**VMS 361**

Animal Disease Management Principles

Dr. John Gay, DVM PhD DACVP
Associate Professor, FDU

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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)

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

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

Most infections are subclinical

- Typically > 10:1
- Can’t identify every infected animal easily
- Important because some animals are more susceptible than normal
  - Neonates
  - Animals with other diseases

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

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**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

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**One goal is reducing infection transmission between infected and susceptible in a herd**

- Reproductive Ratio ($R_o$) 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 $R_o$ less than 1 so agent disappears from herd**
For most “enterics,” the major transmission cycle is fecal-oral and fecal exposure is the major risk.

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.

A particular infectious dose results in differing severity in a herd.

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

Pattern of Host Resistance - Calves
Pattern of Host Resistance - Cows

<table>
<thead>
<tr>
<th>Host Resistance</th>
<th>Nutrition</th>
<th>Transition</th>
<th>Stress</th>
<th>Disease</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agent Exposure</td>
<td>No Disease</td>
<td>BCS DM Mix</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dose</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Most Infectious Diseases are Opportunists!

There are far more opportunists than there are vaccines!

Most vaccines provide marginal protection but not absolute protection

Stress Event

<table>
<thead>
<tr>
<th>Host Resistance</th>
<th>Vaccinate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Decreased Agent</td>
<td>No Disease</td>
</tr>
<tr>
<td>Exposure Dose</td>
<td></td>
</tr>
</tbody>
</table>

High exposure or severe stress overwhelms the best vaccine immunity

Clinical disease outbreaks result from a breakdown that initiates a vicious cycle

Less Susceptible Hosts Now Affected!

<table>
<thead>
<tr>
<th>Higher Exposure</th>
<th>Higher Shedding from Clinical Disease</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moderate Contamination</td>
<td></td>
</tr>
<tr>
<td>Heavier Environmental Contamination</td>
<td></td>
</tr>
</tbody>
</table>

Focus on a “bug” keeps us stuck in a rut!

Vaccinate It!

The Animal Host

The Disease Agent

Kill with antibiotics!

Pretty much ignore this!

On unoriginal thoughts:

The secret to creativity is knowing how to hide your sources

Albert Einstein

Albert Einstein’s more relevant quotes:

The significant problems we have cannot be solved at the same level of thinking we were at when we created them

Insanity: doing the same thing over and over again and expecting different results

We do this a lot in disease problems like calf scours and bovine respiratory disease
On the other hand:

If you can’t dazzle them with dexterity, baffle them with bullshit

Professor H. Hill

Which this is you’ll have to figure out

Focus on the entire husbandry system rather than individual diseases

The Animal Hosts

The Disease Agents

The Environment (Housing, Nutrition, ...)

Different diseases have common risk factors

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

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)

For more, see “A Systematic Approach to Herd Disease Outbreak Investigation” at

http://en.wikipedia.org/wiki/5_Whys

http://en.wikipedia.org/wiki/Five_Ws

What do you need to know for understanding?

Identify Hermagoras’s “seven circumstances” for the components of understanding

- quis, quid, quando, ubi, cur, quem ad modum, quibus adminiculis
  - Who, what, when, where, why, in what way, by what means, to whom it helps?
- I keep six honest serving-men
  - (They taught me all I knew):
    - Their names are What and Why and When
    - And How and Where and Who.
  - Rudyard Kipling, 1902

Ask “Five Why’s?” for the depth of understanding

- Five iterations of asking “why?” usually gets to the root cause

Looking at the question another way

Farm Level Reality –

Most diseases are endemic

The most important question:

If almost all herds have these infectious agents, why do few herds have animals sick with them?

The answer – the presence of risk factors in those herds

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For understanding systems, systems dynamics, and human function in these, two authors

W. Edwards Deming quotes:
• Learning is not compulsory . . . neither is survival
• You can’t manage what you don’t measure
• In God we trust; all others bring data
• Whenever there is fear, you will get wrong figures

How can you determine for yourself if your understanding is sufficient?

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• Whenever there is fear, you will get wrong figures.

Chap 5: IOED
Chap 1: Understand Deeply

http://www.donellameadows.org/systems-thinking-resources/
http://www.donellameadows.org/
http://demingcollaboration.com/

http://www.overcomingbias.com/2010/08/far-is-overconfident.html

Disease severity is determined by many factors

<table>
<thead>
<tr>
<th>Lower Severity</th>
<th>Higher Severity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lower Dose</td>
<td>Higher Dose</td>
</tr>
<tr>
<td>Middle Aged</td>
<td>Neonate or Elderly</td>
</tr>
<tr>
<td>Lower Stress</td>
<td>Higher Stress</td>
</tr>
<tr>
<td>Adequate Cu, Se, Vitamins A, E</td>
<td>Deficient Cu, Se, Vitamins A or E</td>
</tr>
<tr>
<td>No other diseases</td>
<td>Other diseases, co-infections</td>
</tr>
<tr>
<td>Higher social dominance</td>
<td>Lower social dominance</td>
</tr>
<tr>
<td>Lower producing</td>
<td>Higher producing</td>
</tr>
<tr>
<td>Higher specific immunity</td>
<td>Lower specific immunity</td>
</tr>
</tbody>
</table>

Horizontal Transmission Chain

Minimize infectious agent flow through all links of the transmission chain

Herd "Hardening" is applying strategies that reduce dose and shift the curve

The greatest weakness of most strategies is the failure to identify and to address all the potential transmission routes
Apply the general principles to the entire farm system

The neonatal calf is the most susceptible animal on most farms
- Maximize the calf’s natural resistance and acquired immunity
- Delay and minimize the infectious dose the calf is exposed to
  - Because these agents are ubiquitous, calf must eventually acquire the infection and develop an active immunity

Don’t feed antibiotics unless for specific, short duration treatment!

- Not effective against viruses or protozoa
- Most scour-causing bacteria are resistant!
- Selects for more resistance
- Increases host susceptibility to other infections

Avoid antibiotics in milk replacer and starter!

Maximize passive transfer by monitoring it

Passive antibody level vs. scours

Absorbed Passive Antibody Level

Number & Severity of Scour Episodes

Antibodies control bacteria

But only in the calf!

Handle Colostrum like grade A milk for sale

- Disease-causing bacteria grow just as well in Colostrum as in milk
- These bacteria are transferred with the Colostrum into the blood stream
- Harvest into sanitized containers and refrigerate or freeze it if not used immediately
- Don’t pool!
  - BLV, Salmonella, and Johne’s are transferred by Colostrum

Colostrum cooling on the parlor floor (Remember the little black spots)
Disease risk can occur in unexpected ways

Apply sufficient cleaning and sanitizing criteria

General Rules:
- Look Clean
- Feel Clean
- Smell Clean

If it doesn’t, it ain’t

Agents die by exponential decay in the environment

Time reduces exposure dose, reducing exposure consequences

Proper sanitation breaks the half-life curve

Goal: Reduce agent level below infectious dose for typical susceptible animal

For sanitation success doing each cleaning and disinfection step is critical

- First Step - Thorough rinsing and cleaning, whether hutch, hands, or nipples
- Remove all organic matter (feces, blood, milk, milk stone, milk fat, saliva)
  - Protects infectious agents from action of disinfectants (chemical or direct sunlight)
- Soap, water, and scrubbing are the most important; mechanically removing the agents

People often want to skip this step because of the "elbow grease" often involved
Chemical disinfection requires an effective agent at concentration with full contact time

- Use a disinfectant with labeled effectiveness against target agents
  - Many are not effective, such as Pinesol
  - Environmental surfaces – 1-stroke Environ
  - Tissue contact – Nolvasan or tamed iodine
  - General use – Virkon S
- Allow adequate contact time (temperature dependent) at sufficient concentration
  - Organic material (milk, manure) inactivates most disinfectants, especially chlorine-based
  - Chlorine begins evaporating when mixed
People often use a solution too long, use too little, and don’t allow sufficient contact time

VirkonS is one of the best overall disinfectants

- 1.3 ounces of Virkon S per gallon of water
- One gallon of solution treats 135 square feet
- ~$100 per 10 lbs

For more information, see CFSPH “Disinfection 101” at

The final step of full drying is critical!

- Some agents are not killed by disinfectants, only full drying
- Low levels of other agents will likely remain that can begin replicating later
  - Salmonella will grow on a wet board!

A common error is to leave the items in the final tank with the disinfectant, assuming they will be sterile when removed

When hands are not visibly soiled, alcohol-based rubs are more effective than soap and water

Principles for reducing pre-calving exposure - Beef

- Move cows and heifers to separate calving areas several weeks before calving
  - Skin and hair of cows on winter feed and bed ground have infectious agents shed by carrier cows
  - Heifers generally have poorer colostrum
  - Heifers need more calving supervision
  - To avoid “sophomore slump”, heifers should be bred to calve one month ahead of cows

Principles for reducing post-calving exposure - Beef

- 1 Day after calving, move pair to large pasture area to spread out
  - Exposed calf takes about 3 days to begin shedding agent in large numbers
- If scours develops in a group, leave all of that group in place but turn out new pairs to a new pasture
  - Remember the “Iceberg Principle:” Many calves will be subclinical shedders!
Beef Calving System

"The Sandhills Calving System"
• Developed in Nebraska by Dr. David Smith and colleagues
  • http://www.rangebeefcow.com/speakers/presentations/Smith.pdf
  • http://www.rangebeefcow.com/powerpt/smith.pps

Reducing post-calving exposure - Dairy
• Within first day, move calf to a cleaned individual hutch isolated from contact and air space of other calves
• Sanitize anything that contacts calf’s mouth prior to that contact (nipples, esophageal feeders, pill guns, hands)

Reducing post-calving exposure - Dairy
• After weaning from milk, group by age in progressively larger groups
  – 1 to 7 to 14 to 28
• DO NOT hold back calves on the basis of small size; these are often carrier animals that will infect younger groups
  – Group poor doers separately

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

The House Fly *Musca domestica*

Mouth Parts
¾ of "fly spots" are regurgitation of previous meal
Puparium (Pupal Case)

Flies transmit dangerous disease agents

What do you suppose the calf ingests besides water when drinking?
Colostrum cooling on the parlor floor

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Damp straw bedding is a fantastic fly incubator

55

Don’t overlook the cycles of the vermin (flies, rodents, birds)!

55

Parasitic wasp raisers grow their flies in damp straw!

55

Most of all, avoid PPM!

57

Bad Management overwhelms the Best Vaccine every time!

57

The Last Lecture:
Achieving your childhood Dreams
Randy Pausch

http://www.youtube.com/watch?v=ji5_MqjcxSo