VMS 361

Animal Disease Management Principles

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What are the best ways to deal with herd infectious disease problems?

Given that most infectious agents remaining as problems (we've gotten rid of the easy ones):
- Are ubiquitous (holoendemic)
  - If they haven't been found on a premises, they likely haven't been looked for hard enough
- Are opportunists
  - Healthy, normal, low stress animals don't 'break' unless overwhelmed!
- Often co-evolved with their bovine host
- Survive well in the environment, often months
- Aren't reliably curable with drugs
- Establish carrier states in herdmates who then shed it (often for life)
- Vaccines are not 100% effective (if even available)

What is the best approach and what is needed for that approach?

Prevention beats cures every time

Production systems are dynamic relationships between animals, infectious agents, and their environments

When disease problems occur:
- After asking "What's wrong?", ask "How did this system get here?"
- Ask "What changed?"
  - A change in one point of the system often lead to unintended consequences elsewhere that appear after a lag
- Ask "What's different about this system from others?"
  - "A common error is to define the problem not by what's happening in the system but by the lack of our favorite solution" (D Meadows)

Livestock production is a system of interacting cycles with common problem points

Animals in a group have different infection and disease statuses

In a herd you have to manage all the animals in all of the statuses

The disease “Iceberg” means most diseased animals are not detectable visually

Goal: Separate the susceptible from the potential subclinical

Due to the “iceberg phenomenon,” most disease loss in a herd is hidden

Herd Distribution

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

Prevention is key to preventing production loss!

Clinical cases are the “tip of the iceberg” red flags

Consider clinically affected animals Red Flags!
They indicate the presence of a serious herd problem
They are not the full extent of the problem

Prevention beats cures every time

Cures are “stop loss” at best
One goal is reducing infection transmission between infected and susceptible in a herd

- Reproductive Ratio (R₀) is the number of secondary infections due to each infection
  - > 1: Infection spreads
  - = 1: Infection is stable
  - < 1: Infection dies out

- Hard to reduce in intensive management
  - agents co-evolved and survived with hosts when they were extensive, free-ranging

**Goal**: Get R₀ less than 1 so agent disappears from herd

Infection transmission occurs in two forms

**Horizontal**

**Vertical**

Vertical transmission can occur:
- *In utero* – born infected!
- During birth
- Infected colostrum
- Suckled milk

Transmission has three steps – escape, environmental survival, and infection

Infectious agents get out and in many ways

Mammalian Body from bug’s perspective

Multiple entry and exit portals!

For most “enterics,” the major transmission cycle is fecal-oral and fecal exposure is the major risk

In general, minimize all sources of stress

Note the exceptions that trap the unwary
Stress plays a major role in Bovine Respiratory Disease (BRD)

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

BRD involves a wide range of infectious agents, some primary and many secondary

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

**Virus**
- BHV-1 (IBR)
- BHV
- 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 mucous 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
Normal Cilia (Electron Micrograph)

Ciliary damage slows or stops the clearance mechanism

In BRD normal bacteria proliferate, move to lung, are not cleared, and cause inflammation

BRD lung damage is due to a vicious cycle of inflammation

Looking at the question another way

Production systems are dynamic relationships between animals, infectious agents, and their environments

The answer – the presence of risk factors in those herds

A particular infectious dose results in differing severity in a herd

Clinical disease doesn’t occur when resistance is high relative to exposure dose

Both vary over time and location as seasons change and animals move through the production cycle

Goal: Reduce infectious dose, increase host resistance

Pattern of Host Resistance - Calves

Pattern of Host Resistance - Cows

Most Infectious Diseases are Opportunists!

There are far more opportunists than there are vaccines!