Current Concepts on *Salmonella* and Public Health

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Public Health

- The field of human medicine concerned with safeguarding and improving the physical, mental, and social well-being of the community as a whole.

- Veterinary public health relates to the recognition and control of zoonotic disease.
Genus *Salmonella*

- **Species**
  - *Salmonella enterica* and *S. bongori*

- **Subspecies of S. enterica**
  - Enterica (I)
    - Accounts for 59% of serotypes
    - Accounts for 99% of salmonellosis in warm blooded animals
  - Salamae (II)
  - Arizonae (IIIa)
  - Diarizonae (IIIb)
  - Houtenae (IV)
  - Indica (VI)

- **2400+ Serotypes (based on O and H antigens)**

Salmonella Characteristics

- Enterobactereciae
- Gram negative bipolar rod
- Motile
- Facultative anaerobe
- Non-spore forming
- Does not produce an exotoxin in food
- Survives a wide range of pH and temperature
- Somewhat resistant to drying
Disease Syndromes Associated with *Salmonella*

1. Enteric fever or typhoid
2. Enterocolitis or diarrhea
3. Bacteremia
4. Asymptomatic carrier state

- Dependent upon...
  - Infecting serovar
  - Host susceptibility
Salmonella enterica
Host Range

- All bird and animal species
  - People
  - Birds
  - Reptiles
  - Animals
    - Livestock
    - Pets
# Most Common Serotypes

<table>
<thead>
<tr>
<th>Sick People</th>
<th>Sick Cattle</th>
<th>Feedlot Monitoring*</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Typhimurium</td>
<td>1. Typhimurium</td>
<td>1. Anatum</td>
</tr>
<tr>
<td>2. Enteritidis</td>
<td>2. Typhimurium var Copenhagen</td>
<td>2. Montevideo</td>
</tr>
</tbody>
</table>

*Serotypes in feed even more disparate*
Sources of exposure

- Infected People
- Infected Animals and Birds
  - Livestock
  - Pets
  - Birds
  - Reptiles
- Contaminated water
- Contaminated foods
Salmonella: Disease

- Significant cause of severe foodborne dz
  - 3rd most common cause of illness (10% of known)
  - 2nd most common cause of hosp. (26% of known)
  - Most common cause of death (31% of known)

- Infective dose: 15-20 cells (strain variation)
- Incubation period: 6-48 hours
- Duration of infection: EXTREMELY variable
- Infections not rare
- Minority of infections result in disease
Foodborne Illness

- Illnesses which follows ingestion of food containing pathogenic microorganisms, bacterial toxins, or toxic chemical compounds.

- Occasionally, illness also results from ingestion of food adulterated with poisonous plants, poisonous animals, or physical contaminants (glass, needles, etc.)
“Consumers play a lottery every day when they eat.”

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**Health**

09/17/99 - Updated 05:37 PM ET

Sept. 17, 1999

**Food poisoning sickens 76M yearly**

ATLANTA (AP) - In the country considered to have the world's safest food supply, 76 million people are sickened, 325,000 are hospitalized and 5,000 die each year from food poisoning, according to new federal figures.

"These numbers confirm that the number of illnesses and deaths from contaminated food in the U.S. is unacceptably high," said Caroline Smith Dewaal of the Consumer Advocacy Center for Science in the Public Interest. "Consumers play a lottery every day when they eat."
Foodborne Illness

- There is no such thing as zero risk.
- Food has NEVER been sterile!
- It is not uncommon for people in today’s society to be completely unaware that food they eat commonly contains bacteria, viruses, and parasites.
  - Is there more foodborne illness today?
  - Are people generally less aware of how to protect themselves?
Foodborne Illness

- 76 million illnesses annually
- 323,000 hospitalizations
- 5,200 deaths

**Unknown agents:**

- 81% of foodborne illness, and hospitalizations
- 64% of deaths

Source: Mead et al., 1999
Most Common Causes of Illness (*KNOWN* pathogens)

- **Known pathogens:** 13.8 million cases
  - Norwalk-like virus 67%
  - *Campylobacter* 14%
  - *Salmonella* 10%
  - *Clostridium perfringens* 2%
  - *Giardia lamblia* 1.4%
  - *Staphylococcus* 1.3%
  - *Escherichia coli* O157:H7 0.5%
    - EEC total 1.3%

Source: Mead et al., 1999
Hospitalizations *(KNOWN pathogens)*

- Known pathogens: 60,600 cases
  - Norwalk-like virus 33%
  - *Salmonella* 26%
  - *Campylobacter jejuni* 17%
  - *Listeria monocytogenes* 4%
  - *Toxoplasmsma gondii* 4%
  - *Staphylococcus* 3%
  - *Escherichia coli* O157:H7 3%
  - EEC total 4.5%

Source: Mead et al., 1999
Deaths (known pathogens)

- Known pathogens: 1,800 deaths
  - **Salmonella**: 31%
  - **Listeria**: 28%
  - **Toxoplasma**: 21%
  - Norwalk-like virus: 7%
  - **Campylobacter**: 6%
  - **Escherichia coli O157:H7**: 3%
    - EEC total 4.3%
  - **Vibrio vulnificus**: 1%

Source: Mead et al., 1999
## Frequency of Disease With Known Etiology

<table>
<thead>
<tr>
<th>Illness</th>
<th>Hospitalizations</th>
<th>Deaths</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Norwalk virus</td>
<td>1) Norwalk virus</td>
<td>1) <em>Salmonella</em></td>
</tr>
<tr>
<td>2) <em>Campylobacter</em></td>
<td>2) <em>Salmonella</em></td>
<td>2) Listeria</td>
</tr>
<tr>
<td>3) <em>Salmonella</em></td>
<td>3) <em>Campylobacter</em></td>
<td>3) <em>Toxoplasma</em></td>
</tr>
<tr>
<td>4) C. perfringens</td>
<td>4) Listeria</td>
<td>4) Norwalk virus</td>
</tr>
<tr>
<td>5) <em>Giardia lamblia</em></td>
<td>5) <em>Toxoplasma</em></td>
<td>5) <em>Campylobacter</em></td>
</tr>
<tr>
<td>6) Staphylococcus</td>
<td>6) Staphylococcus</td>
<td>6) <em>E. coli</em> O157:H7</td>
</tr>
<tr>
<td>7) <em>E. coli</em> O157:H7</td>
<td>7) <em>E. coli</em> O157:H7</td>
<td>7) <em>V. vulnificus</em></td>
</tr>
</tbody>
</table>

Source: Mead et al., 1999
Foodborne Illness
(Due to 31 Major Pathogens)

- 9.4 million illnesses annually
- 55,961 hospitalizations
- 1,351 deaths

- Data from 2000-2008
- Estimates based on 2006 US population

Why are these statistics so different from those reported in 1999?

Source: Scallan et al., 2011
Sources of exposure

- Infected People
- Infected Animals and Birds
  - Livestock
  - Pets
  - Birds
  - Reptiles
- Contaminated water
- Contaminated foods
Public Health Perspective of Raw Meat Diets in Companion Animals

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Why is this important?

- In 1995, the CDC indicated...
  - 60% of human cases due to 4 serotypes
  - Represents 46.4% of nonhuman isolates
- Most common food sources
  - Poultry, meat products, eggs
- In companion animals, carriage of organism more common than clinical disease.
  - Healthy dogs 1-36%
  - Healthy cats 1-18%

Sanchez, et al. JAVMA 2002;221:492-497
“The FDA does not believe raw meat foods for animals are consistent with the goal of protecting the public from significant health risks, particularly when such products are brought into the home and/or used to feed domestic pets.”

Outline

- Do pets shed pathogenic agents?
  - Agents found in raw food diets

- Do owners feed raw meat diets?
  - What do pet owners feed their pets?

- What is the risk to the public?
Is there an increased risk of shedding pathogenic organisms?
# Salmonella Prevalence in Dogs

<table>
<thead>
<tr>
<th>Reference</th>
<th>Study Information</th>
<th>Study Information</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gorham, et al 1951</td>
<td>Cross-sectional</td>
<td>Dogs (rural) fecal samples (n=809)</td>
<td>1.2%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cats (rural) fecal samples (n=91)</td>
<td>0.0%</td>
</tr>
<tr>
<td>Galton, et al 1952</td>
<td>Cross-sectional</td>
<td>Normal dogs rectal swabs (n=1626)</td>
<td>15.0%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Vet hosp, kennel rectal swabs (n=3459)</td>
<td>17.9%</td>
</tr>
<tr>
<td>Mackel, et al 1952</td>
<td>Cross-sectional</td>
<td>General dog pop. rectal swab (n=1626)</td>
<td>15.1%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>General cat pop. rectal swab (n=91)</td>
<td>12.1%</td>
</tr>
<tr>
<td>McElrath, et al 1952</td>
<td>Cross-sectional</td>
<td>Veterinary hospital rectal swab (n=503)</td>
<td>15.1%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Boarding kennel rectal swab (n=126)</td>
<td>16.6%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Humane society rectal swab (n=895)</td>
<td>7.8%</td>
</tr>
<tr>
<td>Joffe, et al 2002</td>
<td>Case-control</td>
<td>Client dogs (BARF) unknown quantity (n=10)</td>
<td>30.0%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Client dogs (dry) unknown quantity</td>
<td>0.0%</td>
</tr>
<tr>
<td>Hackett, et al 2003</td>
<td>Case-Control</td>
<td>Referral hospital dogs with diarrhea (n=71)</td>
<td>2.8%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>dogs without (n=59)</td>
<td>1.7%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>overall (n=130)</td>
<td>2.3%</td>
</tr>
<tr>
<td>Finley, et al. 2007</td>
<td>Experimental</td>
<td>Purpose bred dogs fed raw food(n=16)</td>
<td>44.0%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>unexposed</td>
<td>0.0%</td>
</tr>
<tr>
<td>Lenz, et al 2009</td>
<td>Cross-sectional</td>
<td>General dog pop. fed raw meat (n=42)</td>
<td>14.3%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>no raw meat (n=49)</td>
<td>0.0%</td>
</tr>
<tr>
<td>Leonard, et al 2011</td>
<td>Cross-sectional</td>
<td>General dog pop. dogs (n=138)</td>
<td>23.0%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>households (n=84)</td>
<td>25.0%</td>
</tr>
</tbody>
</table>
## Salmonella Prevalence in Working Dogs

<table>
<thead>
<tr>
<th>REFERENCE</th>
<th>STUDY INFORMATION</th>
<th>SALM.</th>
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</thead>
<tbody>
<tr>
<td>Galton, et al 1952</td>
<td>Cross-sectional</td>
<td>Greyhounds</td>
</tr>
<tr>
<td>Stucker, et al 1952</td>
<td>Cross-sectional</td>
<td>Greyhounds</td>
</tr>
<tr>
<td></td>
<td>Kennels (n=15)</td>
<td></td>
</tr>
<tr>
<td>Caraway, et al 1959</td>
<td>Case Report</td>
<td>Sentry Dogs</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stone, et al 1993</td>
<td>Case-Control</td>
<td>Greyhounds (D) (n=41)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Greyhounds (H) (n=35)</td>
</tr>
<tr>
<td>Cantor, et al 1997</td>
<td>Cross-sectional</td>
<td>Sled Dogs</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Morley, et al 2006</td>
<td>Cross-sectional (outbreak)</td>
<td>Greyhounds</td>
</tr>
<tr>
<td>McKenzie, et al 2010</td>
<td>Cross-sectional</td>
<td>Sled Dogs</td>
</tr>
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</tr>
</tbody>
</table>
Do raw meat diets harbor pathogenic microorganisms?
Types of Raw Food Diets (RFDs)

- Commercially complete RFDs
  - Provide complete balanced diet
  - Meats include
    - those for human consumption
    - those not for human consumption (condemned carcasses/offal)

- Homemade complete RFDs
  - Typically based on book or internet recipes
  - Prepared at home

- Commercial combination diets
  - Mix of grains/supplements intended to be combined with raw meats at home
# Raw Foods and Treats

<table>
<thead>
<tr>
<th>Reference</th>
<th>Year</th>
<th>Study Design</th>
<th>Food Description</th>
<th>Sample Size</th>
<th>Salm Proportion</th>
<th>Campy Proportion</th>
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<tbody>
<tr>
<td>Chengappa, et al</td>
<td>1993</td>
<td>Cross-sectional</td>
<td>Raw meat diets</td>
<td>(n=112)</td>
<td>44.6%</td>
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<tr>
<td>Stone, et al</td>
<td>1993</td>
<td>Case-Control</td>
<td>Raw meat</td>
<td>n=41</td>
<td>56.0%</td>
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<tr>
<td>Clark, et al</td>
<td>2001</td>
<td>Cross-sectional</td>
<td>Pig ear treats</td>
<td>(n=94)</td>
<td>51.0%</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Other (hoof, rawhide)</td>
<td>(n=39)</td>
<td>30.0%</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Treats from manuf.</td>
<td>(n=171)</td>
<td>29.0%</td>
<td></td>
</tr>
<tr>
<td>Joffe, et al</td>
<td>2002</td>
<td>Case-control</td>
<td>BARF diet</td>
<td>(n=10)</td>
<td>80.0%</td>
<td>0.0%</td>
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<tr>
<td>White, et al</td>
<td>2003</td>
<td>Cross-sectional (random)</td>
<td>Dog treats (eg. pig ears)</td>
<td>(n=158)</td>
<td>41.0%</td>
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</tr>
<tr>
<td>Weese, et al</td>
<td>2005</td>
<td>Cross-sectional</td>
<td>Raw meat diets (8 manufacturers)</td>
<td>(n=25)</td>
<td>20.0%</td>
<td>0.0%</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>13 dog, 8 cat, 4 unspecified</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Morley, et al</td>
<td>2006</td>
<td>Cross-sectional (outbreak)</td>
<td>Greyhounds</td>
<td>raw food samples</td>
<td>37.5%</td>
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<tr>
<td>Strohmeyer, et al</td>
<td>2006</td>
<td>Prospective longitudinal</td>
<td>20 raw meat diets</td>
<td>(n=240)</td>
<td>7.1%</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>2 dry dog foods</td>
<td>(n=24)</td>
<td>0.0%</td>
<td>0.0%</td>
</tr>
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<td></td>
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<td></td>
<td>2 canned dog foods</td>
<td>(n=24)</td>
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<td>0.0%</td>
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<tr>
<td>Finley, et al</td>
<td>2008</td>
<td>Cross-sectional</td>
<td>Raw meat diets</td>
<td>(n=166)</td>
<td>21.0%</td>
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<tr>
<td>MMWR</td>
<td>2008</td>
<td>Outbreak</td>
<td>Dry dog food</td>
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<td>70 human cases</td>
<td></td>
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<tr>
<td>Lenz, et al</td>
<td>2009</td>
<td>Cross-sectional</td>
<td>Raw meat food</td>
<td>(n=40)</td>
<td>5.0%</td>
<td>0.0%</td>
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</table>
## Recent Cat Food Recalls

<table>
<thead>
<tr>
<th>Month</th>
<th>Reason</th>
<th>Number of Products</th>
<th>Number of Manufacturers</th>
</tr>
</thead>
<tbody>
<tr>
<td>February</td>
<td>Salmonella</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>March</td>
<td>Salmonella</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>June</td>
<td>Salmonella</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>June</td>
<td>Thiamine deficient</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>July</td>
<td>Salmonella</td>
<td>15</td>
<td>6</td>
</tr>
<tr>
<td>August</td>
<td>Salmonella</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>December</td>
<td>Aflatoxin</td>
<td>6</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>32</strong></td>
<td><strong>12</strong></td>
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</table>

<table>
<thead>
<tr>
<th>Month</th>
<th>Reason</th>
<th>Number of Products</th>
<th>Number of Manufacturers</th>
</tr>
</thead>
<tbody>
<tr>
<td>February</td>
<td>Thiamine deficient</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>May</td>
<td>Salmonella</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>June</td>
<td>Salmonella</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>5</strong></td>
<td><strong>3</strong></td>
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</table>
## Recent Dog Food Recalls

<table>
<thead>
<tr>
<th>Date</th>
<th>Reason</th>
<th>Number of Products</th>
<th>Number of Manufacturers</th>
</tr>
</thead>
<tbody>
<tr>
<td>January</td>
<td>Salmonella</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>February</td>
<td>Salmonella</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>March</td>
<td>Salmonella</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>April</td>
<td>Salmonella</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>June</td>
<td>Salmonella</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>July</td>
<td>Salmonella</td>
<td>106</td>
<td>8</td>
</tr>
<tr>
<td>August</td>
<td>Salmonella</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>September</td>
<td>Salmonella</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>October</td>
<td>High Vitamin D</td>
<td>6</td>
<td>1</td>
</tr>
<tr>
<td>December</td>
<td>Aflatoxin</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>132</strong></td>
<td><strong>19</strong></td>
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</tbody>
</table>

### 2011 Dog Food Recalls

<table>
<thead>
<tr>
<th>Date</th>
<th>Reason</th>
<th>Number of Products</th>
<th>Number of Manufacturers</th>
</tr>
</thead>
<tbody>
<tr>
<td>January</td>
<td>Salmonella</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>March</td>
<td>Salmonella</td>
<td>10</td>
<td>3</td>
</tr>
<tr>
<td>May</td>
<td>Salmonella</td>
<td>10</td>
<td>3</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>21</strong></td>
<td><strong>7</strong></td>
</tr>
</tbody>
</table>
What do owners feed to their pets?
Pet feeding practices

- Commercial pet food
  - 90% of dogs for at least ½ of food
  - Most commonly dry food

- Bones or raw food
  - Main meal
    - dogs 16.2%
    - cats 9.6%
  - Treat
    - dogs 7.4%
    - cats 0.9%

- Supplements
  - Regular basis
    - dogs 9%
    - cats 3.1%
  - Infrequent basis
    - dogs 4.2%
    - cats 2.4%

Laflamme DP, etal. JAVMA, 2008; 232:687-694
Proponents of non-conventional diets...

- Nutritional value of ingredients used
- Use of preservatives and additives
- “Carnivores should eat raw meat and bones”

- Other purported benefits
  - Improved skin and coat
  - Decreased breath, body, fecal odor
  - Improved health (allergies, arthritis)
What is the public health risk?
## Interactions with our pets

<table>
<thead>
<tr>
<th>Activity</th>
<th>Dogs</th>
<th>Cats</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pet or cuddle</td>
<td>94.8%</td>
<td>96.2%</td>
</tr>
<tr>
<td>Ride in car</td>
<td>52.1%</td>
<td>4.7%</td>
</tr>
<tr>
<td>Sleep together</td>
<td>30.2%</td>
<td>60.6%</td>
</tr>
<tr>
<td>Eat together</td>
<td>22.2%</td>
<td>26.2%</td>
</tr>
<tr>
<td>Go to work together</td>
<td>7.2%</td>
<td>1.5%</td>
</tr>
</tbody>
</table>

# Environmental Contamination

<table>
<thead>
<tr>
<th>REFERENCE</th>
<th>STUDY INFORMATION</th>
<th>RESULTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Morley, et al</td>
<td>Cross-sectional (outbreak)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Greyhounds</td>
<td></td>
</tr>
<tr>
<td></td>
<td>environment (soil, water</td>
<td></td>
</tr>
<tr>
<td></td>
<td>buckets, food bowls, counters,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>sink)</td>
<td>45.3%</td>
</tr>
<tr>
<td>Lenz, et al</td>
<td>Cross-sectional (vacuum)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>General dog pop.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>raw meat (n=38)</td>
<td>10.5%</td>
</tr>
<tr>
<td></td>
<td>no raw meat (n=44)</td>
<td>4.5%</td>
</tr>
<tr>
<td>Leonard, et al</td>
<td>Cross-sectional</td>
<td></td>
</tr>
<tr>
<td></td>
<td>General dog pop.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>households (n=84)</td>
<td>25%</td>
</tr>
<tr>
<td>Rice, et al</td>
<td>Cross-sectional (vacuum)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>No livestock or Salm.</td>
<td>(n=12)</td>
</tr>
<tr>
<td></td>
<td>Livestock</td>
<td>(n=12)</td>
</tr>
<tr>
<td></td>
<td>Livestock + Salm.</td>
<td>(n=26)</td>
</tr>
<tr>
<td></td>
<td>Vet clinic cat Salm.</td>
<td>(n=16)</td>
</tr>
<tr>
<td></td>
<td>Laboratory</td>
<td>(n=13)</td>
</tr>
</tbody>
</table>
## Is there a public health risk?

<table>
<thead>
<tr>
<th>REFERENCE</th>
<th>YEAR</th>
<th>STUDY INFORMATION</th>
<th>DOG AND/CHILD</th>
<th>ANIMAL PRODUCT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Morse, et al</td>
<td>1976</td>
<td>Case Report</td>
<td>Dog and child</td>
<td>Chicken broth</td>
</tr>
<tr>
<td>Sato, et al</td>
<td>2000</td>
<td>Case Report</td>
<td>Dog and child</td>
<td>Commercial dog food and boiled chicken</td>
</tr>
<tr>
<td>Cherry, et al</td>
<td>2004</td>
<td>Case report</td>
<td>Dog/cat and vet tech/pet owner</td>
<td></td>
</tr>
<tr>
<td>MMWR</td>
<td>2008</td>
<td>Outbreak Investigation</td>
<td>70 people</td>
<td>Dry dog food</td>
</tr>
</tbody>
</table>
Potential Public Health Impact

- 62% US households own a pet
  - 38.2 million cat owners
  - 45.6 million dog owners
- Zoonotic agents isolated from raw food diets
  - *Salmonella* spp.
  - *Campylobacter* spp.
  - *Yersinia* spp.
  - *Cryptosporidium* spp.
  - *Toxoplasma*
  - *Clostridium*
- Antimicrobial resistance

Who Should NOT Feed Raw Meat to Their Pets?
High Risk...

- Households
  - Infants
  - Elderly
  - Immunocompromised

- Animals
  - Immunocompromised
  - Relevant comorbidities
  - Breeding facilities
  - Dogs in contact with high-risk individuals
    - eg. hospital visitation dogs
Is food-borne illness becoming more common?
The Aging US Population

http://flatrock.org.nz/topics/money_politics_law/boom_moves_along.htm
Age Distribution of U.S. Population, Percent of Total
Annual July Estimates 1930 to 2009

Source: Census Bureau and Advisor calculations
Deaths Associated with Foodborne Bacterial Pathogens

- FoodNet Surveillance Data, 1996-2005
- Lab confirmed bacterial infections = 121,536
- Deaths = 552 (0.5%)
  - 39% *Salmonella* related
  - 30% *Listeria* related
  - 89% among hospitalized patients

- Greatest age-specific average annual mortality occurred in adults ≥ 65 years of age.

Behravesh, et al. 2011
How do you prevent foodborne illness?
To prevent foodborne illness, you must understand where your food comes from.
Changes in Food Production:

- More Intensive Agriculture
  - More production per acre
  - More animals per acre / greater crop yield per acre
  - Increased production in animals

- More Food Being Produced by Fewer People
  - Fewer people understand agriculture
  - Fewer exposed to pathogens
    - Knowledge
    - Immunity

- Regional, National, and Global Food Economy
  - Vertical integration
  - Larger production facilities
  - Greater distribution
Lifestyle changes affecting food behavior
(American Meat Institute 1996)

- **Key findings**
  - Increasing number of women in the workforce
  - Decreasing commitment to food preparation
  - Greater number of single heads of households.

- **Increased consumer interest**
  - Convenience
  - Saving time

- **Decreased consumer interest**
  - Food preparation
  - Proper food handling
Preventing Foodborne Illness

- Water safety
- Sewage disposal
- Education
- Pre-harvest food safety
  - Environment
  - Stress
  - Disease
  - Antimicrobial use
Preventing Foodborne Illness

- Processing plant HACCP
  - Critical control points
- Carcass Handling
  - Minimize gross contamination
  - Hot water wash (>180°)
  - Hot organic acid wash (>140°)
  - Steam pasteurization
- Hand Washing!
Preventing Foodborne Illness

- Post-harvest food safety
  - Contamination at slaughter
  - Cross-contamination

- Temperature
  - Keep hot foods hot
  - Keep cold foods cold

- Hand hygiene

- Reduce handling time

- Washing food
Food Safety in the Home

- Proper food handling could mitigate much of the risk.
- About 25% of all Americans regularly eat raw or undercooked ground meat products.
- About 33% of American households do not use safe food-handling practices to prevent cross-contamination in the kitchen.

Source: Altekruse et al 1996
People's hand-washing tales a whitewash, study says

September 18, 2000
Web posted at: 4:42 p.m. EDT (2042 GMT)

(CNN) -- When it comes to hand-washing in the United States, it's do as I say, not as I do, researchers found.

The American Society for Microbiology wanted to know how many people told the truth about their hand-washing habits. So volunteers called more than 1,000 people across the country and asked. Of those surveyed, 95 percent said they always washed after using a public restroom.

But then, sneaky microbiology society observers watched people in public restrooms in New York, Chicago, Illinois; New Orleans, Louisiana; San Francisco, California; and Atlanta, Georgia, to see whether they actually did wash their hands. It turns out that about one third of people weren't exactly on the up and up.

"Your hands are the most important means from which germs travel from one person to another," said Dr. Julie Gerberding, director of hospital infectious programs at the Centers for Disease Control and

The Dirty Truth:
Percentage of people who said they wash their hands after using a public restroom
Hand washing

- What they say:
  - After using bathroom
    - Men 92%
    - Women 97%
  - AFTER:
    - Using public Restroom
    - Using bathroom at home
    - Changing a diaper
    - Before eating or handling food
    - Petting a dog or cat
    - Coughing or sneezing
    - Handling money

- What they do:
  - After using bathroom
    - Men 58%
    - Women 75%
Questions?

Thank you for your attention!