Epidemiologic Risk Analysis Study of *Giardia* spp. and *Cryptosporidium* spp. in Domestic and Wild Animals

Susan E. Wade, Hussni O. Mohammed, Stephanie L. Schaaf, Peter E. Ziegler

Dept. Population Medicine and Diagnostic Sciences College of Veterinary Medicine, Cornell University
Waterborne Disease Outbreaks

- Occur when water is untreated, inadequately treated, or when there is contamination of the distribution system
- Have been associated with contamination of water by sewage, sludge, agricultural runoff
- Swimming pools & other recreational water associated with recent outbreaks
- Thousands of people affected
Foodborne Disease Outbreaks

- **Giardia** – Associated with eating raw & poorly cooked food (salads, sandwiches, tacos), iced drinks
- **Cryptosporidium** – Associated with eating raw and poorly cooked food (sausage, milk, salad, cider, frozen tripe)
- Food handlers asymptomatic or handled children’s diapers, and didn’t wash hands
- Hundreds of people affected
Control

♦ Depends on breaking the chain of infection by:
  ✔ preventing fecal contamination of environment, including food and water
  ✔ preventing ingestion of food and water which is contaminated by fecal material
  ✔ avoiding animal to animal contact
Control con’t.

♦ (Oo)cysts stay viable longer in cool moist conditions
♦ Cysts killed by heating, drying, freezing, UV light
♦ Most disinfectants do not kill at concentrations that can be used around animals
♦ Ozone, low molecular weight gases
♦ Manure management
  - Heating manure to 65C for period of time (compost)
  - Storing; spreading in areas of low hydrologic activity
**Giardia Infection in Ruminants**

- Seen primarily in young animals
  - Most common in animals <6 months of age
  - Highest cyst shedding 2-3 months of age (calves)
  - Adults shed low levels of cysts
- Infection may/may not be associated with diarrhea
- Clinical significance poorly understood
- Periparturient shedding (sheep)
Cryptosporidium Infection in Ruminants

- Associated with diarrheal illness in young, usually <1 month of age
  - Calves – shedding seen most at 7-21 days of age
- Disease associated with stress (weather, overcrowding, malnutrition, lack of colostrum)
- Usually high morbidity, low mortality
- Periparturient shedding (sheep)
Potential Sources of Infection
Procedure

- Risk Analysis - a systematic and integrated approach
  - Risk identification (identify the problem)
  - Risk communication (awareness)
  - Risk management (suggest ways to control)
Risk Identification - Part I

Cross-sectional Study

Dairy Herd Population

Sample

Determine extent of the problem
Examine potential risk factors
Phase I Results

- 2,943 fecal samples were examined for presence of *Giardia* and *Cryptosporidium*

- **Prevalence**
  - Proportion of samples positive out of all samples tested

- Data on 163 hypothesized risk factors were collected
Farm Prevalence of Parasites

Prevalence rate (%)

- C. parvum
- C. andersoni
- Giardia
Prevalence of Giardia

**Prevalence (%)**

**Age Group**

Overall  | <6 months  | 6-24 months  | >24 months
---|---|---|---
Overall | 10 | 18 | 2
<6 months | 12 | 20 | 4
6-24 months | 8 | 14 | 6
>24 months | 4 | 6 | 8
Prevalence of *C. parvum*

<table>
<thead>
<tr>
<th>Age of Group</th>
<th>Prevalence (%)</th>
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<tbody>
<tr>
<td>Overall</td>
<td>0.5</td>
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<tr>
<td>&lt;6 months</td>
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<tr>
<td>6-24 months</td>
<td>2.5</td>
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<tr>
<td>&gt;24 months</td>
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</table>
Hypothesized Risk Factors

- **General management**
  - number of animals
  - changes in population

- **Maternity management**
  - type of housing
  - cleaning of calf area

- **Preweaned calf care**
  - animal contact
  - colostrum feeding

- **Postweaned calf care**
  - disposal of bedding
  - ventilation

- **Animal health**
  - vaccination program
  - medical history

- **Intrinsic factors**
  - age, sex
  - season of collection
Association between Presence of Water & *Giardia* in Preweaned Calves

![Bar chart showing the association between water availability and occurrence of *Giardia* in preweaned calves.](chart.png)

- **None**: Lower odds ratio
- **Periodic**: Moderate odds ratio
- **Continuous**: Higher odds ratio
- **Varies**: Intermediately high odds ratio
Association between Bedding Used and *Giardia* in Postweaned Calves
Association between Ventilation and Risk of *C. parvum* in Calves

![Bar graph showing the odds ratio of *C. parvum* infection in calves with and without ventilation.](image-url)

- **Ventilation of Calf Housing**
- **Odds Ratio**
Association between Cleaning and Risk of *C. parvum* in Calves

![Bar chart showing odds ratio for cleaning of calf housing]
Risk Identification - Part II
Longitudinal Study
Establish Causal Relationship

Compare incidence of certain given factors to incidence when those factors are not present
Phase II Results

- 10,907 fecal samples were examined for presence of *Giardia* and *Cryptosporidium*

**Incidence**
- Proportion of new cases out of all animals at risk during a specified period of time, i.e.

\[
\frac{\text{(# of new cases)}}{\text{(total # of animals - old cases)}}
\]
Incidence of Infection

Control - I
Giardia - II
G&Cp - III

C. parvum
C. andersoni
Giardia
Risk Management

♦ Continuation of longitudinal study
  ♦ identify beneficial management practices
  ♦ evaluate these practices
  ♦ recommend best management practices (BMP’s) based on an intervention trial
Young Stock Management

♦ Provide adequate colostrum and nutrition
♦ Reduce calf to calf contact (contact with feces)
♦ Keep calves in dry, clean environment
♦ Raise preweaned calves separately
♦ Disinfect hutches or pens between animals
♦ Handle healthy animals before sick animals
♦ Control rodents and pets
♦ Use prophylactic measures such as vaccines and coccidiostats
New York City Watershed Wildlife Project

♦ Purpose

♦ To determine species of wildlife infected with *Giardia* and *Cryptosporidium*

♦ To determine prevalence of *Giardia* and *Cryptosporidium* in infected species

♦ To determine density of selected mammalian species in the NYC Watershed
New York City Watershed Wildlife Project

♦ Procedure
  ♦ Mammals trapped in all habitats in each of the reservoir drainages
  ♦ Mammals trapped in three land uses - natural (nonagricultural), agricultural, municipal
  ♦ Mammals sampled quarterly to determine any seasonality of infection
  ♦ Density sampling
### Giardia - Species with Highest Prevalence

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<thead>
<tr>
<th>MAMMAL SPECIES</th>
<th>2 Ways</th>
<th>Positive</th>
<th>Prevalence</th>
<th>MAMMAL SPECIES</th>
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<td>Four Target Species</td>
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## Cryptosporidium - Species with Highest Prevalence

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<th>TESTED 2 WAYS</th>
<th>POSITIVE</th>
<th>PREVALENCE</th>
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</table>

Four Target Species
Conclusions - Wildlife

♦ Highest prevalence of *Giardia* in red-backed vole, muskrat, meadow vole, deer/white-footed mouse, rat, beaver

♦ Highest prevalence of *Cryptosporidium* in opossum, chipmunk, gray squirrel, raccoon, skunk

♦ When prevalence in wildlife from agricultural land use was compared with # of positive samples in dairy cattle, usually wildlife had a higher prevalence for both parasites.
Conclusions - Wildlife con’t.

♦ Land use with highest prevalence of *Giardia* infection in wildlife was municipal, then agricultural, and lowest in natural areas.

♦ Land use with highest prevalence of *Cryptosporidium* in wildlife was agricultural, then municipal, and lowest in natural areas.