Evaluation of Listeriosis Surveillance in San Diego County, 2005–2010

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Public Health Significance of Listeriosis

- Around 800 laboratory confirmed cases per year
  - Estimated to be ~1,600 including undiagnosed cases
- Hospitalization rate 94% for confirmed cases
- High case-fatality rate: 20%-30%
  - Accounts for 19% of foodborne illness related deaths
- Most cases sporadic
- Outbreaks uncommon
  - 3 to 4 per year
- Long incubation period
Listeria monocytogenes

- Gram (+) rod
- Found in soil, water, mud
- Present in unpasteurized milk and milk products, manure
- Hardy organism
Exposure and Transmission

- Ingestion of contaminated food
  - Unpasteurized soft cheeses [queso fresco]
  - Raw milk
  - Ready-to-eat foods
  - Produce

- Neonatal infections
  - In utero
  - Passage through infected birth canal
At risk populations

- Neonates
- Pregnant women
  - 13x more likely to become infected
  - 17% of cases
  - Pregnancy-associated cases more than 3x more likely to report Hispanic ethnicity
- Underlying conditions
- Elderly
- Weakened immune systems
  - AIDS patients 300x more likely to become infected
Clinical Presentation

- **Noninvasive infection**
  - Febrile gastroenteritis
  - Asymptomatic infection

- **Invasive infection**
  - Febrile gastroenteritis
  - Bacteremia
  - Meningoencephalitis

- **Pregnant women**
  - Mild, flu-like illness
  - Miscarriage
  - Stillbirth
  - Premature delivery
Incidence Rate of Listeriosis in San Diego County, California, and the United States, 2005–2009
## Case Demographics in San Diego County, 2005 – 2010 (N=93)

<table>
<thead>
<tr>
<th>Variable</th>
<th>n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Case-fatalities</td>
<td>4 (4)</td>
</tr>
<tr>
<td>Female</td>
<td>55 (59)</td>
</tr>
<tr>
<td>Pregnant (N=91)</td>
<td>15 (16)</td>
</tr>
<tr>
<td>Fetal Loss (N=15)</td>
<td>8 (53)</td>
</tr>
<tr>
<td>Hispanic (N=13)</td>
<td>8 (62)</td>
</tr>
<tr>
<td>Age ≤ 1</td>
<td>7 (8)</td>
</tr>
<tr>
<td>Age ≥ 65</td>
<td>39 (42)</td>
</tr>
<tr>
<td>Race (N=82)</td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>64 (78)</td>
</tr>
<tr>
<td>Black or African American</td>
<td>1 (1)</td>
</tr>
<tr>
<td>Asian or Pacific Islander</td>
<td>10 (12)</td>
</tr>
<tr>
<td>Hispanic Ethnicity (N=82)</td>
<td>24 (29)</td>
</tr>
</tbody>
</table>
Purpose of Listeriosis Surveillance

- Monitor morbidity and mortality
- Detect changes in incidence over time
- Comply with the California Code of Regulations Reporting laws
- Facilitate disease prevention
- Identify possible outbreaks
Evaluation Objectives

- Characterize system attributes
- Identify strengths and weaknesses of system
- Determine completeness of reporting
- Make recommendations to improve the system
Methods

- Analyzed
  - County disease registry data
  - Hospital discharge data
  - Case report forms/risk history forms (n=30)
  - Patient medical and laboratory records (n=46)
- Audited the reporting of 4 hospital laboratories
- Discussions with county epidemiology staff
Confirmed Case Definition

- Clinically compatible case that is laboratory confirmed
- Clinical description
  - Febrile gastroenteritis
  - Bacteremia or meningoencephalitis
  - Miscarriage or stillbirth
- Laboratory criteria
  - Isolation of *L. monocytogenes* (LM) from sterile site (e.g. blood or CSF)
  - Isolation of LM from placental or fetal tissue
System Operation

Positive LM Culture

Provider Laboratory

Provider
System Operation

Positive LM Culture

Provider Laboratory

Provider

County Epidemiology
- Case investigation
System Operation

Positive LM Culture

Provider Laboratory

County Public Health Laboratory
- Confirmatory test

Provider

County Epidemiology
- Case investigation
System Operation

- Positive LM Culture
  - Provider Laboratory
    - County Public Health Laboratory - Confirmatory test
  - Provider Laboratory
    - County Epidemiology - Case investigation
    - State Public Health Laboratory
      - PFGE
      - Upload to PulseNet
Positive LM Culture

Provider Laboratory

County Public Health Laboratory
- Confirmatory test

State Public Health Laboratory
- PFGE
- Upload to PulseNet

County Epidemiology
- Case investigation

State Public Health Department
Simplicity

- Established reporting structure
- Straightforward case definition

Lengthy case investigation
- 3 case report forms
  - County – 10 pages
  - State – 7 pages
  - CDC – 15 pages
- Supplemental cheese consumption questionnaire
Flexibility

- Updating local case report forms time consuming
- Online forms complicate county information systems
- Interoperability concerns between state CalREDIE and county systems
Acceptability

- Providers and laboratories required to report cases
- Audit of hospital laboratories: 100% reporting
  - 4/11 laboratories audited
  - Represents 42% (38/93) of cases
- Lengthy case interviews, usually at least 1 hour
Timeliness

- Mandatory reporting by providers and laboratories within 1 working day of diagnosis
  - 77% of cases (69) reported within 1 working day
  - Average and median: 1 working day
  - Range: 0 – 10 working days
Data Quality: Completion of Select Case Report Questionnaire Sections (N=30)

- Assoc. with Other Cases
- Lab Info
- Medications/Treatment
- Clinical Info
- Food History
- Pregnancy Status
- Outcome
- Demographics
- Underlying Conditions
- Contact Info

Percent
# Pregnancy Status Identification in County Disease Registry Among Pregnant Women (N=15)

<table>
<thead>
<tr>
<th>Pregnancy Identification</th>
<th>n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Correctly Identified</td>
<td>5 (33)</td>
</tr>
<tr>
<td>Not Identified</td>
<td>10 (66)</td>
</tr>
</tbody>
</table>
## Completeness of Reporting

<table>
<thead>
<tr>
<th></th>
<th>In Hospital Discharge Data</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yes</td>
</tr>
<tr>
<td>In County</td>
<td></td>
</tr>
<tr>
<td>Disease Yes</td>
<td>73</td>
</tr>
<tr>
<td>Disease No</td>
<td>10</td>
</tr>
</tbody>
</table>

Proportion Reported: $\frac{93}{103} = 90\%$
### Predictive Value Positive

<table>
<thead>
<tr>
<th>Reported to County</th>
<th>Confirmed Case</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yes</td>
<td>Yes</td>
<td>93</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Predictive Value Positive: 93/94 = 99%**
### Representativeness of Cases in County Disease Registry Compared to Full Population of Cases

<table>
<thead>
<tr>
<th>Variable</th>
<th>Disease Registry (N=93)</th>
<th>Disease Registry + Discharge Data (N=103)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>55 (59)</td>
<td>59 (57)</td>
</tr>
<tr>
<td>Pregnant*</td>
<td>15 (16)</td>
<td>18 (17)</td>
</tr>
<tr>
<td>Age ≤ 1</td>
<td>7 (8)</td>
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<td></td>
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<td>71 (76)</td>
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<tr>
<td>Hispanic Ethnicity*</td>
<td>24 (29)</td>
<td>28 (30)</td>
</tr>
</tbody>
</table>

*Incomplete Data
Stability

- Mandatory reporting
- Dedicated epidemiology staff
- Lack of funding for PFGE testing in public health laboratory
Summary

- **Strengths**
  - Simplicity
  - Acceptability
  - Timeliness
  - Data quality
  - Completeness
  - Predictive value positive
  - Representativeness

- **Areas for Improvement**
  - Multiple case report forms
  - Flexibility
  - Stability
Recommendations

- Simplify case report forms
  - Use county form with a CDC supplement
  - Create online form in county registry
- Completely fill laboratory and case linkage sections of case report form, and update with new information as needed
- Make “pregnancy status” field mandatory field in county disease registry
- If case is pregnant, find and document infection/health outcome of neonate (and vice versa)
Limitations

- Hard copy of case reports and risk history forms unavailable during 2005–2007
- Hospital discharge data does not contain personal identifier information
- Difficult to obtain hospital laboratory records
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