Manure Biosecurity and Safe Handling: Animal and Human Health Implications

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Presentation is About Risk

- Prevent bad stuff from happening.
- When it does happen, keep it from being “too bad.”

Prevent

Prepare and Respond
An Interesting Relationship

1

30

300

3,000
Pathogens

- Disease-causing agent
- Bacteria
- Viruses
- Other critters (protozoans – though not always formally defined as a pathogen)
<table>
<thead>
<tr>
<th>Disease/Pathogen</th>
<th>Manure</th>
<th>Water</th>
</tr>
</thead>
<tbody>
<tr>
<td>BVD</td>
<td>M</td>
<td>C</td>
</tr>
<tr>
<td>Coccidiosis</td>
<td>M</td>
<td>C</td>
</tr>
<tr>
<td>Cryptosporidiosis</td>
<td>M</td>
<td>C</td>
</tr>
<tr>
<td>Giardia</td>
<td>M</td>
<td>C</td>
</tr>
<tr>
<td>E.coli</td>
<td>M</td>
<td>C</td>
</tr>
<tr>
<td>Salmonella spp.</td>
<td>M</td>
<td>C</td>
</tr>
<tr>
<td>Campylobacter</td>
<td>M</td>
<td>C</td>
</tr>
<tr>
<td>Listeria</td>
<td>M</td>
<td>C</td>
</tr>
<tr>
<td>Johne’s Disease</td>
<td>M</td>
<td>C</td>
</tr>
</tbody>
</table>

M = Major source of organism
C = Source when contaminated by rodents, fecal material, animal tissue/fluids or other unknown sources.
E-Coli O157:H7

- Shiga toxin producing strains of E. coli
- Includes E. coli O157:H7
- Clinical manifestations
  - HUS (predominantly a disease of children)
- 1983 - First association between hamburgers and HC.
- 1993 - Public recognition – JACK IN THE BOX
- Prevalence of EC O157:H7 in animal manure is relatively low (0-3%)
- Feedlot: 1-3% animals positive for E. coli O157:H7
What’s Salmonella?

- Rod shaped bacteria
- Intestinal bacteria)
  - Salmonella (genus)
    - enterica (species)
    - serovar (over 2200 serovars)

Example: *Salmonella enterica* serovar *typhimurium* = *S. Typhimurium*
## Salmonella Dublin

<table>
<thead>
<tr>
<th>Soil</th>
<th>Manure</th>
<th>Other</th>
</tr>
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</table>
| Surface or covered - 300 to 329 days | Feces of carrier cows - 159 days | **Pasture**  
91 to 231 days |
| **Slurry** | | |
| 10 °C | 132 days | |
| 20 °C | 57 days | |
| 30 °C | 13 days | |
Principles TOTALLY Apply for All Infectious Diseases

• Bovine TB
• Johnes Disease
Farm Inputs
Animals on farm, new additions, domestic animals, rodents, birds, and wildlife

On-farm Traffic
Visitors, suppliers, haulers, vehicles

Manure, saliva, milk, tissues

Manure from other farms

Pasture & feed
Water

Feed storage
Feeding and watering equipment

Animal contact

Susceptible Animals

Modified from: Biosecurity Of Dairy Farm Feedstuffs by Bovine Alliance on Management and Nutrition
Hudson Farm Case

- Jeff Hudson
- Truck driver
- Dave (hired man)
- Kids John (13) and Susan (11)
- Vet
- Additional community members
October 1, 10.00 am
Call on cell phone...
3 calves – from neighbor
Nobody’s home, so calves taken to calf barn. Jeff’s kids care for the calves that night after school.
October 4  (3-days later)

5.00 am
3 new calves, and 2 other calves have high temp. and bloody diarrhea …!

8.00 am
The Vet examines the herd.
He also takes a swab sample for lab testing.

He then treats the calves, and then tells Jeff …”You might have a serious problem”
October 4  (that same night)

8.00 p.m.

A total 7 out of 9 calves are now sick. He treats the sick calves.

11.00 PM

Jeff, has to take both [female] and [male] to the County Hospital emergency room --- abdominal cramps and high temperature.

This has not been a good day for Jeff!
October 5

4.00 am
Children admitted.
Dave, the hired man volunteers to help

5.00 am
4 dead calves
Dave loads the dead calves on the loader and takes them out of the barn.

6.00 am
The cows have just returned from milking, he quickly TURNS AROUND hoses down the skid steer, and begins to load feed.
October 8 – A week from the original “incident”

- Nothing much happening on the farm.
- The remaining sick calves nursed back to health.
- On October 8th, the children return home.
  Diagnosis: *Salmonellosis*.

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October 10

- The veterinarian calls to tell that *Salmonella* from his calves is an emergent type of *Salmonella* called **DT104**.

*Salmonella (genus) enterica (species), this serotype is S. Typhimurium, DT104 is a phage type*
October 12

- **4.00 am**
  - 18 cows being in production are scouring!

- **9.00 am**
  - Sick cows are moved from the milk barn to the maternity/sick pen.

- **11.00 am**
  - The Vet examines the cows.
    - Verdict: Salmonellosis.

- **12.00 noon**
  - Mr. Smith, a neighbor, who buys raw milk on occasion tells Jeff that they are going to host **24 Boy Scouts over the weekend** on his game farm.
<table>
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<tr>
<th>Time</th>
<th>Event</th>
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<tr>
<td>9.00 am</td>
<td>Jeff learns, 6 of 24 boy scouts are hospitalized &amp; 1 in serious condition.</td>
</tr>
<tr>
<td>11.00 am</td>
<td>The County Health Officer, the State Regulatory Veterinarian, The Milk Agent, his Veterinarian, FDA and USDA officials come to the farm.</td>
</tr>
<tr>
<td>11.30 am</td>
<td>Herd is to be quarantined, till further notice.</td>
</tr>
</tbody>
</table>
All newspapers carry the outbreak story!

Milk makes kids sick ........

Salmonella outbreak traced to dairy farm ........

Milk contains bugs that makes people sick ........

Scientists say ........ Dairy farming ......

Dairy cows ..... All infected with dangerous bugs

Killer bug on the loose ...... dairy cows responsible
Take Home Points

• Animal healthy and human health closely related.

• Basic infection control practices:
  – Control people, vehicle, and animal traffic.
  – Hygiene – boots*, equipment, vehicles,* and equipment.
  – Control water runoff (stormwater, other sources of standing water).
  – Control rodents, birds, wildlife
Additional Slide – Vehicle sanitation study

- Tires (usually) the most important component for transmission of disease.
- Cool wet conditions 100X worse (based on bacterial count) than warm, dry.
- Driving ≈ 0.1 mile on asphalt road reduces bacterial count on footprint of tire.
- Sanitizer (such as 2% Virkon S) on tires has some value when applied under pressure, though cost-effectiveness might be prohibitive.
Additional Slide – Boot sanitizer study

• Scrubbing all visible manure from boots, THEN soaking boots in CLEAN disinfectant does work (such as Roccal D Plus).

• Getting loose organic matter off with detergent is easier – water also works!

• Walking through (or even scrubbing in) a contaminated bath is doubly bad.
  – It might further contaminate.
  – It might give a false sense of security.
Mechanical Hazards, “Trauma”

- From moving parts, transfer of energy
  - Entanglements
  - Roadway collisions
  - Runovers
  - Outcomes from “mundane” injuries (cuts, puncture wounds, etc.)
Safety -- It’s More than an Attitude Issue

- It’s largely a “hardware” issue
- Consistently, 1 in 5 farms (19.5%) will be the site of an “injury” based on our studies of MN, WI, NE, SD, and ND.
- 80% require medical care/treatment.
Wrap Points

- Power shafts (drive shafts, PTO’s, etc.)
- Gear, belt, chain drives
- Power + Speed = a deadly combination
Stored Energy and High Pressures

- Springs
- Compressed air
- Hydraulic systems
- High pressure fluids
- Not always an “obvious” danger
Crush Points

- Booms
- Rollovers
- Articulated systems
- Highway collisions
Brakes

- Critical Relationship – Ratio between towed implement weight and tractor.
- Assumes tractor brakes are fully functioning!
Ratio = \frac{\text{Total weight of towed load}}{\text{Total weight of tractor}}

OK
- Without brakes: ratio \leq 1.5
- With brakes: ratio \leq 4.5

Not OK
- Without brakes: ratio > 1.5
- With brakes: ratio > 4.5
Case Study – Swine Operation Near Hastings, MN

- August (cool summer, VERY hot weekend).
- Pit 12 ft. deep, 49 inch diameter.
- August 7\textsuperscript{th} during pumping, pump plugged.
- Wire rope broke when retrieving pump w/ cable & winch system.
Case Study

- First worker (age 27) entered, 9 feet down, overcome, face first into waste slurry.
- Second worker (first victim’s uncle, age 46) summoned to the site, he too climbed into the pit and was overcome.
Case Study

- 20-minutes later, both bodies retrieved by rescuers with SCBA.
- Three weeks later, investigative measurements showed zero H₂S, normal O₂ levels.
Three Days Later,

• A second Minnesota double fatality occurred (a father – dairy farmer, and his 23 year old son) in pit under barn.

• Incidents described in CDC report:
Manure Gas Claims the Lives of Five People

By James Carrabba
Agricultural Safety Specialist
The New York Center for Agricultural Medicine & Health - NYCAMH

On July 2, 2007, gas in a manure pit claimed the lives of five people on a Virginia farm. The victims included a 34-year-old farmer who climbed down into the pit to unclog a pipe and was overcome by manure gas. An attempted rescue claimed the lives of four more people that included a worker, the farm owner’s wife, and two daughters aged 11 and 9. A similar incident occurred on a Michigan farm in 1989 when five family members died in a manure-receiving pit that had an oxygen deficient atmosphere. It was the same scenario. One person went down into a pit to make a repair and was overcome by manure gas. The other victims died attempting a rescue of the initial victim.
Gases

• Manure pit gases
• Silo gas
• Carbon dioxide
• Carbon monoxide
Manure Pit Gases

- product of anaerobic decomposition of livestock waste
- can be extremely deadly
- released during agitation and pumping of waste
- typical mask/cartridge/canister respirators offer ZERO protection!!
Manure Pit
Gases Include:
Hydrogen Sulfide

- Detectable at low levels (.005 to .1 ppm).
- Nasty rotten-egg smell.
- Worker exposure limit is 10 ppm (based on 8-hour workday).
- Low levels (50-100 ppm) causes olfactory paralysis.
- **IDLH** -- 300 ppm.
- Rapid respiratory arrest at 1000 ppm (one breath – paralyzes the diaphragm used to breathe).
- Heavier than air.
- Usually found with other airborne hazards including oxygen deficiencies.
Carbon Dioxide

- No odor.
- Heavier than air.
- TLV exposure limit is 5,000 ppm.
- IDLH 50,000 ppm
- Can cause death by asphyxiation
- Can also be found in bins and silos with respiring product.
Methane

- Colorless, odorless
- Can displace oxygen – asphyxiate person
- TLV exposure limit is 1,000 ppm.
- Lighter than air
- Explosive
Ammonia (vapor)

- Odor detection limit 1-5 ppm
- Severely irritating 50 ppm (eyes), 100 ppm (respiratory tract)
- TLV 25 ppm
- IDLH 500 ppm
- Lethal 10,000 ppm
- Heavier than air
Evaluating Hazards

- Gas levels
- Flammables
- Oxygen levels
- Several types of monitors – typically $1,000 to $2,500
Controlling Hazards

- Typically done in the framework of a “confined space” entry program.
- Specifics beyond our scope today.
General Requirements:

- Identify the confined spaces
- Evaluate potential hazards
- Prevent unauthorized entry
- Develop written entry procedures
- Choose the right equipment
- Assign duties to the entry team
- Provide training
- Develop and implement rescue procedures
A Few Words About Respirators

• All respirators are not “equal.”
• Need the right respirator for the job.
• Dust masks, cartridge respirators and “gas masks” provide zero protection against H2S and oxygen deficiencies.
Final Take Home Points

• Safety takes proactive efforts to change practices, situations, hazards.
• On mechanical safety --- brakes, highway lighting and marking, eliminating situations where contact with “energy” occurs.
• On pathogens –
  – Basic biosecurity practices – systematic approach.
  – “Best thing” your Mom ever taught you…(??)