



### Pathogens



Water borne pathogens involving livestock included in this study are:

- Coliform (E coli 0157)
- Viruses (bovine enterovirus, coronavirus and rotavirus)



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### Pathogens

- Pathogens can exist where production animals are located.
- Some pathogens can only affect other animals.
- Other pathogens are **zoonotic**, meaning they can be transmitted from animals to humans.
- Pathogens are released into the environment: air, soil and water.



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### Pathogens

- I will discuss coliforms, E coli O157:H7 and selected viruses.
- How they get into the environment.
- Why they are a concern.
- When and why they occur.



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## Pathogens-Water Borne



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## Pathogens

- Pathogenic bacteria and viruses are potentially available from many different animal species in watersheds. Wildlife, pets and companion animals, agricultural animals, and humans are all possible sources of pathogens. In addition, urban development is often associated with an increase in bacteria in runoff (Young and Thackson, 1999).
- Human contamination or defective water treatment plants have been implicated in previous large-scale waterborne outbreaks while most current waterborne outbreaks are associated with swimming pools and recreational waterbodies (lakes and rivers) (Levy et al., 1998; Upton, 1999).



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## Pathogens-Water Borne

- Most reported water borne disease outbreaks (WBDO) are associated with human health issues not animal health.



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## Pathogens-Water Borne

- During 2001--2002, a total of 31 human cases of Water Borne Disease Outbreaks. WBDOs associated with drinking water were reported by 19 states, according to the Centers for Disease Control and Prevention's most recent survey of water-related outbreaks.



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## Pathogens-Water Borne

- During 2005 and 2006, 20 outbreaks associated with drinking water were reported to have occurred. These included ten outbreaks of acute respiratory illness (ARI), nine outbreaks of acute gastrointestinal illness (AGI) and one outbreak of Hepatitis A.



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## Coliforms



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### E coli 0157 in water

The direct identification and counting of bacteria in water is not practical because the cells are not distinguishable from one another under the microscope.



- For water, coliforms associated with fecal material are identified and counted.
- These key organisms (coliform) are the indicator bacteria that are used to evaluate the potential for water contamination by pathogens.
- Although indicator bacteria are not pathogenic in and of themselves, high numbers may indicate fecal contamination from animal manure (domestic or wildlife), leaky septic tanks or faulty wastewater treatment facilities etc.

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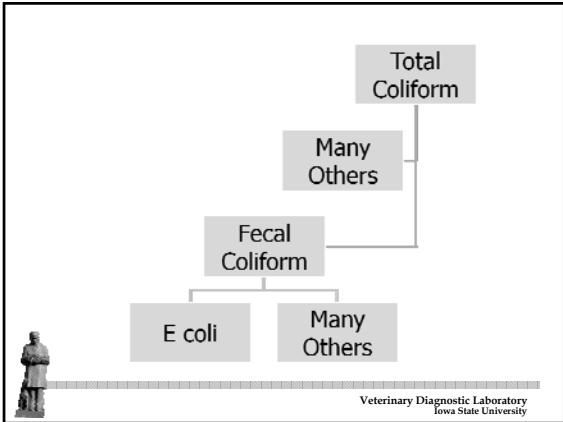
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### E coli 0157:H7



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## Coliforms

- Total coliform is the broadest category of indicator bacteria.
- Fecal coliform is a subgroup of total coliform.
- This subgroup is the most commonly used indicator of bacterial pollution in watersheds.
- *Escherichia coli (E. coli)* is a member of the fecal coliform subgroup.



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## Coliforms

- Bacteria in feces of warm blooded animals.
- E coli O157:H7 does not cause illness in the animals that harbor this bacteria but when humans ingest it, it can be serious.
- This deadly strain of intestinal bacterium has been responsible for many food recalls, human illness and even deaths.



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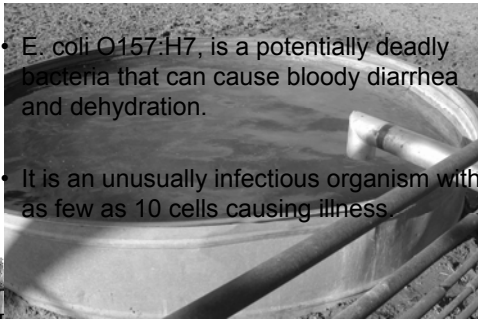
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## Coliforms

- E. coli O157:H7, is a potentially deadly bacteria that can cause bloody diarrhea and dehydration.
- It is an unusually infectious organism with as few as 10 cells causing illness.



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## E coli O157:H7

- *E. coli O157:H7*—Although this organism is not pathogenic to cattle themselves, calf water troughs and moist mixed cattle rations have been cited as sources of *E. coli O157:H7* on farms (Hancock et al., 1997).
- *E. coli O157:H7* has been shown to persist in water trough sediment for at least 4 months and may even grow in the environment (Hancock et al., 1997).



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## E coli O157:H7

- Two surveys of dairy and beef cattle (Hancock et al., 1997) showed wide-spread distribution of *E. coli O157:H7* in feedlots, ranging from 63 to 75 percent of the 100 herds sampled.
- However, the data also showed that the entire herd was not affected. Only 1 to 2 percent of the cows in any given herd carried *E. coli O157:H7*.



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## E coli O157

- *E. coli O157:H7* appears to be only a transient member of the bacterial flora of a cow, colonizing cattle from 1 to 2 months, rather than being a long-term carrier (Besser et al., 1997).
- One study showed that *E. coli O157:H7* increased with dietary stress (Cray et al., 1995).
- Other influences on the *E. coli O157:H7* are related to season (found more frequently after May 1) and cow age, more common in cows 3 to 18 months old (Hancock et al., 1997).



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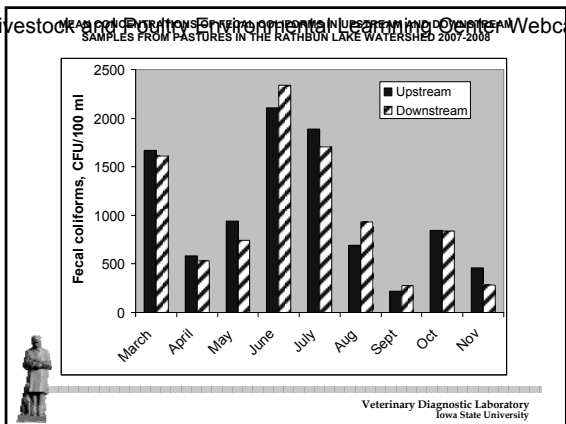
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### Coliforms-Summary of Study

- Coliforms counts in the surface water from the pastures in the study varied widely.
- Coliform concentration was affected by high rainfall events.

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### Coliforms-Summary of Study

- We found in some pastures downstream from CRP ground that the coliform count was higher in the incoming water than the water leaving the pasture.
- In other words the water leaving the pasture was lower in coliform counts than the incoming water that was runoff from CRP ground.

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## Coliforms

- E coli 0157:H7 was not found in surface water in the pastures studied over a 3 year period.
- Coliforms ≠ E coli 0157:H7



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## Pathogens-human viral

- The 2 most common pathogenic human viruses that can get into the environment and cause illness.
- Hepatitis A
- Norwalk virus



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## Viral Human Pathogens

- Runoff from spreading of municipal sludge and manure may be a source of viruses to waterbodies.

In addition, septic tank effluent may be the most significant source of pathogenic viruses in the subsurface environment (CAST, 1992).



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## Viral Animal Pathogens

- In the study Dr Russell is currently conducting in south central Iowa, he has demonstrated the presence of cattle viruses in surface water.
- He has identified Bovine enterovirus (BEV), Bovine coronavirus (BCV), and Bovine rotavirus (BRV).
- This demonstrates that these viruses can survive in the environment and in water.



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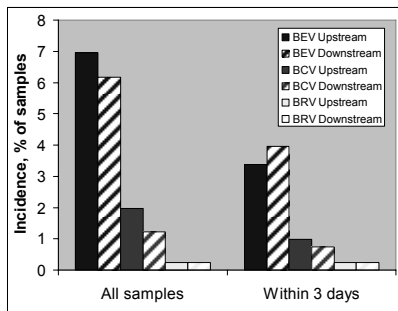
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### Bovine Viruses in Surface Water



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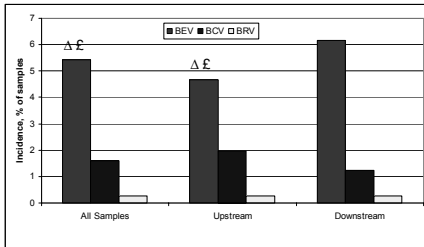
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### MEAN INCIDENCES OF BEV, BCV, and BRV IN ALL WATER SAMPLES WITH UPSTREAM AND DOWNSTREAM SAMPLES RELATED TO CATTLE PRESENCE IN PASTURES ON AND/OR



△ Related to cattle presence on the day of sampling  
 ▲ Related to cattle presence on the day of sampling  
 £ Related to cattle presence three days prior to sampling



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## Viral Pathogens

- Little evidence shows that viruses shed in the excrement of livestock have posed a waterborne threat to human health in the United States (Cliver, 1994).
- Interspecies transmission of rotaviruses has been demonstrated experimentally. Livestock-derived rotaviruses are generally not considered a source of human waterborne infection (Acha and Szyfres, 1987).



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## Viral Animal Pathogens

- Viruses from animals may be able to be transmitted from animal to animal in the environment.
- BUT
- There is little scientific information to indicate whether transmission of viruses from animals to the environment and then to animals is a concern or not.



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## Viral Pathogens

- The use of bacterial indicators aren't useful for predicting risks of viral pathogens as measures of water quality.



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## Pathogens

- There is a lack of association between coliforms and enteric viruses in the environment.
- Bacterial indicators have low predictive ability for enteric viruses and low or no correlation to viruses in the environment.



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## Pathogens

- The fate of coliforms and viral pathogens in environmental systems is disparate.
- Coliform bacteria are more susceptible than enteric viruses to extremes in pH, salinity, and temperature.
- In addition, bacteria are more easily removed by filtration through natural aquifer systems.
- Overall, virus persistence and mobility generally exceed that of bacteria in environmental waters.



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## Pathogens-Summary

- The main measure of the pathogenic potential of water is to measure coliforms.
- Coliforms may or may not indicate the potential for bacterial pathogens in water.
- Coliforms do not indicate whether viruses are present in surface water.



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## Stream Water Quality

- Questions?



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