucociliary clearance mechanism failure and gravity

Normal: pink-colored area

Abnormal: purple-colored area
In chronic cases, abscesses form that contain pus.

Pleural effusion (fluid accumulation) is abnormal.

Fibrinous pleuritis is abnormal.

Why is BRD a big problem for cattle compared to other species?

**Bovine Lungs (Compared to Mammalian Mean)**
- 25% of lung volume per unit body weight
- 50% of alveolar surface area
- 200% of resting tidal volume and 300% airflow rate
- “Shock” organ

**Consequences:**
- Reduced heat tolerance
- Decreased resistance to infectious, toxic or noxious substances
- High air flow rates transport more bacteria to lung

Because of the space occupied by the rumen, the cow has relatively small lung capacity.
Considering the disease components, how can you prevent BRD?

- **Stress**
  - predisposes to viral infections
- **Virus:** (PI3, IBR, BRSV)
  - Decreases mucociliary clearance
- **Bacteria:** (*M. haemolytica*)
  - Pneumonia inflammatory cascade

Many risk factors are controllable

**Examples:**

- **Immunity**
  - Increase colostral passive transfer
- **Nutrition**
  - Adequate immune active trace elements and vitamins
- **Environment**
  - Protect from wide temperature swings

In general, minimize all sources of stress

![Stress Image]

The risk factor web is complex

![Risk Factor Web]

Individual calf hutches are the best dairy calf housing

![Calf Hutches Image]

Control host and environmental risk factors for BRD

**At herd of origin:**

- wean, creep feed, perform surgeries at least 3 wks prior to shipment (dehorning, castrating)
- vaccinate against respiratory pathogens
- avoid nutrient deficiencies (Vit A,E,Se, Cu, Zn)

**During transport:**

- adequate energy prior to shipment
- avoid prolonged transit time
- avoid going through multiple auctions
“Shipping Fever” host and environment risk factors

At Feedlot:
- Avoid surgery and MLV vaccines on arrival
- Minimize mixing
  - Socialization stress, exposure to carrier animals
- Minimize large groups
- Avoid rapid introduction of high concentrate diets
- Avoid feeding NPN on arrival
- Antibiotics in water may decrease water intake
- Avoid temperature fluxes and high dust

Long transport, particularly through salesyards, is bad

Vaccines don’t work equally well in all animals

Bell-shaped “normal” distribution

Working in high dust is bad

BRD vaccination success depends on many factors

Bad management will overwhelm the best vaccine
Vaccines must be timed appropriately and boosted if needed

Considerations for choosing killed vaccines

**Killed Advantages:**
- Resistant to improper storage and handling
- Less likely to contain infectious contaminants
- Less immunosuppressive

**Killed Disadvantages:**
- Require two doses for protection
- Higher cost
- Narrower spectrum of protection against diverse strains
- Shorter duration of protection
- More likely to cause anaphylactic (allergic) reactions

Considerations for choosing modified live (MLV) vaccines

**MLV Advantages:**
- Require a single dose for protection
- Lower cost
- Broader spectrum and longer duration of protection

**MLV Disadvantages:**
- Must replicate to reach critical antigenic mass
- Easily killed by improper storage and handling
- More likely to contain infectious contaminants
- Often immunosuppressive, exacerbating other infections
- May cause disease in stressed animals
- If abortifacient, may cause abortion in pregnant animals

Vaccination can fail for many reasons

Store vaccines properly!

Handle vaccines properly!
Residual disinfectant will kill MLV vaccines

Be careful how syringes are disinfected when using MLV vaccines

Sterilize syringes by boiling

Read vaccine label claims carefully

- Be very skeptical of advertising claims
  - Advertising is essentially unregulated
- read labels very carefully
  - Note what they don’t claim
  - Note what they specifically claim
- A high titer is not necessarily evidence of protection against the disease!

Because vaccine labels are regulated by the USDA, label claims have specific meanings

Highest to lowest efficacy:
- Prevention of infection
  - Prevents colonization and replication
- Prevention of disease
  - Prevents > 80% of clinical cases but infection occurs
- Aid in disease prevention
  - Significantly reduces clinical cases but less than 80%
- Aid in disease control
  - Reduces severity or duration or delays onset
- Other claims
  - Reduces shedding

Contrast Pfizer package inserts:

- Ultrabac 7 (Clostridia bacterin-toxoid)
  - “Indications: For use in healthy cattle and sheep for the prevention of blackleg, . . .”
- Bovshield 3 (BVD IBR-PI3 MLV Vaccine)
  - “Indications: BOVISHIELD 3 is for the vaccination of healthy, non-pregnant cattle as an aid in the prevention of infections by infectious bovine rhinotracheitis (IBR) virus, . . .”

Detecting animals with clinical BRD early is important

For most infectious diseases:
- Good treatment response requires early detection
- Clinically ill animals are "red flags" for the problem in rest of group
- The key to profit is preventing the problem in other animals!

Signs of Clinical BRD:

- Cough (moist or dry)
  - cough on movement
- Labored breathing
  - Not effortless
  - Winged elbows
  - Abnormal sounds when breathing
  - Exercise intolerance
- Nasal discharge
- Dirty nose
- Nasal erosions, ulcers, etc
- Foul breath
- Cyanosis (blue)
- Depressed, separated from group
General Appearance

**Healthy Animals:**
- Look at intruder in pen, tracking movement
- Move immediately to feed when delivered

**Sick Animals:**
- Usually ignore pen intruder but excitable if hypoxic (lacking oxygen)
- Hang back from group, don’t move to new feed

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Close-up Appearance

**Healthy Animals:**
- Smooth, clean, moist pink nose
- No slobbering
- Ears up, bright eyes, little tear staining

**Sick Animals:**
- Nasal discharge, crusty, dirty muzzle
- Slobbering, open mouth
- Ears dropped, not attentive
- Head down, neck extended
Normal Nose

Abnormal Serous Discharge – Early Stage

Crusty Muzzle with Slobbering, Tearing

Open Mouth Breathing – Early Stage

Peeling nose – Later Stage

Mucopurulent Discharge - Later Stage
“Shipping fever” exam findings

- Onset 6-10 days after insult (weaning, transit, grouping, working)
- Depression, fever (>105°F initially), anorexia (not eating), weight loss, nasal / ocular (eye) discharge
- Rapid, shallow respiration, often painful (grunting)
- Coughing, usually moist, exacerbated by movement
- Severe dyspnea (labored breathing) terminally

Enzootic Calf Pneumonia Exam Findings

- Incubation 3-10 days
- Explosive onset (esp. dairy & veal)
- Fever (103-106°F)
- Harsh, dry cough; nasal discharge
- Dyspnea, mouth breathing
- Dehydration, ± diarrhea
- Course 10-14 days
- “Chronics”
  - suppurative pneumonia
  - never thrive

How is BRD treated?

Primarily:

- Early detection
  - Before lung lesions become severe
- Appropriate antibiotic:
  - Effective against organism
  - Large enough dose by appropriate route long enough
- Support (3 “R’s”):
  - Rest: Dry comfortable, ventilated, protected
  - Rumen: Fresh, palatable feeds
  - Rehydration: Oral, IV

Many antibiotics are available for treatment

<table>
<thead>
<tr>
<th>Drug Name</th>
<th>Trade Name</th>
</tr>
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<tbody>
<tr>
<td>Ceftiofur</td>
<td>Naxcel, Excenel</td>
</tr>
<tr>
<td>Florfenicol</td>
<td>Nuflor</td>
</tr>
<tr>
<td>Enrofloxacin</td>
<td>Baytril</td>
</tr>
<tr>
<td>Oxytetracycline</td>
<td>(many)</td>
</tr>
<tr>
<td>Tilmicosin</td>
<td>Micotil</td>
</tr>
<tr>
<td>Tylosin</td>
<td>Tylan</td>
</tr>
<tr>
<td>Erythromycin</td>
<td>Gallimycin</td>
</tr>
<tr>
<td>Sulfadimethoxine</td>
<td>(several)</td>
</tr>
<tr>
<td>Penicillin</td>
<td>(many)</td>
</tr>
<tr>
<td>Ampicillin</td>
<td>Polyflex</td>
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Drug effectiveness and cost varies (3 isolate surveys, mid-90’s)

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Treatment decisions are based on a balance of cost and effectiveness
All antibiotics are potentially toxic, some more than others

- Oral lincocin kills cattle and sheep
- Fatal allergic reactions occur
- High doses may be nephrotoxic (kidneys) or ototoxic (ears)
- Chloramphenicol causes fatal aplastic anemia in humans
- Micotil IV kills cattle and by any route kills humans
  - Several human deaths from accidental injection

Micotil is particularly dangerous for humans

- Do Not Use in Automatically Powered Syringes

Cattleman dies due to accidental injection

http://www.cdc.gov/niosh/face/stateface/ne/03ne004.html

Nebraska rancher hospitalized after accidental injection of Micotil

- Treated 2 calves with a 20 cc plastic syringe
- Treated first calf, placed the syringe in mouth, and reached to open squeeze chute
- Calf lunged, causing pipe handle to strike hand, driving it into needle and injecting 1 cc
- Burning sensation, severe ringing in ears, tongue and lips felt swollen
- Iced site and taken to emergency room
- Airlifted to a regional medical center and spent 2 days in ICU

Rough bolus gun use can severely damage throats

Vaccination program recommendations are local and herd specific

“Vaccine Program Recommendations” in:
Basic Concepts for Cow-Calf Herd Health Programs
http://www.vetmed.wsu.edu/courses-jmgay/FDUCowCalfHH.htm

TAMU Ranch to Rail: Value Added Calf (TexVAC) Vaccination Management Guidelines