Listeriosis

1. Clinical characteristics
2. Human health burden
3. Trends in incidence
4. Sources
5. Conclusions
1. Clinical characteristics
1. Clinical characteristics

Pregnancy-associated infection

Non-pregnancy-associated infection

- Immune compromised
- Previously healthy
Pregnancy-associated infection

- Pregnant woman may have fever, or not have a defined illness

- Spread to the fetus
  - Sepsis, miscarriage, stillbirth

- Spread to the newborn baby
  - Meningitis
Non-pregnancy-associated infection

- Immune compromised (malignancy, organ transplant, immunosuppressive medications, HIV/AIDS)
  - Invasive disease (Sepsis, meningitis, encephalitis)

- Previously healthy
  - Most often asymptomatic
  - Diarrheal illness, rarely invasive
Clinical outcomes of 169 laboratory-confirmed cases in the FoodNet, 2000-2003

- **28 (17%)** pregnancy-associated cases
  - All invasive infections
  - 18 (65%) hospitalized
  - 7 (25%) associated with stillbirth

- **141 (83%)** non-pregnancy-associated cases
  - All invasive infections
    - 108 (76%) immune compromised
    - 33 (24%) previously healthy
  - 131 (92%) hospitalized
  - 22 (15%) died

- Overall hospitalization rate 82%
- Overall mortality 17%
2. Human health burden
Estimated annual human health burden of selected foodborne diseases, United States

<table>
<thead>
<tr>
<th>Pathogen</th>
<th>Illnesses</th>
<th>Deaths</th>
<th>Case-fatality rate</th>
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</thead>
<tbody>
<tr>
<td>Campylobacter</td>
<td>2,453,926</td>
<td>124</td>
<td>0.1%</td>
</tr>
<tr>
<td>Salmonella</td>
<td>1,412,498</td>
<td>582</td>
<td>0.8%</td>
</tr>
<tr>
<td>E. coli O157:H7</td>
<td>73,480</td>
<td>61</td>
<td>0.8%</td>
</tr>
<tr>
<td>Listeria</td>
<td>2,518</td>
<td>504</td>
<td>20.0%</td>
</tr>
</tbody>
</table>

Mead P, et al, *Emerging Infectious Diseases, 1999*

- 4 per million persons in general population
  - 2 per million among White, non Hispanic
  - 2 per million among African-Americans
  - 4 per million among Asians
- 2 per million among non-Hispanic
- 7 per million among Hispanics


- Among infants
  - Incidence rate 12 fold higher among Hispanics than among non-Hispanics

- Among women of childbearing age
  - Incidence rate 11 fold higher among Hispanics than among non-Hispanics

3. Trends in incidence
Early timeline: establishing surveillance

- **1985**: Large California outbreak: 142 cases with 40 deaths due to Mexican style soft cheese, queso fresco
- **1986**: Active surveillance began in sentinel locations
- **1989**: Associated with turkey hot dog – industry efforts to control
- **1996**: Active surveillance incorporated into FoodNet (with support of USDA-FSIS and FDA-CSFAN)
Trend in incidence of laboratory-confirmed *Listeria* infection in sentinel sites in the United States, 1986-2008

New regulatory policies, Industry efforts

FoodNet began
FoodNet Sites, 2009

~ 46 million persons (15% of U.S. population)
National Health objectives for the incidence of laboratory-confirmed *Listeria* infection

- Healthy People 2010 National Health Objective was a 50% reduction in the incidence of laboratory-confirmed *Listeria* infections
  - Baseline 1996-1998
  - Goal: incidence of 2.4 cases per 100,000 population in 2010

- Presidential Initiative accelerated National Health Objective to 2005

†The position of each line indicates only the relative change in the incidence of that pathogen compared with the years 1996-1998. The actual incidences of these infections can differ
Trend in incidence of laboratory-confirmed *Listeria* infection

- **No change** in *Listeria* infections in 2008 compared with previous 3 years

- National Health objective for 2005 was 0.24 cases/100,000 persons
  - 2004: 0.27 cases/100,000 persons
  - 2005: 0.30 cases/100,000 persons
  - 2006: 0.31 cases/100,000 persons
  - 2007: 0.27 cases/100,000 persons
  - 2008: 0.29 cases/100,000 persons
FIGURE 1. Percent change in incidence of laboratory confirmed bacterial and parasitic infections in 2008 compared with 2005-2007, by pathogen - Foodborne Diseases Active Surveillance Network, United States
Trend in incidence of laboratory-confirmed *Listeria*

- Incidence has declined from 1989
  - Two periods of greatest decline
    - 1989 to 1993
    - 1997 to 2001

- In 2009, the incidence was 36% below the incidence from the 1996-1998 FoodNet baseline
  - We did NOT meet the National Health Objective of a 50% reduction by 2005
4. Sources
Sources of laboratory-confirmed *Listeria* infections

- Source attribution: the partitioning of the human health burden to specific sources
  - Attribution may be conducted at different places from farm-to-table

- "Point of consumption" attribution
  - Case-control studies of sporadic infections
  - Outbreak investigations
Sources of laboratory-confirmed *Listeria* infections

- Determining the source is difficult
  - geographically dispersed
  - Incubation period of up to 30 days makes remembering food eaten difficult

- Case-control studies
  - Selection of controls difficult

- Outbreaks
  - Delays common
Case-control studies of sporadic infections

  - Uncooked or non-reheated hot dogs

  - Soft cheeses and food purchased at retail (deli counters)

- 2000-03 FoodNet (Varma J, *Clinical Infectious Diseases* 2007)
  - Hummus and melons purchased at retail (grocery stores)
Recent timeline: improving outbreak detection and response

- 1998: PulseNet began routine PFGE of *Listeria*
Trend in incidence of laboratory-confirmed cases of listeriosis in sentinel sites in the United States, 1986-2008

FoodNet began

PulseNet began subtyping
PulseNet molecular fingerprinting network

Participating laboratories

PFGE patterns

National database
Trend in incidence of laboratory-confirmed cases of listeriosis in sentinel sites in the United States, 1986-2008

Hot dog
Turkey deli meat
PulseNet began subtyping
Hot dog-associated outbreak 1998-1999

- 108 cases in 24 states, 13 were perinatal
- 14 deaths (all adults), 4 miscarriages
- Epidemiological investigation implicated eating hot dogs from Plant A

Turkey deli meat-associated outbreak, 2002

- 54 patients in 9 states
  - 42 non-pregnant adults
  - 8 deaths, 3 miscarriages/stillbirths
- Outbreak was caused by turkey deli meat
- Post-processing contamination likely
- USDA-FSIS issued new microbial sampling policy
  - Increased environmental testing
  - Can base recall on testing of food contact surfaces

Gottlieb S, et. al. *Clinical Infectious Diseases* 2006 42:29-36
Recent timeline: improving outbreak detection and response

- 1998: PulseNet began routine PFGE of *Listeria*
- 2001: Became nationally notifiable
- 2004: Began Listeria Initiative
Listeria Initiative

- All isolates are fingerprinted in PulseNet
- Encourage states to use a standard case interview form
- Monitoring for clusters
- Immediate analysis of clusters using case-control study design
  - Cases: serotype/genotype matched
  - Controls: patients with non-matching isolates
Trend in incidence of laboratory-confirmed cases of listeriosis in sentinel sites in the United States, 1986-2008

- PulseNet began subtyping Nationally notifiable Listeria Initiative
- Hot dog
- Turkey deli meat

Legend:
- Cases per million population
- Year

CDC
Centers for Disease Control and Prevention
**Lm Outbreaks reported to CDC Foodborne Outbreak Reporting System, 1978-2007**

Before PulseNet 1978-1997
- 5 outbreaks (no multistate outbreaks)
- Avg size of outbreak = 53.8 cases
- Food implicated in 5/5 outbreaks

Era of PulseNet 1998-2004
- 13 outbreaks (4 multistate outbreaks)
- Avg size of outbreaks = 20.3 cases
- Food implicated in 10/13 outbreaks

Era of Listeria Initiative 2004-2007
- 3 outbreaks (1 multistate)
- Avg size of outbreaks = 5.5 cases
- Food implicated in 6/9 outbreaks
## Outbreaks of *Listeria monocytogenes* Infections Reported to eFORS, 1998-2007

<table>
<thead>
<tr>
<th>Year</th>
<th>State</th>
<th>Serotype</th>
<th>Ill</th>
<th>Food</th>
<th>III</th>
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<td>1998</td>
<td>ML</td>
<td>4b</td>
<td>108</td>
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<td>1999</td>
<td>MN</td>
<td>1/2a</td>
<td>5</td>
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<td>1999</td>
<td>NY</td>
<td>1/2a</td>
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<td>1999</td>
<td>NY</td>
<td>1/2b</td>
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<tr>
<td>1999</td>
<td>FL</td>
<td>2</td>
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<tr>
<td>1999</td>
<td>ML</td>
<td>1/2a</td>
<td>11</td>
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<td>2000</td>
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<td>2000</td>
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<td>12</td>
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<td>2001</td>
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<td>2003</td>
<td>NY</td>
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<td>2003</td>
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<td>4b</td>
<td>12</td>
<td>queso fresco, unpasteurized</td>
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<tr>
<td>2005</td>
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<tr>
<td>2006</td>
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<tr>
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<td>MA</td>
<td>4b</td>
<td>4</td>
<td>pasteurized milk</td>
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### Summary
- **21 Outbreaks**
  - Deli meat = 7
  - Cheese = 4
  - Hot dogs = 2
  - Pate = 1
  - Salad = 1
  - Chicken = 1
  - Milk = 1
- Not reported = 4
Selected recent outbreaks: (1) February 2008

- Routine testing of chicken salad at retail yielded *Listeria*; product recalled
- Patient’s PFGE pattern matched that of the recalled chicken products (patient died)
- Prompt interview of patient’s family
  - Patient ate chicken salad from same plant but on list of recalled products
  - Recall expanded
- *Listeria* isolated at the plant; plant temporarily closed
Selected recent outbreaks:
(2) August-September 2008

• Outbreak in NYC hospital: 5 persons hospitalized for other reasons (immune suppressed), became infected with *Listeria* of same PFGE pattern; 3 patients die

• Outbreak caused by tuna salad contaminated in the hospital’s kitchen

• *Listeria* same PFGE isolated from kitchen
  – Immune suppressed patients not on special diet (survey of NY city hospitals finds similar in other hospitals)
Selected recent outbreaks:
(3) October 2008-March 2009

- Rapid patient interviews identifies Mexican style soft cheese in common (when have only 3 cases)
- Although outbreak lasts six months, identification of source was rapid
  - 8 patients – all Hispanic ethnicity; 7/8 pregnant (all stillborn)
  - Traced to commercially-produced, pasteurized Mexican-style soft cheese
  - *Listeria* with same PFGE isolated from patients, cheese, and plant: plant closed
Selected recent outbreaks:
(4) March 2008 – March 2009

Prolonged outbreak: No common exposures identified using rapid interviews
- 20 patients in 7 states
- Hypothesis interviews identifies alfalfa sprouts eaten by couple cases
- Case-control study implicated alfalfa sprouts
- Outbreak caused by alfalfa sprouts produced at a single grower
- *Listeria* of same PFGE pattern isolated from patients, sprouts, and sprouting facility: facility closed
Sources

- For last two decades outbreaks most often caused by:
  - Processed ready-to-eat meats, especially turkey and hot dogs
  - Typically contaminated after initial processing
  - Locus of contamination in the processing plant
  - Fresh soft cheeses made with raw milk
  - Recent outbreak associated with alfalfa sprouts

- Sporadic cases associated with:
  - Unreheated hot dogs, undercooked poultry
  - Foods from a deli, soft cheeses
  - Hummus, sliced melons
5. Conclusions
General conclusions from the epidemiological data

- **BURDEN**
  - Mortality is high (about 20%)
  - Highest incidence in Hispanics

- **TREND**
  - Overall incidence has declined from 8 per million to 2.9 per million in the last two decades
  - Little change since 2002: did NOT meet National Goal

- **SOURCE**
  - Enhanced surveillance leading to more outbreaks
  - Novel foods continue to be identified: Produce identified for first time

- Targeted efforts to reduce contamination have been followed by declines in incidence of human illness
Thank you

The findings and conclusions in this presentation are those of the author and do not necessarily represent the views of the Centers for Disease Control and Prevention.