CHANGING EPIDEMIOLOGICAL PATTERNS OF *SALMONELLA* serotype ENTERITIDIS IN BARBADOS: IMPLICATIONS FOR TOURISM AND TRADE

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Background

*Salmonella* serotype Enteritidis (SE)

- Pathogen of global public health concern
- Emerged in 1980’s; growing worldwide pandemic
- Leading cause of salmonellosis in most countries
- Poultry and Eggs harbor the organism
- SE contaminates egg contents before the shell is formed
- Intact Shell Eggs: major source of SE
- Raw & Undercooked Egg Dishes: main implicated foods
- Polyclonal: different geographic regions- specific phage type
SE in the Caribbean

- First reported in 1980: Most common *Salmonella* by 1996

  - Trinidad and Tobago:
    - From 1% in 1992 to 69% in 1996
    - Since 1995: most prevalent *Salmonella*

- Barbados:
  - From 3% to 15% from 1990 to 1999
  - 2nd most common *Salmonella*, after S.typhimurium

- Jamaica:
  - 11% to 49% from 1997-1999
  - Most common *Salmonella* since 1998

- Multiple hotel outbreaks involving tourists in B’dos & J’ca
SE in Trinidad and Tobago (Indar-Harrinauth et al. 2001)

- Isolation rate/100,000 pop: **0.8** in 1992 to **8.5** in 1996
- Seasonal occurrence: 41% during Dec-Jan.
- Children <10yr: highest rate of infection (25/100,000 pop)
- **Raw & undercooked eggs**: major vehicles of infection
- Main foods: Homemade eggnog, cake batter, ice cream; raw egg-containing beverages: *reflect cultural customs*
- Refrigerated eggs: protective against SE infection
- PT4 is the dominant SE phage type
Objectives

**SE study in Barbados**

- determine the occurrence and distribution of SE
- describe the demographic, clinical and socio-cultural features of human SE infections
- define the etiology (cause) of SE infection
- identify the potential sources and risk factors for SE
- recommend appropriate Prevention Measures
Methods

- **Descriptive Epidemiological Studies**
  - Retrospective (1996-1998)
  - Prospective Study: (Aug ‘98-Nov 2000)

- **Matched Case Control study** (Feb ‘99-March 2001)
  - Age -and- neighborhood matched study (2 controls/case)
    - (age group criteria: <1 ,1- 4, 5-9, 10-19, 20-49,>50)
  - std. questionnaire, face to face interviews
  - signed informed consent

- **Outbreak Investigations**: cohort analysis

- **Statistical Analysis**: Epi- Info 6.04
  - Odds Ratio >1, p< 0.05, C.I: >1
  - **Serotyping** (Ewing 1986) ; **Phagetype**ing (Ward et al.1987)
RESULTS
SE in Barbados

- 10-year Review: 1990 to 1999
  - Percent increase: 3% to 15%
  - Isolation rate: 1.1 to 10.5 /100,000 pop

- 3-year Review: 1996-1998
  - SE doubled (6-11%), ST decreased (55-35%)
  - Seasonal variation: 67% in Summer (June-Aug)
  - Children <10yr: 44% of cases; (39 /100,000 pop)
  - 33% in 20-49 age group; 10% >50 years
  - 61% in 2 parishes (includes main tourist belt)
Salmonella Isolates by Serotype, Barbados, 1990–1999

Percentage of all isolates


SE
ST
Others
SE Incidence by Age Group, Barbados, 1996-1998
Prospective Descriptive study (Aug 98 - Nov 2000)

Characteristics of 60 culture confirmed SE cases

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Percent of Cases (n=60)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residents: Visitors</td>
<td>85% : 15%</td>
</tr>
<tr>
<td>Children &lt;10 years</td>
<td>49%</td>
</tr>
<tr>
<td>Africans: Mixed: Caucasians</td>
<td>85%: 10%:5%</td>
</tr>
<tr>
<td>Males :Females</td>
<td>47% : 53%</td>
</tr>
<tr>
<td>Ass. with Outbreaks: family: outside</td>
<td>37%: 23%</td>
</tr>
<tr>
<td>Hospitalization</td>
<td>32%</td>
</tr>
<tr>
<td>Treatment: ORF :IV : Antibiotics</td>
<td>95% : 18 % : 8 %</td>
</tr>
<tr>
<td>Underlying Illness</td>
<td>7%</td>
</tr>
<tr>
<td>Do not usually Refrigerate eggs home</td>
<td>30%</td>
</tr>
<tr>
<td>Do not usually Wash eggs home</td>
<td>71%</td>
</tr>
</tbody>
</table>
**Reported Symptoms among 60 confirmed SE cases, Barbados, August 1998-Nov 2000**

<table>
<thead>
<tr>
<th>Symptom</th>
<th>Cases (N = 60)</th>
<th>(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diarrhea</td>
<td>60</td>
<td>(100)</td>
</tr>
<tr>
<td>Ab. cramps</td>
<td>53</td>
<td>(88)</td>
</tr>
<tr>
<td>Fever</td>
<td>53</td>
<td>(88)</td>
</tr>
<tr>
<td>Bloody stool</td>
<td>24</td>
<td>(40)</td>
</tr>
<tr>
<td>Vomiting</td>
<td>29</td>
<td>(48)</td>
</tr>
<tr>
<td>Nausea</td>
<td>21</td>
<td>(5)</td>
</tr>
<tr>
<td>Headache</td>
<td>6</td>
<td>(10)</td>
</tr>
<tr>
<td>Chills</td>
<td>5</td>
<td>(8)</td>
</tr>
<tr>
<td>Muscle Aches</td>
<td>5</td>
<td>(8)</td>
</tr>
</tbody>
</table>
Foods Consumed by SE cases 3 days before Illness Onset, Barbados, August 1998-Nov 2000

- Any food with Eggs: 85%
- Food with Raw Eggs: 1.6%
- Undercooked Eggs: 65%
- Cooked Eggs: 35%
- Eggs in Baked Dishes: 30%
- Caesar salad with eggs: 20%
- Cooked chickens: 72%
- Undecooked chickens: 22%
Matched Case Control Study (Feb 99- March 2001)
38 cases: 76 controls

Univariate analysis of selected risk factors for SE infection

<table>
<thead>
<tr>
<th>Risk Factor</th>
<th>Cases</th>
<th>Controls</th>
<th>mOR</th>
<th>95% CI</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shell Eggs</td>
<td>87%</td>
<td>50%</td>
<td>8.9</td>
<td>2.3-54.</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Undercook Eggs</td>
<td>88%</td>
<td>8%</td>
<td>44.8</td>
<td>7.8-1502</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Soft boiled eggs</td>
<td>51%</td>
<td>5%</td>
<td>31.2</td>
<td>5.2-1103</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Scrambled eggs</td>
<td>21%</td>
<td>2.6%</td>
<td>9.3</td>
<td>1.6-67</td>
<td>0.001</td>
</tr>
<tr>
<td>Caesar Salad</td>
<td>16%</td>
<td>1%</td>
<td>7.9</td>
<td>1.4-73</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Undercook Chicken</td>
<td>39%</td>
<td>3%</td>
<td>8.4</td>
<td>1.8-72</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Pooling of eggs</td>
<td>24%</td>
<td>5%</td>
<td>3.2</td>
<td>4.5-1101</td>
<td>&lt;0.01</td>
</tr>
</tbody>
</table>
SE Outbreaks (Aug 1998-March 2001)

- 39 SE outbreaks
  - Family: 62%
  - Outside home (restaurants, hotels, fast food): 37%
    - Hotels Outbreaks: 53%
      - Majority: August; main tourist belt region
  - Contributory factors:
    - Poor kitchen and personal hygiene
    - Poor food safety/food handling practices
    - Pooling
    - Cross contamination
    - Lack of knowledge on food safety
<table>
<thead>
<tr>
<th>Month</th>
<th>No. ill</th>
<th>Food</th>
<th>PTs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aug’98</td>
<td>12 (8 visitors)</td>
<td>Caesar Salad(c eggs), Egg-glazed pastries</td>
<td>PT 8</td>
</tr>
<tr>
<td>Nov ‘98</td>
<td>8 (6 visitors)</td>
<td>Scrambled eggs (soft yolk)</td>
<td>PT 8</td>
</tr>
<tr>
<td>June ‘99</td>
<td>5 (4 visitors)</td>
<td>Fried eggs (soft yolk)</td>
<td>PT 4</td>
</tr>
<tr>
<td>Aug’99</td>
<td>2 (3 visitors)</td>
<td>U/cooked chicken</td>
<td>PT2</td>
</tr>
<tr>
<td>Aug’00</td>
<td>7 (3 visitors)</td>
<td>Caesar Salad(c eggs)</td>
<td>PT 8</td>
</tr>
<tr>
<td>Jan ‘01</td>
<td>3 (2 visitors)</td>
<td>U/cooked chicken</td>
<td>PT2</td>
</tr>
</tbody>
</table>
## Family (home) SE outbreaks

<table>
<thead>
<tr>
<th>Month</th>
<th>No ill</th>
<th>Food</th>
<th>PTs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oct’98</td>
<td>4</td>
<td>Soft boiled eggs (pooled)</td>
<td>PT8</td>
</tr>
<tr>
<td>Nov’98</td>
<td>2</td>
<td>Raw cake batter</td>
<td>PT 8</td>
</tr>
<tr>
<td>Dec’98</td>
<td>8</td>
<td>Soft boiled eggs</td>
<td>PT 4</td>
</tr>
<tr>
<td>Feb’99</td>
<td>3</td>
<td>Fried eggs (soft yolk)</td>
<td>PT 8</td>
</tr>
<tr>
<td>Mar’99</td>
<td>4</td>
<td>Scrambled eggs</td>
<td>PT 8</td>
</tr>
<tr>
<td>April’99</td>
<td>4</td>
<td>Soft boiled eggs (pooled)</td>
<td>PT 8</td>
</tr>
<tr>
<td>July ‘99</td>
<td>5</td>
<td>Undercooked chicken</td>
<td>PT 2</td>
</tr>
<tr>
<td>June’00</td>
<td>5</td>
<td>Lasagna (with eggs)</td>
<td>PT4</td>
</tr>
<tr>
<td>Sept’00</td>
<td>3</td>
<td>Soft boiled eggs (pooled)</td>
<td>PT8</td>
</tr>
<tr>
<td>Nov’00</td>
<td>6</td>
<td>Scrambled eggs</td>
<td>PT8</td>
</tr>
<tr>
<td>Jan’01</td>
<td>4</td>
<td>Soft boiled eggs (pooled)</td>
<td>PT8</td>
</tr>
</tbody>
</table>
Phage types of human SE isolates
Barbados, 1997-2000

Year of Isolation

Percentage of phage type

PT8
PT4
PT2

1997 1998 1999 2000
Conclusions

- SE infection in Barbados is associated with
  - undercooked eggs (m0R 8.4, CI 6.8-1937)
  - undercooked chickens (m0R 8.2, CI 1.5-73.6)
  - 1st time undercooked chicken :SE source in C’bean

- Main foods: Soft boiled eggs, scrambled eggs and fried eggs (soft yolk), caesar salad

- PT 8 predominate in Barbados, followed by PT4 and 2
  - first time PT2 identified in C’bean

- SE outbreaks and cases -involved visitors:
  - serious implications for tourism and trade
Epidemiology of SE in Barbados vs Trinidad

- Although both egg associated, different foods
- Different cultural practices
  - Raw egg foods and drinks not common in Bdos
  - Refrigeration
- Chickens not found as a SE source in T & T
- Different seasonal occurrence
- Visitors: 15% cases in Bdos, none in T&T
- Different PTs: different entry source of for SE
- Hotel outbreaks and Tourism
  - Use of imported table eggs and chickens
Recommendations

SE in Bdos: Implications for Health, Food Safety, Trade, Tourism

- Farm to Table approach for prevention and control
- Improvement in Surveillance and Response, Outbreak Inv
- Public Health Education: targeted to Specific groups
  - Thorough cooking of all egg-containing dishes
  - Thorough cooking of chicken-containing dishes
  - Avoid pooling of eggs
  - Refrigeration of eggs at home
- Reduction of SE in flocks
  - Hatchery surveillance; environmental testing, traceback
- Regulate importation of table eggs, feeds and chickens
- Virulence studies on SE PTs