Epidemiologic surveillance of human multi-drug resistant *Salmonella* Newport infections in Wisconsin, 2003 - 2006

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**Background: *Salmonella***

- Human *Salmonella* infections in U.S. per year
  - >1 million cases, 15,000 hospitalized, 500 deaths
  - Total cost nearly $3 billion
- Multi-drug resistant *Salmonella* infections
  - Increase in hospitalizations, morbidity, mortality
  - Linked to antibiotic use in human, veterinary medicine
  - Resistance to critically important antimicrobials is of particular concern
Background: multi-drug resistant *Salmonella* Newport

- Phenotype Newport-MDR AmpC (MDR-SN)
- Resistant to 9 antimicrobials
- ↓ susceptibility or resistant to ceftriaxone
- Genes located on plasmid → transfer of resistance to previously susceptible bacteria
- Risk factors include exposure to dairy cattle, raw milk products, ground beef, other foods

Part 1: retrospective study methods

- Compiled data from human *Salmonella* Newport infections among Wisconsin residents, 2003 – 2005
- Serotyping and susceptibility testing by Wisconsin State Laboratory of Hygiene
- Data analyzed using Epi Info 2002
- Determined prevalence of multi-drug resistance (MDR)
- Evaluated case characteristics, infection rates, reported exposures
- Assessed associations between resistance and potential risk factors
### Part 2: prospective study methods

- Wisconsin residents with *S. Newport* infection, 2006
- Designed comprehensive questionnaire, based on MN Department of Health foodborne illness questionnaire
- Interviewed case patients; data entered and analyzed using Epi Info 2002
- Compared case characteristics and exposures for MDR-SN vs. non-resistant (pansusceptible) infections
- Serotyping and susceptibility testing by Wisconsin State Laboratory of Hygiene

### Results: patient demographics, 2003–2005

- **n = 268**
- **57% female**
- **Age (yrs)**
  - Range: <1 – 96
  - Median: 34
### Significant associations between reported variables and MDR-SN infection, 2003 - 2005

<table>
<thead>
<tr>
<th>VARIABLE</th>
<th>MDR-SN resistance (n = 137)</th>
<th>No resistance detected (n = 95)</th>
<th>Odds ratio</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male gender</td>
<td>Yes: 71, No: 66</td>
<td>Yes: 29, No: 67</td>
<td>2.5</td>
<td>0.001a</td>
</tr>
<tr>
<td>Contact with cattle</td>
<td>20: No detected, 117: Yes</td>
<td>0: No detected, 95: Yes</td>
<td>undefined</td>
<td>0.0001a</td>
</tr>
<tr>
<td>Contact with farm/pet zoo</td>
<td>14: No detected, 123: Yes</td>
<td>0: No detected, 95: Yes</td>
<td>undefined</td>
<td>0.001a</td>
</tr>
<tr>
<td>Drank raw milk</td>
<td>10: No detected, 127: Yes</td>
<td>0: No detected, 95: Yes</td>
<td>undefined</td>
<td>0.006b</td>
</tr>
<tr>
<td>Contact with pet reptile</td>
<td>0: No detected, 137: Yes</td>
<td>7: No detected, 88: Yes</td>
<td>0.00</td>
<td>0.002b</td>
</tr>
</tbody>
</table>

- a: Mantel-Haenszel p-value.
- b: Fisher's exact two-tailed p-value.


*Based on preliminary 2004 data from Centers for Disease Control and Prevention National Antimicrobial Resistance Monitoring System.
Part 2: demographic and antimicrobial resistance analyses, 2006 case patients

- 24 Wisconsin case patients with laboratory-confirmed *Salmonella* Newport infection to date in 2006
- 63% female
- 67% MDR-SN
- Male gender associated with MDR-SN infection

Clinical characteristics of patients with MDR-SN and pansusceptible infections, 2006

<table>
<thead>
<tr>
<th>CHARACTERISTIC</th>
<th>MDR-SN resistance (n=11)</th>
<th>No resistance detected (n = 5)</th>
<th>Relative risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diarrhea</td>
<td>11 (100%)</td>
<td>5 (100%)</td>
<td>1.32</td>
</tr>
<tr>
<td>Median days (range) of diarrhea</td>
<td>5 (3 – 21)</td>
<td>9 (3 – 24)</td>
<td>N/A</td>
</tr>
<tr>
<td>Bloody stool</td>
<td>4 (36.4%)</td>
<td>4 (80%)</td>
<td>1.4</td>
</tr>
<tr>
<td>Median days (range) of bloody stool</td>
<td>4.5 (1 – 19)</td>
<td>2 (1 – 21)</td>
<td>N/A</td>
</tr>
<tr>
<td>Vomiting</td>
<td>6 (54.5%)</td>
<td>2 (40.0%)</td>
<td>3</td>
</tr>
<tr>
<td>Fever</td>
<td>8 (72.7%)</td>
<td>2 (40.0%)</td>
<td>3.6</td>
</tr>
<tr>
<td>Treated with antibiotics</td>
<td>9 (81.8%)</td>
<td>3 (60.0%)</td>
<td>1.4</td>
</tr>
<tr>
<td>Hospital admission</td>
<td>3 (27.3%)</td>
<td>1 (20.0%)</td>
<td>1.4</td>
</tr>
</tbody>
</table>
Reported exposures among case patients interviewed in 2006 (n = 16)

- Significantly associated* with MDR-SN infection:
  - Lived on or visited dairy farm (p = 0.003)
  - Ate ground beef from own dairy herd or from butcher (p = 0.03)

- Other exposures among patients with MDR-SN infection:
  - Drank raw milk (n = 2)
  - Pig ears, rawhide (n = 1)
  - Puppy with salmonellosis after fed raw steak (n=1)

* Fisher’s exact test

Human population-based MDR-SN infection rates by Wisconsin public health region, 2003 - 2006

Data are MDR-SN case rates per 10,000 persons, 2003 – 2006.
Public health region populations based on 2004 WISH estimates.
Conclusions

- Substantial increase in prevalence of MDR-SN in Wisconsin vs. national data
- Resistance to ceftriaxone of particular concern, and may be spread to previously susceptible bacteria
- Persons exposed to dairy cattle, unpasteurized milk, and ground beef may be at increased risk for MDR-SN infection
- Continuation of prospective case-control study, enhanced surveillance and preventive efforts are warranted

Acknowledgements

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  - *WI State Laboratory of Hygiene*
- Patrick Remington
  - *UW School of Medicine & Public Health*
- Felicita Medalla
  - *Centers for Disease Control and Prevention National Antimicrobial Resistance Monitoring System*
Extra: Newport-MDR AmpC

- Resistant to amoxicillin/clavulanate, ampicillin, cefoxitin, ceftiofur, cephalothin, chloramphenicol, streptomycin, sulfamethoxazole, and tetracycline

- At least decreased susceptibility to ceftriaxone