Foodborne Outbreaks, Listeriosis, Yersiniosis

Objectives
- Know steps of outbreak investigations
- Understand major reservoirs and transmission of listeriosis
- Understand major reservoirs and transmission of yersiniosis

Disease Surveillance
- Systematic collection, analysis, and use of data
- Includes specific diseases (notifiable conditions) and clusters of diseases

Purpose
- Prevent additional cases
- Detect outbreaks and new sources
- Monitor trends
- Guide public health programs

WAC
- Notifiable conditions

Reporters to LHJ include:
- Health care providers, hospitals, labs, schools, veterinarians

Foodborne Outbreak Definition
- Two or more persons experience a similar illness after ingestion of a common food or meal AND
- Food/meal is implicated as the source of illness by:
  - Epidemiologic evaluation (statistical evidence)
  OR
  - Laboratory evidence (identifying agent in food)
  OR
  - Other compelling supportive information (i.e., field investigation, confessed ill food worker, etc)

Purpose of Outbreak Investigations
- Verify outbreak
- Identify source
- Remove source
- Control disease spread
- Prevent future outbreaks
- Describe new disease
- Evaluate prevention strategies

Steps in Outbreak Investigations
- Know disease processes (agent)
- Verify diagnosis
- Confirm an outbreak and notify
- Interview cases and comparison group for exposures
- Implement control measures
- Identify additional cases
- Test hypotheses
- Final recommendations
- Outbreak and individual reports

General Foodborne Disease Guidelines*

<table>
<thead>
<tr>
<th></th>
<th>Incubation Period</th>
<th>Duration</th>
<th>Symptoms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preformed Toxins</td>
<td>Hours</td>
<td>Hours</td>
<td>Vomiting, neurologic (bot)</td>
</tr>
<tr>
<td>Viral Infections</td>
<td>Day (except HAV)</td>
<td>Day (except HAV)</td>
<td>Vomiting, diarrhea (except HAV)</td>
</tr>
<tr>
<td>Bacterial Infections</td>
<td>Days</td>
<td>Days</td>
<td>Diarrhea (bloody), fever</td>
</tr>
<tr>
<td>Parasitic Infections</td>
<td>Week</td>
<td>Weeks</td>
<td>Watery diarrhea</td>
</tr>
</tbody>
</table>

*see Control of Communicable Diseases Manual for details on specific diseases
Identification of Agent

- Symptoms
- Incubation period (epi curve)
- Transmission route
- Source
- Laboratory – verify diagnosis

Confirm Outbreak

- Definition of an outbreak: too many cases
- Identification of an outbreak
  - Surveillance data
  - Epidemiology experience
  - Literature

Case Definitions

- Purpose – reduce false positives and false negatives when counting cases
- Clinical case definition
  - Used for treatment decisions
  - Important not to miss any cases
- Surveillance case definition
  - Used for public health statistics
  - Important not to count non-cases
- Outbreak case definition
  - Used for public health decisions
  - Important to count most cases

Surveillance Case Definitions

- Surveillance case definition typically involves clinical and laboratory criteria
  - Clinical criteria for typical presentation, usually not sufficient for a case definition alone
  - Laboratory criteria for specific agent, may be sufficient for a case definition alone

Outbreak Case Definitions

- Outbreak case definition typically emphasize clinical criteria
  - Clinical criteria for typical presentation during a specific time period or associated with a specific event
  - Laboratory criteria included but less likely to be available

http://www.cdc.gov/epo/dphsi/casedef/index.htm
Exposure Investigation
- Investigate source of exposure to case
- Investigate transmission by case
- Determine reservoir(s)
- Base investigation on experience (personal, published) of exposure and transmission for the agent

Potential Exposure Routes

Common Exposures – Listeriosis
- Humans
- Food
- Animals
- Soil, water

Incubation Period
- Time from exposure to first symptom
- Use to interview case about possible exposures
- Listeriosis variable; estimated 3 weeks for severe illness: Outbreak cases 1-70 days from single exposure

Communicable Period
- Time during which an infected person can directly or indirectly transmit the infection
- Use for disease control
- Listeriosis 7-10 days shedding delivery
- Stool positive for months – unclear risk

Interviews
- Case characteristics – person, place, time
- Exposure period – pertinent activities and exposure
- Likely sources or exposures – typical and known for the agent
- Secondary spread – risk to contacts of case
- Attack rate (food specific)
Controlling Disease Spread

• Treat case
• Determine and remove source of exposure
• Identify and institute control measures for others exposed
  – Shared exposure
  – Exposed to case

Epi Studies

• Demonstrate if an exposure resulted in illness
• Types of studies
  – Case finding: identify existence of a problem
  – Retrospective cohort: study exposed group to find illness
  – Case-control: study ill group compared to non-ill to find exposure
• Case finding
  – Guest lists, credit card slips, office roster, ER surveillance
• Retrospective cohort
  – Guest lists, credit card slips, office roster
• Case-control
  – Identify control(s) for each case

Listeria

• Agent recognized over 100 years ago
• First named Bacillus hepatis
• Seven Listeria species
  – Listeria monocytogenes is only significant human pathogen
• Enters phagocytic cells
  – relatively protected from immune system
• No immunity to subsequent infection

Listeria Taxonomy

• Gram-positive flagellated bacteria
  – aerobic, facultative anaerobe
  – non-spore former
  – able to multiply at refrigerator temperature
  – isolation aided by cold enrichment
  – difficult to isolate, particularly from feces: no standard lab method for feces; food can be tested (cold enrichment)
• At least 11 serotypes
  – pathogens primarily serovars 1a, 1b, 4b
• Typing by PFGE, other methods

Listeria Reservoirs

• “Ubiquitous”
• Resists cold and drying even without spores
  – grows at 3°C (37.4°F)
  – long shelf-life
  – contamination may occur after processing
  – long persistence in a location (factory)
• Environmental: soil, mud, dust, animal feed, water, sewage, silage, mineral oil (used in nursery)
• Animals: almost all tested animals
  – mammals, birds, fish, arthropods, crustaceans

Listeria Transmission

• Enters GI tract, eye, skin, lab (skin)
• Foodborne
  – first demonstrated 1981 with coleslaw
  – raw sheep manure had been used on cabbages
  – infectious dose may be ~1000 organisms (raw milk outbreak)
• Environmental
• Fecal-oral
• Waterborne
• Nosocomial transmission reported
• Outbreaks difficult to document
**Listeria Foodborne Transmission**

- Occurs in refrigerated ready-to-eat products
  - raw milk
  - cheeses (particularly soft-ripened varieties)
  - deli meats and salads
  - hotdogs (14% US cases), bologna
  - ice cream
  - fermented raw-meat sausages, paté
  - raw and cooked poultry and meat
  - raw and smoked fish (15% cold smoked fish)
  - raw vegetables


**Listeria Pathogenicity**

- Incubation days to weeks
- Communicable weeks
- Invades phagocytic cells – become bloodborne
- Can cross into brain or over placenta
- Healthy host may be asymptomatic or fever only

**Listeria exposure**

- nothing
- subclinical infection
- acute infection
- resolved, nonimmune
- death

**Listeriosis Sepsis**

- Blood stream infection with *Listeria*
- Newborns, immunosuppressed adults (cancer, transplant, diabetes, AIDS)
- Fever, chills
- May be difficult to diagnose without blood culture
- Mortality moderate even with treatment

**Listeriosis Meningoencephalitis**

- Infection around brain
- Results from bacterial infection
- Newborns, immunosuppressed adults
- Low fever, headache, sometimes subtle symptoms, may be change in mental status
- Mortality moderate even with treatment

**Listeriosis in Pregnancy**

- Most often in third trimester
- Woman with chills, fever, may have back pain
- May not affect pregnancy
- May lead to fetal infection, prematurity, or death
- Maternal mortality minimal
Fetal Listeriosis
• Transplacental transmission
• Abscesses in multiple internal organs (liver, spleen, kidney, brain)
• Mortality high without prompt treatment

Focal Listeriosis
• Any age
• Reported in veterinarians, neonates
• Results from direct contact or bloodstream infection
• May affect skin, eye, heart, bone, artificial joint, brain, liver, etc.
  – mild gastroenteritis affecting health people
  – mild skin infection in poultry workers, vets

Listeriosis Surveillance
• Surveillance case definition:
  – Clinical: meningitis, bacteremia, other manifestations
  – Laboratory: Listeria isolation from normally sterile site OR isolation from tissues at miscarriage
  – Confirmed case: clinically compatible case that is laboratory confirmed

Listeriosis Surveillance – U.S.
• No national surveillance
• Estimated 7.0 cases/million annually
  – 2500 serious infections, 500 deaths
• Washington rate 2-4/million annually
  – 10-20 cases annually
  – 1-3 deaths annually
  – several miscarriages in addition to cases
  – higher rate in summer

Listeriosis Surveillance – Europe
• No uniform surveillance
  – systems include reference lab, universal voluntary reporting, statutory notification, sentinel labs, syndromic surveillance, none
• Estimated 3.4 cases/million annually
  – range 0.3-7.5 depending on surveillance system
• Outbreaks 1991-2002
  – 19 outbreaks in nine countries
  – 526 cases total, mean 11/outbreak recently
  – vehicles included: pork, sliced cold meat, rice salad, trout, raw milk cheese, corn salad, ice cream cake, spreadable raw sausage

Listeriosis Outbreaks
• Uncommon identified cause of outbreaks
• May reflect recognition
  – High proportion of mild cases
  – Diffuse outbreaks from widely distributed products difficult to recognize
  – Better outbreak identification based on newer molecular methods
### Listeriosis Risk Groups

- **Pregnant**
  - In Washington, women eating Mexican-style unpasteurized cheese
- **Older**
- **Immunocompromised** (leukemia, other cancer, organ transplant, diabetes, steroids, AIDS, collagen vascular disease)
- **Overall 30% of cases perinatal**
- **Most cases occur after age 40**

### Yersinia

- **Identified 1934 or 1939** (two different claims)
- **Variously named including Germe X**
- **Current name 1964**
- **Able to multiple at refrigerator temperature, low oxygen**
- **Small non-spore forming gram negative rod**
- **Requires iron for growth**
- **Increase yield with cold enrichment**
- **Ribotype and PFGE for outbreaks**

### Yersinia enterocolitica Reservoirs

- **Most environmental isolates not pathogenic**
  - ponds, lakes
  - animals (asymptomatic): pigs (pharynx, feces), mammals (dogs, cats), birds, frogs, fish, flies, fleas, snails, crabs, oysters, various wild animals in Bulgaria (rabbit, boar, fox, otter, jackal)
- **Zoonotic disease of wild and domesticated birds and mammals (rodents)**
- **Human illness uncommon**

### Yersinia Routes of Transmission

- **Foodborne** – raw pork and pork products, beef, raw milk, food washed in contaminated water (sprouts)
- **Water** – natural water outbreaks reported Europe and Japan
- **Direct fecal-oral** – probably from domestic animals
- **Secondary transmission rare**
- **Rare transfusion infection from asymptomatic or mildly ill donor**

### Common Exposures – Yersiniosis

- **Humans**
- **Animals**
- **Food**
- **Water**
**Yersiniosis Infections**

- Incubation 3-7+ days
- Infections probably underdiagnosed
- Febrile diarrhea, rarely may be bloody
- Complications: abdominal pain (unnecessary appendectomy), ulceration of intestine, endocarditis, rash, bacteremia, erythema nodosa, urine infections, endocarditis, meningitis, hepatitis, peritonitis, abscesses, skin lesions

**Yersiniosis Infections**

- Post-infectious arthritis 2-3%, may be associated with HLA-B27
- Increased risk of severe complications for immunosuppressed, young, old
- Mortality up to 50% in case series but overall is rare
- *Y. enterocolitica* more common in younger children
- Georgia found 1% of stool positive at pediatric hospital, mostly under a year of age
- About 20% of Washington cases under a year of age

**Yersiniosis Case Definition**

- Clinical criteria: febrile diarrheal illness; may have only abdominal pain
- Laboratory criteria: Isolation of *Y. enterocolitica* or *Y. pseudotuberculosis* from stool, urine, or normally sterile site
- Confirmed case: laboratory confirmed OR meets clinical criteria and epidemiologically linked to lab confirmed case

**Yersiniosis Surveillance**

- Worldwide
- Higher incidence in Scandinavia, northern Europe, Japan
- Human illness more common in colder weather or temperate latitudes
- No national surveillance
- Estimated annual rate 6/100,000 in Norway
- Washington annual rate 4-7 per million – 25-35 cases annually, no deaths for years

**Yersiniosis Outbreaks**

- Outbreaks rare, particularly in the U.S.
  - 1976 chocolate milk in Oneida County, NY
  - 1982 tofu in King County, WA (water source)
  - 1995 milk in VT and NH (rinsed bottles; pig)