Salmonella Atlas
Serotype-Specific Surveillance in Kentucky
2011-2015

Kentucky Department for Public Health
Division of Epidemiology and Health Planning
Infectious Disease Branch
Reportable Disease Section
275 East Main St.
Frankfort, KY 40621
# Salmonella Serotypes

**Map and Graphs**  
**Quick Reference**

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<td>S. I 4,5,12: I -</td>
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<td>S. Muenchen</td>
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<td>S. Stanley</td>
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<td>S. Thompson</td>
<td>37</td>
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<tr>
<td>S. Typhimurium</td>
<td>38</td>
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</table>
Salmonella Atlas
Serotype-Specific Surveillance in Kentucky
2011-2015

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Introduction

In the United States, salmonellosis is estimated to cause over 1.2 million illnesses a year, leading to some 23,000 hospitalizations and 450 deaths\(^5\).

Every year *Salmonella* organisms are one of the most common causes of laboratory-confirmed cases of enteric disease reported by the Foodborne Disease Active Surveillance Network (FoodNet)\(^1\).

Rates of infection are highest among children younger than 4 years of age. Invasive infections and mortality are higher in infants, elderly people and those with immunosuppressive conditions.

The principal reservoirs for *Salmonella* include birds, mammals, reptiles, and amphibians. Primary food vehicles of transmission include food of animal origin such as poultry, beef, eggs, and dairy products. Other foods such as fruit, vegetables, peanut butter, etc. have also been vehicles for *Salmonella* outbreaks but are contaminated by an infected animal or human carrier. Transmission also occurs by ingestion of contaminated water, contact with infected reptiles or amphibians, and rodents\(^1\).

Infectious dose varies among individuals, foods, and amounts of foods consumed.

There are over 2500 *Salmonella* serotypes: approximately 2,000 cause human disease. Most serotypes causing human disease are divided among O – antigen groups A through E. *Salmonella* Typhimurium (serogroup B) and *Salmonella* Enteritidis (serogroup D) commonly cause enterocolitis in the United States. In Kentucky, the top four *Salmonella* serotypes Typhimurium, Enteritidis, Newport, and Javiana, accounted for over half of all *Salmonella* infections in the state.

In 2005, the Council of State and Territorial Epidemiologists (CSTE) adopted a position statement calling for serotype-specific reporting of laboratory-confirmed salmonellosis cases. Thus, the intention of this report is to provide a graphic epidemiologic summary of the common *Salmonella* serotypes reported in Kentucky during the period of 2011-2015. It should serve as a reference to public health workers on the epidemiology of these serotypes and provide a basis for comparing local cases to state level data.
Case Definitions and Nomenclature

CDC Case Definition (2012)

Clinical Description
An illness of variable severity commonly manifested by diarrhea, abdominal pain, nausea, and sometimes vomiting. Asymptomatic infections may occur, and the organism may cause extra intestinal infections.

Laboratory Criteria for Diagnosis
Suspect: Detection of *Salmonella* from a clinical specimen using a non-culture based method.

Confirmed: Isolation of *Salmonella* from a clinical specimen. Specimen may be blood, gallbladder aspirate, sputum, stool, urine, wound, etc.

CDC Case Classification (2012)

Confirmed
A case that meets the laboratory criteria for diagnosis. When available, O and H antigen serotype characterization should be reported. Both asymptomatic infections and infections at sites other than the gastrointestinal tract, if laboratory confirmed, are considered confirmed cases that should be reported.

Probable
A clinically compatible case that is epidemiologically linked to a confirmed case. All epi-linked cases need to be entered into the National Electronic Disease Surveillance System (NEDSS).

Suspected
A case that meets the suspect laboratory criteria for diagnosis.

Nomenclature

The genus *Salmonella* is composed of two species: *enterica* and *bongori*. *Salmonella enterica* is further subdivided into subspecies, which are designated by name and roman numerals: *enterica* (I), *salame* (II), *arizonae* (IIIa), *diarizonae* (IIIb), *houtenae* (IV), and *indica* (VI). Subspecies are further classified into serotypes based on the surface structure of their O and H antigens. Serotypes may be designated by name or antigenic formula (see below). Serotypes are further characterized using pulsed-field gel electrophoresis (PFGE), which identifies the strain.

Classification of *Salmonella*:

Genus → Species → Subspecies → Serotype

*Salmonella* → *enterica* → *enterica* → Typhimurium OR I 4,5,12:i:1,2

Antigenic Formula: O antigens: Phase 1H antigen: Phase 2H antigen.

4,5,12 1 2
Methods

Serotype Inclusion and Exclusion Criteria
A total of 117 *Salmonella* serotypes were reported in Kentucky between 2011 through 2015. Detailed analyses and mapping in this Atlas (See description of Figures A-F below) are reported on only the top 26 serotypes. These 26 serotypes had 10 or more cases each and represent over 92 percent of all recorded cases of *Salmonella* in the period 2011 through 2015. Graphs depicting further analysis of the variables “month,” “age,” and “sex” (See description of Figures 1-3 below) are presented on the five most prevalent serotypes in the atlas but not for the other 21 serotypes due to the limited amount of data available for these serotypes.

Detailed serotype analyses (beginning on page 9) are arranged alphabetically by serotype.

Figures
A series of figures (A-F) are presented for Total *Salmonella* Serotypes and each individual serotype analysis (the top 26) included in this report. Figures A-F were generated using ArcMAP GIS version 9.3. In the detailed analysis of each serotype:

- Figure A shows the 5-year average incidence rates of *Salmonella* per county. Incidence rates were calculated based on 2014 county populations.

- Figures B-F present county-specific cases for each year in the 2011 to 2015 period. These maps are included to display the temporal changes in disease prevalence from year to year.

An additional set of figures (1-3) is presented for Total *Salmonella* Serotypes and for each of the top five *salmonella* subspecies included in this report.

- Figure 1 presents the total case count by month for each of the years in the five-year period.

- Figure 2 shows the average case count by month for three age groups. The age group ranges were applied from those used in the CDC’s Atlas of *Salmonella* in the United States, 1968-2011.

- Figure 3 presents the average case count by month and sex for the five years of data.
Salmonella Serotype Frequency
2011-2015

Typhimurium
Enteritidis
Newport
I,4,5,12:i-
Javiana
Bareilly
Infantis
Thompson
Heidelberg
Muenchen
Montevideo
Java
Braenderup
Poona
Berta
Norwich
Mbandaka
Hartford
Oranienburg
Agona
Saintpaul
Braenderup
Java
Montevideo
Muenchen
Heidelberg
Thompson
Infantis
Bareilly
Javiana
I,4,5,12:i-
Enteritidis
Typhimurium
# Salmonella Serotype Frequency 2011-2015

## Very Common (100-650 Cases)

<table>
<thead>
<tr>
<th>Very Common</th>
<th>Typhimurium</th>
<th>Enteritidis</th>
<th>Newport</th>
<th>Javiana</th>
<th>I,4,5,12:i-</th>
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</thead>
</table>

## Common (25-99 Cases)

<table>
<thead>
<tr>
<th>Common</th>
<th>Bareilly Infantis Thompson Heidleburg Muenchen Montevideo Java Braenderup Saintpaul Agona Oranienburg Hartford</th>
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</thead>
</table>

## Less Common (10-24 Cases)

<table>
<thead>
<tr>
<th>Less Common</th>
<th>Mbandaka Norwich Berta Poona Stanley Anatum Altona Mississippi Hadar Uganda</th>
</tr>
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</table>

## Rare (3-9 Cases)

<table>
<thead>
<tr>
<th>Rare</th>
<th>Cotham Arizonae Sandiego Schwarzengrund Bovismorbificans Kentucky I,4,5,12:B:- Miami Paratyphi A Rubislaw</th>
</tr>
</thead>
</table>

## Very Rare (1-2 Cases)

<table>
<thead>
<tr>
<th>Very Rare</th>
<th>Abaetetuba Dahra Holcomb IIIA G, Z51:- Marina Richmond Adelaide Derby Houtenae IIIB 48:C:Z Matopeni Rissen Agbeni Eppendorf Hvittingfoss IIIB 50:K:Z Minnesota Senftenberg Amager Gaminara I 1,4,5,12:-:1,2 IIIB G,Z51:- Monschaui Shubra Anecho Group 51 I 4,12:i:- IIIIB 50:K Nima Solt Bardo Group 60 I 6,7,:-:1,5 Ituri Ohio Pennsylvania Tennessee Bispebjerg Group E I 6,7:-:e,n,z15 Jangwani Onderstepoort Urbana Cerro Group H I 6,7:k:= Johannesburg Panama Uzaramo Chailey Group W I Rough: B:E,N,X Kintambo Paratyphi B Virchow Chester Group Z I,4,5,12,i:- Liverpool Pomona Weltevreden Corvallis Havana I,4,5,12:D:- Livingstone Putten Wien Cubana Herston IIIA 51:Z4,Z23 :- Manhattan Reading Worthington</th>
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# Epidemiologically Linked *Salmonella* Outbreaks in Kentucky

<table>
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<th>Exposure Source</th>
<th>Serotype Associated</th>
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<tbody>
<tr>
<td>2015</td>
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<tr>
<td>Raw Sprouted Nut Butter Spreads</td>
<td>Paratyphi B variant L(+) tartrate (+)</td>
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<tr>
<td>Small Turtles</td>
<td>San Diego, Poona</td>
</tr>
<tr>
<td>Cucumbers</td>
<td>Poona</td>
</tr>
<tr>
<td>Pork</td>
<td>I 4, 5, 12 I-, Infantis</td>
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<tr>
<td>Aspen Foods: Raw, frozen, stuffed chicken entrees</td>
<td>Enteritidis</td>
</tr>
<tr>
<td>Barber Foods: Raw, frozen, stuffed chicken entrees</td>
<td>Enteritidis</td>
</tr>
<tr>
<td>Live Poultry</td>
<td>Enteritidis, Hadar, Indiana, Muenchen</td>
</tr>
<tr>
<td>Frozen Raw Tuna</td>
<td>Paratyphi B variant L (+) tartrate (+), Weltevreden</td>
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<tr>
<td>Pet Crested Geckos</td>
<td>Muenchen</td>
</tr>
<tr>
<td>2014</td>
<td></td>
</tr>
<tr>
<td>Cucumbers</td>
<td>Newport</td>
</tr>
<tr>
<td>Bean Sprouts</td>
<td>Enteritidis</td>
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<tr>
<td>Nut Butter</td>
<td>Braenderup</td>
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<tr>
<td>Organic Sprouted Chia Powder</td>
<td>Newport, Hartford, Oranienburg</td>
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<tr>
<td>Frozen Feeder Rodents</td>
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<tr>
<td>Live Poultry</td>
<td>Infantis, Newport, Hadar</td>
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<tr>
<td>Pet Bearded Dragons</td>
<td>Cotham, Kisorawe</td>
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<td>Tyson Chicken</td>
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<td>Raw Cashew Cheese</td>
<td>Stanley</td>
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<td>2013</td>
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<tr>
<td>Foster Farms Chicken</td>
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<td>Tahini Sesame Paste</td>
<td>Montevideo, Mbandaka</td>
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<td>Live Poultry</td>
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<td>Live Poultry</td>
<td>Lille, Newport, Mbandaka</td>
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<td>Cucumbers</td>
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<td>Ground Beef</td>
<td>Typhimurium</td>
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<td>Small Turtles</td>
<td>San Diego, Pomona, Poona</td>
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<td>Peanut Butter</td>
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<td>Mangoes</td>
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<td>Cantaloupe</td>
<td>Typhimurium, Newport</td>
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<td>Hadar</td>
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<td>Live Poultry</td>
<td>Montevideo</td>
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<tr>
<td>Live Poultry</td>
<td>Infantis, Newport, Lille</td>
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<td>Dry Dog Food</td>
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<td>Raw Scraped Tuna Product</td>
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<td>Small Turtles</td>
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<td>Restaurant Chain A</td>
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<td>Alfalfa and Spicy Sprouts</td>
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<td>Chicks and Ducklings</td>
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<tr>
<td>Turkey Burgers</td>
<td>Heidelberg</td>
</tr>
<tr>
<td>Cantaloupe</td>
<td>Panama</td>
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Total *Salmonella* Serotypes in Kentucky

**Figure 1. Total Case Count by Year and Month**

**Figure 2. Average Case Count by Age and Month**

**Figure 3. Average Case Count by Sex and Month**

**Figure A. 5-year Incidence rate per 100,000**
S. Agona

Figure A. Agona 5-year Incidence rate per 100,000

Figure B. Agona Reported Cases 2015

Figure C. Agona Reported Cases 2014

Figure D. Agona Reported Cases 2013

Figure E. Agona Reported Cases 2012

Figure F. Agona Reported Cases 2011
S. Altona

Figure A. Altona 5-year Incidence rate per 100,000

Figure B. Altona Reported Cases 2015

Figure C. Altona Reported Cases 2014

Figure D. Altona Reported Cases 2013

Figure E. Altona Reported Cases 2012

Figure F. Altona Reported Cases 2011
S. Anatum

Figure A. Agona 5-year Incidence rate per 100,000

Figure B. Anatum Reported Cases 2015

Figure C. Anatum Reported Cases 2014

Figure D. Anatum Reported Cases 2013

Figure E. Anatum Reported Cases 2012

Figure F. Anatum Reported Cases 2011
S. Bareilly

Figure A. Bareilly 5-year Incidence rate per 100,000

Figure B. Bareilly Reported Cases 2015

Figure C. Bareilly Reported Cases 2014

Figure D. Bareilly Reported Cases 2013

Figure E. Bareilly Reported Cases 2012

Figure F. Bareilly Reported Cases 2011
S. Berta

Figure A. Berta 5-year Incidence rate per 100,000

Figure B. Berta Reported Cases 2015

Figure C. Berta Reported Cases 2014

Figure D. Berta Reported Cases 2013

Figure E. Berta Reported Cases 2012

Figure F. Berta Reported Cases 2011
S. Braenderup

Figure A. Braenderup 5-year Incidence rate per 100,000

Figure B. Braenderup Reported Cases 2015

Figure C. Braenderup Reported Cases 2014

Figure D. Braenderup Reported Cases 2013

Figure E. Braenderup Reported Cases 2012

Figure F. Braenderup Reported Cases 2011
S. Enteritidis

Figure 1. Total Case Count by Year and Month

Figure 2. Average Case Count by Age and Month

Figure 3. Average Case Count by Sex and Month

Figure A. Enteritidis 5-year Incidence rate per 100,000
Figure B. Enteritidis Reported Cases 2015

Figure C. Enteritidis Reported Cases 2014

Figure D. Enteritidis Reported Cases 2013

Figure E. Enteritidis Reported Cases 2012

Figure F. Enteritidis Reported Cases 2011

Reported Cases
- 0
- 1 to 5
- 6 to 10
- 11 to 25
- > 25
S. Hadar

Figure A. Hadar 5-year Incidence rate per 100,000

Figure B. Hadar Reported Cases 2015

Figure C. Hadar Reported Cases 2014

Figure D. Hadar Reported Cases 2013

Figure E. Hadar Reported Cases 2012

Figure F. Hadar Reported Cases 2011
S. Hartford

Figure A. Hartford 5-year Incidence rate per 100,000

Figure B. Hartford Reported Cases 2015

Figure C. Hartford Reported Cases 2014

Figure D. Hartford Reported Cases 2013

Figure E. Hartford Reported Cases 2012

Figure F. Hartford Reported Cases 2011
S. Heidelberg

Figure A. Heidelberg 5-year Incidence rate per 100,000

Figure B. Heidelberg Reported Cases 2015

Figure C. Heidelberg Reported Cases 2014

Figure D. Heidelberg Reported Cases 2013

Figure E. Heidelberg Reported Cases 2012

Figure F. Heidelberg Reported Cases 2011
Figure 1. Total Case Count by Year and Month

Figure 2. Average Case Count by Age and Month

Figure 3. Average Case Count by Sex and Month

Figure A. S. I,4,5,12:i- 5-year Incidence rate per 100,000
Figure B. I,4,5,12:I- Reported Cases 2015

Figure C. I,4,5,12:I- Reported Cases 2014

Figure D. I,4,5,12:I- Reported Cases 2013

Figure E. I,4,5,12:I- Reported Cases 2012

Figure F. I,4,5,12:I- Reported Cases 2011

Reported Cases

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<tr>
<td>Green</td>
<td>6 to 10</td>
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<tr>
<td>Yellow</td>
<td>11 to 25</td>
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<tr>
<td>Red</td>
<td>&gt; 25</td>
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S. Infantis

Figure A. Infantis 5-year Incidence rate per 100,000

Figure B. Infantis Reported Cases 2015

Figure C. Infantis Reported Cases 2014

Figure D. Infantis Reported Cases 2013

Figure E. Infantis Reported Cases 2012

Figure F. Infantis Reported Cases 2011
S. Java

Figure A. Java 5-year Incidence rate per 100,000

Figure B. Java Reported Cases 2015

Figure C. Java Reported Cases 2014

Figure D. Java Reported Cases 2013

Figure E. Java Reported Cases 2012

Figure F. Java Reported Cases 2011
S. Javiana

Figure 1. Total Case Count by Year and Month

Figure 2. Average Case Count by Age and Month

Figure 3. Average Case Count by Sex and Month

Figure A. 5-year Incidence rate per 100,000
S. Mbandaka

Figure A. Mbandaka 5-year Incidence rate per 100,000

Figure B. Mbandaka Reported Cases 2015

Figure C. Mbandaka Reported Cases 2014

Figure D. Mbandaka Reported Cases 2013

Figure E. Mbandaka Reported Cases 2012

Figure F. Mbandaka Reported Cases 2011
S. Mississippi

Figure A. Mississippi 5-year Incidence rate per 100,000

Figure B. Mississippi Reported Cases 2015

Figure C. Mississippi Reported Cases 2014

Figure D. Mississippi Reported Cases 2013

Figure E. Mississippi Reported Cases 2012

Figure F. Mississippi Reported Cases 2011
S. Montevideo

Figure A. Montevideo 5-year Incidence rate per 100,000

Figure B. Montevideo Reported Cases 2015

Figure C. Montevideo Reported Cases 2014

Figure D. Montevideo Reported Cases 2013

Figure E. Montevideo Reported Cases 2012

Figure F. Montevideo Reported Cases 2011
S. Muenchen

Figure A. Muenchen 5-year Incidence rate per 100,000

Figure B. Muenchen Reported Cases 2015

Figure C. Muenchen Reported Cases 2014

Figure D. Muenchen Reported Cases 2013

Figure E. Muenchen Reported Cases 2012

Figure F. Muenchen Reported Cases 2011
S. Newport

Figure 1. Total Case Count by Year and Month

Figure 2. Average Case Count by Age and Month

Figure 3. Average Case Count by Sex and Month

Figure A. Newport 5-year Incidence rate per 100,000
S. Norwich

Figure A. Norwich 5-year Incidence rate per 100,000

Figure B. Norwich Reported Cases 2015

Figure C. Norwich Reported Cases 2014

Figure D. Norwich Reported Cases 2013

Figure E. Norwich Reported Cases 2012

Figure F. Norwich Reported Cases 2011
S. Oranienburg

Figure A. Oranienburg 5-year Incidence rate per 100,000

Figure B. Oranienburg Reported Cases 2015

Figure C. Oranienburg Reported Cases 2014

Figure D. Oranienburg Reported Cases 2013

Figure E. Oranienburg Reported Cases 2012

Figure F. Oranienburg Reported Cases 2011
S. Poona

Figure A. Poona 5-year Incidence rate per 100,000

Figure B. Poona Reported Cases 2015

Figure C. Poona Reported Cases 2014

Figure D. Poona Reported Cases 2013

Figure E. Poona Reported Cases 2012

Figure F. Poona Reported Cases 2011
S. Saintpaul

Figure A. Saintpaul 5-year Incidence rate per 100,000

Figure B. Saintpaul Reported Cases 2015

Figure C. Saintpaul Reported Cases 2014

Figure D. Saintpaul Reported Cases 2013

Figure E. Saintpaul Reported Cases 2012

Figure F. Saintpaul Reported Cases 2011
S. Stanley

Figure A. Stanley 5-year Incidence rate per 100,000

Figure B. Stanley Reported Cases 2015

Figure C. Stanley Reported Cases 2014

Figure D. Stanley Reported Cases 2013

Figure E. Stanley Reported Cases 2012

Figure F. Stanley Reported Cases 2011
S. Thompson

Figure A. Thompson 5-year Incidence rate per 100,000

Figure B. Thompson Reported Cases 2015

Figure C. Thompson Reported Cases 2014

Figure D. Thompson Reported Cases 2013

Figure E. Thompson Reported Cases 2012

Figure F. Thompson Reported Cases 2011
S. Typhimurium

Figure 1. Total Case Count by Year and Month

Figure 2. Average Case Count by Age and Month

Figure 3. Average Case Count by Sex and Month

Figure A. Typhimurium 5-year Incidence rate per 100,000
References


