Scenario: You manage youngstock on a large operation

As youngstock manager, you need to be able to explain the “what,” “why” and “how’s” sufficiently to:
- Establish standard operating procedures (SOP’s) for youngstock
- Hire, train, motivate, monitor and evaluate employees following these SOP’s to care for youngstock

What do you need to know to explain the ‘Nuts & Bolts’?

What resources are available?

How big a problem is calf scours? How much is it costing (or could cost) the operation?

First step for determining management strategy:
- Total Mortality (death) prior to weaning – USDA NAHMS
  - 6% Beef
  - 11% Dairy
- Scours as reason for Mortality:
  - 18% Beef
  - 60% Dairy
- Tracking on this operation
  - What you don’t routinely measure, you can’t manage!

Diarrhea is the disruption of normal gut physiology

- Body water cycles in and out of intestinal tract as part of digestion
  - 25% of body water cycles thru intestinal tract daily
- Two forms of disruption:
  - Normal secretion into intestine, reduced (malabsorption) back out
    - Most infectious diarrheal agents
    - Fermentative diarrhea
  - Excess secretion (hypersecretion) into intestine, overloaded reabsorption back out
    - E. coli K99, cholera

Diarrhea: Loss of body water & salts (electrolytes)
Balanced intake and output are essential to normal fluid balance

Body Fluids are 60% of Body Wt:
- Blood 5%
- Tissue 15%
- Cellular 40%

Respiration
Water Intake
Intestine

Fecal Loss
Urine Loss

Body Fluids are 60% of Body Wt:
- Blood 5%
- Tissue 15%
- Cellular 40%

Intestine

Balanced Intake & Output

Diarrhea causes dehydration and electrolyte imbalance
- Body water loss => Dehydration
  - Circulation effects - Skin “tents”, sticky mouth, cold limbs and ears, sunken eyes
  - Urine output drops and stops if severe
- Body electrolyte (salts) loss and imbalance
  - Affects heart and skeletal muscle function
    - If shifts are severe enough, heart stops
  - Depresses CNS

Depressed scouring calf

http://homepage.usask.ca/~vim458/virology/studpages2007/Ashley/home.html

Malabsorption causes diarrheal imbalance
- Imbalance = Shrinking Body Fluid Volume
- Cells > Tissue > Blood > Out!

Hypersecretion causes diarrheal imbalance
- Cells > Tissue > Blood > Out!

The most important treatment is replacement fluid
- Detect scouring calf before fluid loss becomes profound so oral replacement works
  - How do you instruct employees to detect these calves?
- Replace both lost body fluid (water) and electrolytes (salts) in large enough quantity often enough that loss does not become profound
  - How do you instruct employees to treat these calves?
What to Use: Oral rehydration solutions (ORS) have 4 key ingredients besides water

- Dextrose (glucose) – for energy
- Glycine – for absorption
- Salts - potassium chloride, salt, dicalcium phosphate, magnesium sulfate
- Sodium bicarbonate - buffer

2.3% glycine and 44 grams dextrose (glucose)
- “high energy” label – required to fuel absorption
- Caution: Still only ½ the energy of milk!

Feeding only fluids too long leads to death by starvation / hypothermia

Use high energy electrolytes with glycine

Entrolyte H.E.    Re-sorb

Use esophageal feeder to quickly transfer fluids

http://u.osu.edu/beef/2016/03/23/tube-feeding-colostrum-an-essential-skill-for-all-producers/

For several reasons, antibiotics are the least important treatment!

- Agents that cause calf scours are:
  - Viruses or protozoa that antibiotics have no effect upon
  - Bacteria that are usually resistant to the OTC antibiotics
- Antibiotics, particularly OTC (over the counter) oral antibiotics, are usually ineffective!
  - Antibiotics in scour boluses
  - Antibiotic-containing milk replacer
  - Antibiotic-containing starters

To be successful, treatment must be early!

“Key to successful treatment!”

Determine how to treat a scouring calf by classifying it into one of three categories

- Degree of dehydration
  - Early  < 5% Body Wt – supplemental oral fluids
  - Moderate 7% Body Wt – high energy oral fluids
  - Severe > 9% Body Wt – emergency IV fluids

- 5 classification components - LOBES:
  - Limbs
  - Oral membranes
  - Body Position
  - Eyes
  - Skin

http://u.osu.edu/beef/2016/03/23/tube-feeding-colostrum-an-essential-skill-for-all-producers/
**Early Fluid Loss (<5% BW)**

- Calf is:
  - Limbs - warm
  - Oral membranes - moist
  - Body position - standing and mobile
  - Eyes - bright
  - Skin - “tents” for << 4 seconds
- Calf will suckle electrolyte solution from a bottle
- Leave calf on milk and add several 2 quart electrolyte feedings per day until scouring slows
  - Reason: If calf doesn’t have adequate fat reserves, feed removal can cause death by starvation/hypothermia before scouring stop

**Dehydration Sign** – skin “tenting” pinch and twist test

**Moderate Fluid Loss (7% BW)**

- Calf is:
  - Limbs - cold
  - Oral membranes - warm but sticky
  - Body position - dull, lying down but upright
  - Eyes - sunken slightly with a slight gap
  - Skin - “tents” distinctly for ~5 secs
- RX: to survive 1/2 gallon of warm special “high energy” electrolyte solution (Enterolyte HE) by esophageal feeder twice several hours apart
- In cold conditions move calf to warm area where it can be monitored

**Severe Fluid Loss (>9% BW)**

- Calf is:
  - Limbs - cold
  - Oral membranes - cold, pale and dry to touch
  - Body position - lying flat in a coma
  - Eyes - deeply sunken with a big gap
  - Skin - stays “tented”
- RX: Only 1 gallon of special electrolyte fluids by IV drip will save the calf
  - SQ and oral fluids won’t be absorbed because circulation is too poor
- Unless employees have been trained to do IV’s and IV equipment is available, take calf to veterinary clinic

**Fluid volume must replace loss and keep up with continuing losses**

- Enough balanced electrolyte fluids must be given to:
  - Replace % of body weight (BW) lost
  - Meet maintenance requirements (50 ml / kg BW per day)
  - Keep up with ongoing loss of 1 to 4 Liter per day in the diarrhea
- For a 7% dehydrated 80 lb calf, this is 6 to 9 quarts of electrolyte solution the first day
  - 1 Enterolyte H.E. pack is only 2 quarts! -> 4 packages
Commonest Infectious Diarrheal Agents

- **Bacteria**
  - *Escherichia coli* (E. coli) strains
  - *Salmonella* serotypes dublin, typhimurium, newport and others
- **Viruses**
  - Rotavirus
  - Coronavirus
- **Protozoa**
  - Cryptosporidia
  - Coccidia

Use a systematic, integrated approach to disease control:
Milk pasteurization model

<table>
<thead>
<tr>
<th>Organism</th>
<th>Temperature</th>
<th>Survival Time to Required Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organism 1</td>
<td>Higher heat tolerance but rapid dieoff</td>
<td></td>
</tr>
<tr>
<td>Organism 2</td>
<td>Lower heat tolerance but slower dieoff</td>
<td></td>
</tr>
<tr>
<td>Organism 3</td>
<td>Doesn’t determine Boundary Conditions in this set of Bugs</td>
<td></td>
</tr>
</tbody>
</table>

Boundary Conditions for Pasteurization

Pasteurization time vs. temperature thermal death curves for target organisms

http://www.hoards.com/E_calf_heifer/CC02

Key *E. coli* characteristics

- Normal gut flora of all mammals so *E. coli* is ubiquitous (everywhere)
- Three disease forms:
  - Colisepticemia - any strain
  - Enterotoxigenic - specific strains
  - Enteropathogenic - specific strains
- A most common cause of calf death
- OTC antibiotics are usually not effective
- Some very effective ones are illegal to use!

Baytril cannot be used off-label, even by veterinarians

“Federal law prohibits the extra-label use of this drug in food-producing animals”

A complete veterinarian’s label doesn’t protect you from prosecution by the FDA

Colisepticemia is caused by any *E. coli*

- Spreads through calf’s body to cause abscesses in the brain, eyes, kidneys, and joints
- Occurs when calf ingests manure, mud or other material before or along with colostrum
- Virtually impossible to treat successfully
- Prevented by:
  - calving in clean, dry areas
  - cows having clean udders
  - Harvesting colostrum cleanly and keeping refrigerated or frozen
  - feeding 4 qts of high quality colostrum within 4 hours of birth

*E. coli* are everywhere in manure-contaminated mud!
Bad conditions > First mouthful is *E. coli*!

Low density, no mud > Excellent conditions!

**Enterotoxigenic *E. coli* (ETEC)**

- **Specific strain (K99)** attaches to intestinal cells and causes a hypersecretory diarrhea
  - Toxin turns on cell’s fluid pump
- Almost the only diarrhea that **occurs within first 3 days of life**, often in first day
  - Calf can die of dehydration **before diarrhea appears**!
- Prevented by feeding colostrum containing K99 antibodies
- Cow vaccine available

http://people.vetmed.wsu.edu/jmgay/courses/FDUUCowCalfRH.htm#Vaccination_Programs

**Corona & Rotaviral Diarrhea**

- Virus kills cells of intestinal villi, causing malabsorption diarrhea
  - Calf begins shedding $10^{11}$ virus per gram of feces 3 days after infection.
- Carrier cows continually shed low numbers of virus
- Virus survives **weeks** in the environment
- Vaccines available
- Antibiotics are ineffective (virus)

3 Keys to Management and SOP's

DR Smith (2007). Basic principles of “Sandhills Calving System”
http://beef.unl.edu/a95a3e40-93f8-4893-a296-d709f5b4e6f8a.pdf
Cryptosporidial Diarrhea

- Ubiquitous organism that survives for months in the right environment
- No practical antibiotics are effective
- Not killed by most disinfectants
  - Chlorine dioxide at practical concentrations (?)
- Killed by complete drying
- This is a zoonotic disease, particularly for the immunocompromised

Salmonella Diarrhea

- Calves can shed it in feces, urine, saliva and nasal secretions, contaminating everything they touch and everything that touches them (hands, esophageal feeders, nipples, ...)
- Salmonella survive in the environment for months
  - Only direct sunlight kills it in the environment
- Usually resistant to OTC antibiotics
The major Salmonella transmission cycle is typical of most enteric pathogens: fecal-oral with fecal exposure being the major risk.

Most are unaware of the other Salmonella transmission routes and exposure risks:

- Manure
- Milk
- Urine
- Dust Inhalation
- Oronasal Secretions
- Infect the Unwary!

Salmonella can be transmitted via every body orifice.

Salmonella Diarrhea

- Antibiotics:
  - Depress the normal bacterial flora, making the animal more susceptible to infection and prolonging the diarrhea
  - May be required if infection is systemic; use injectable
- Vaccines of questionable effectiveness
- This is a zoonotic disease, meaning that humans get it!
  - Establish employee sanitation protocols for hands, boots, work clothes

Salmonella has superb survival abilities, surviving well under common farm environmental conditions:

- Salmonella survives for months in materials that dried without heating, such as fecal pats and dust
  - killed by exposure to direct sunlight
- Salmonella survives well in water
  - killed by microbial predators in water
- Salmonella replicates in moist environments (< 85% dry matter) even with scarce nutrients
  - Salmonella will grow on a wet board!
  - Moist feedstuffs
- Salmonella replicates in the intestinal tract of every species in the farm environment
  - Livestock, humans, domestic pets, vermin, wild animals

Low level Salmonella contamination can cause problems:

Cross-Contamination?

Low-level Salmonella Contamination

Weather, misters?

Moist Feedstuff

Favorable Environmental Temperature

Summertime, enclosed barn?

Replication

Infectious Dose!

One fecal pellet from infected rodent = infectious dose for mature cattle

http://people.vetmed.wsu.edu/jmgay/courses/FDIUHerdSalmonella.htm
Undifferentiated Bovine Respiratory Disease Complex (BRD)

Aka:
- “Shipping Fever” - beef industry
- Enzootic Calf Pneumonia - dairy industry
- Bovine Pasteurellosis - technical

Google “Cornell Consultant” for recent literature
http://www.vet.cornell.edu/consultant/consult.asp
http://vet.cornell.edu/consultant/Consult.asp?Fun=Cause_4572&spc=Bovine&dxkw=pneumonia