National Enteric Disease Surveillance: *Salmonella* Annual Report, 2011

An overview of surveillance methods and systems for *Salmonella* infections is available at http://www.cdc.gov/nationalsurveillance/PDFs/NationalSalmSurveillOverview_508.pdf (1).

Human Surveillance Data: Laboratory-based Enteric Disease Surveillance (LEDS)

The Laboratory-based Enteric Disease Surveillance (LEDS) system collects reports of laboratory-confirmed human *Salmonella* isolates from state public health laboratories. Reporting to LEDS is voluntary, and the number of states submitting reports varies somewhat from year to year although almost all states report every year. Serotypes are summarized in this annual report as reported by state laboratories; they are usually not confirmed by CDC. Occasionally, more than one isolate is reported from a single episode of infection in a person; this report includes only one isolate of a given *Salmonella* serotype per person within a 30-day period.

In this report, we summarize the number of infections reported and also report incidence rates (cases per 100,000 population), which are calculated as the number of *Salmonella* infections in humans reported for a given year divided by the state population for that year.

Data were received from all 51 reporting jurisdictions (50 states plus the District of Columbia) in 2011. For maps (Figures 2a to 2h), data was excluded from states where

- the number of laboratory-confirmed human *Salmonella* isolates reported to LEDS was less than 20% of the number of salmonellosis cases reported to the National Notifiable Diseases Surveillance System (NNDSS):
  - » 7 reporting jurisdictions were excluded: Florida, Kansas, Louisiana, Mississippi, New Hampshire, Nevada, Tennessee
- the number of fully serotyped laboratory-confirmed human *Salmonella* isolates reported to LEDS was less than 20% of *Salmonella* isolates reported to LEDS:
  - » 7 reporting jurisdictions were excluded: Kentucky, Maine, Montana, Nebraska, Texas, Vermont, Wyoming

Data in this report current as of 1/14/2013.
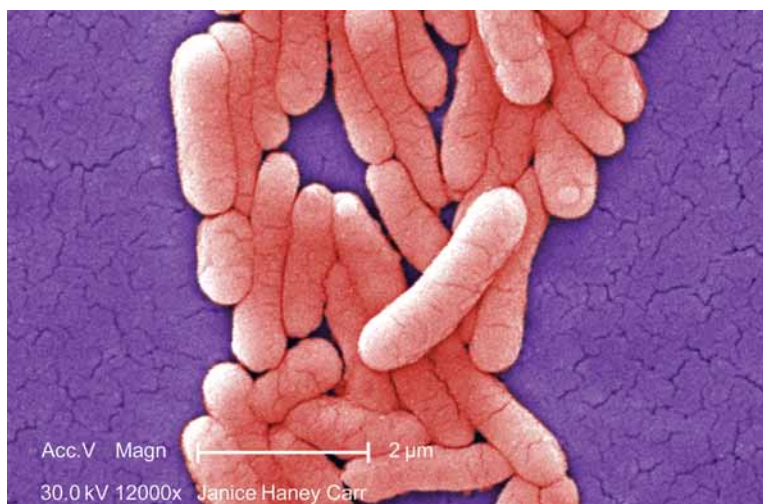
Colorized scanning electron micrograph (SEM) of clustered Gram-negative *Salmonella typhimurium* bacteria.

National Center for Emerging and Zoonotic Infectious Diseases
Division of Foodborne Waterborne, and Environmental Diseases

Table 1. Laboratory-confirmed human *Salmonella* infections reported to CDC, with the 20 most frequently reported serotypes listed individually, United States, 2011

Rank	Serotype	Number Reported	Percent
1	Enteritidis	7553	16.5
2	Typhimurium (including Typhimurium var. 5-)	6131	13.4
3	Newport	5211	11.4
4	Javiana	2937	6.4
5	I 4,[5],12:i:-	1339	2.9
6	Montevideo	1196	2.6
7	Heidelberg	1103	2.4
8	Muenchen	984	2.1
9	Infantis	910	2.0
10	Branderup	739	1.6
11	Oranienburg	721	1.6
12	Saintpaul	709	1.5
13	Mississippi	549	1.5
14	Thompson	536	1.2
15	Agona	505	1.1
16	Paratyphi B var. L(+) tartrate+	431	0.9
17	Bareilly	429	0.9
18	Typhi	383	0.8
19	Berta	321	0.7
20	Anatum	282	0.6
	Sub Total	**32969**	**71.9**
	All Other Serotyped	6864	15.0
	Unknown	4173	9.1
	Partially serotyped	1603	3.5
	Rough, mucoid, and/or nonmotile isolates	219	0.5
	Sub Total	**12859**	**28.1**
	Total	**45828**	**100**

All serotyped isolates are listed in Table 3

State public health laboratories reported 45,828 laboratory-confirmed *Salmonella* infections to CDC through LEDS

• The top 4 serotypes in 2011 were Enteritidis (17%), Typhimurium (including Typhimurium var. 5-) (13%), Newport (11%) and Javiana (6%).

Table 2. Laboratory-confirmed human *Salmonella* infections reported to CDC, percent change among the 20 most frequently reported serotypes, comparing 2001, 1006, and 2011

Rank				Number Reported			Percent Change		
2001	2006	2011	Serotype	2001	2006	2011	2001 vs 2006	2006 vs 2011	2001 vs 2011
2	2	1	Enteritidis	5613	6740	7553	20	12	35
1	1	2	Typhimurium*	7040	6866	6131	-2	-11	-13
3	3	3	Newport	3168	3373	5211	6	54	64
5	5	4	Javiana	1068	1433	2937	34	105	175
20	6	5	I 4,[5],12:i:-	297	1233	1339	315	9	351
6	7	6	Montevideo	628	1061	1196	69	13	90
4	4	7	Heidelberg	1895	1495	1103	-21	-26	-42
8	8	8	Muenchen	586	753	984	28	31	68
12	14	9	Infantis	441	491	910	11	85	106
13	12	10	Braenderup	396	561	739	42	32	87
7	9	11	Oranienburg	598	719	721	20	0	21
10	11	12	Saintpaul	471	588	709	25	21	51
16	10	13	Mississippi	336	604	549	80	-9	63
9	15	14	Thompson	514	447	536	-13	20	4
14	13	15	Agona	372	538	505	45	-6	36
11	16	16	Paratyphi B var. L(+) tartrate+	466	417	431	-11	3	-8
21	21	17	Bareilly	206	256	429	24	68	108
15	17	18	Typhi	343	413	383	20	-7	12
17	22	19	Berta	334	252	321	-25	27	-4
22	24	20	Anatum	188	238	282	27	18	50

Note: * Typhimurium includes var. 5- (formerly var. Copenhagen)

Although reports of serotype I 4,[5],12:i:- increased 351% in 2011 from 2001, this reflects, for the most part, a change in reporting practice (1).

- In 2011, serotype Javiana had the largest increase (250%) since 2001 of any of the top 20 serotypes for which surveillance has been stable; most of this increase occurred after 2006.

Figure 1. Incidence rate of laboratory-confirmed human *Salmonella* infection reported to CDC (all serotypes and serotypes with more than 1000 infections reported to CDC in 2011), United States, 1970–2011
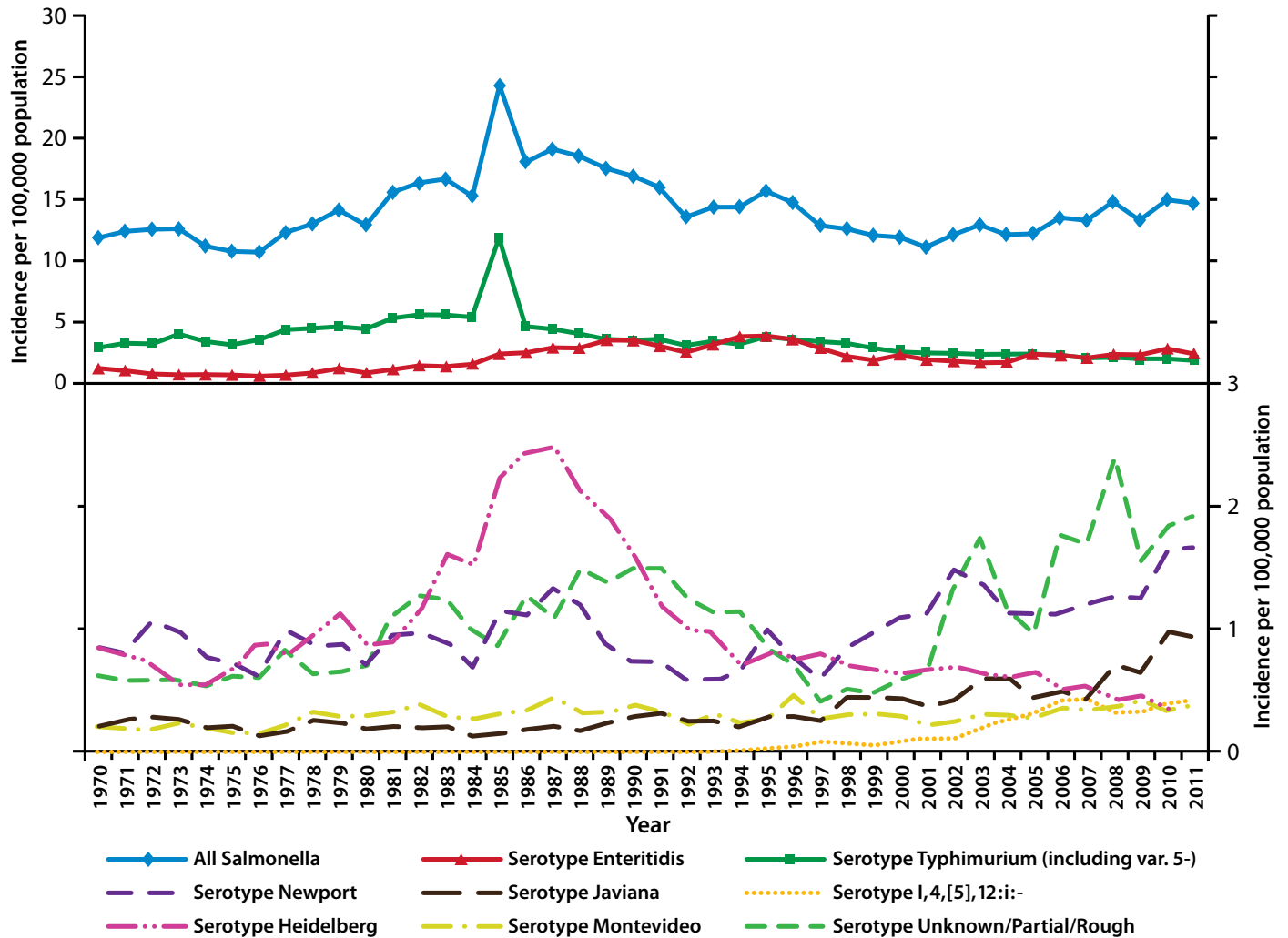

The top panel of this graph shows the incidence rate of infection with *Salmonella* (all serotypes) and with serotypes Typhimurium (including serotype Typhimurium var. 5-) and Enteritidis from 1970 to 2011

- Since 1970, the incidence rate of infection with all *Salmonella* has been driven largely by the incidence rate of infection with serotypes Typhimurium (including serotype Typhimurium var. 5-) and Enteritidis

- The spike in incidence rate seen in 1985 reflects an outbreak of *Salmonella* serotype Typhimurium infections associated with pasteurized milk (2)

The bottom panel of this graph shows the incidence rate of infection with all serotypes of *Salmonella* with more than 1000 infections reported to CDC in 2011: this includes serotypes Newport, Javiana, I, 4,[5],12:i:-, Heidelberg, Montevideo, and infections with an unknown, rough, or partial serotype

- The incidence rate of infection with serotype Heidelberg has been decreasing steadily following a peak in 1987

- Since the late 1990s, the incidence rates of infection with serotypes Javiana, Newport, and I,4,[5],12:i:- have been steadily increasing

- Since 2000, the incidence of infection with isolates with an unknown, rough, or partial serotype have been increasing

Figure 2a. Incidence rate of laboratory-confirmed human *Salmonella* infection reported to CDC (all serotypes), by state, United States, 2011*
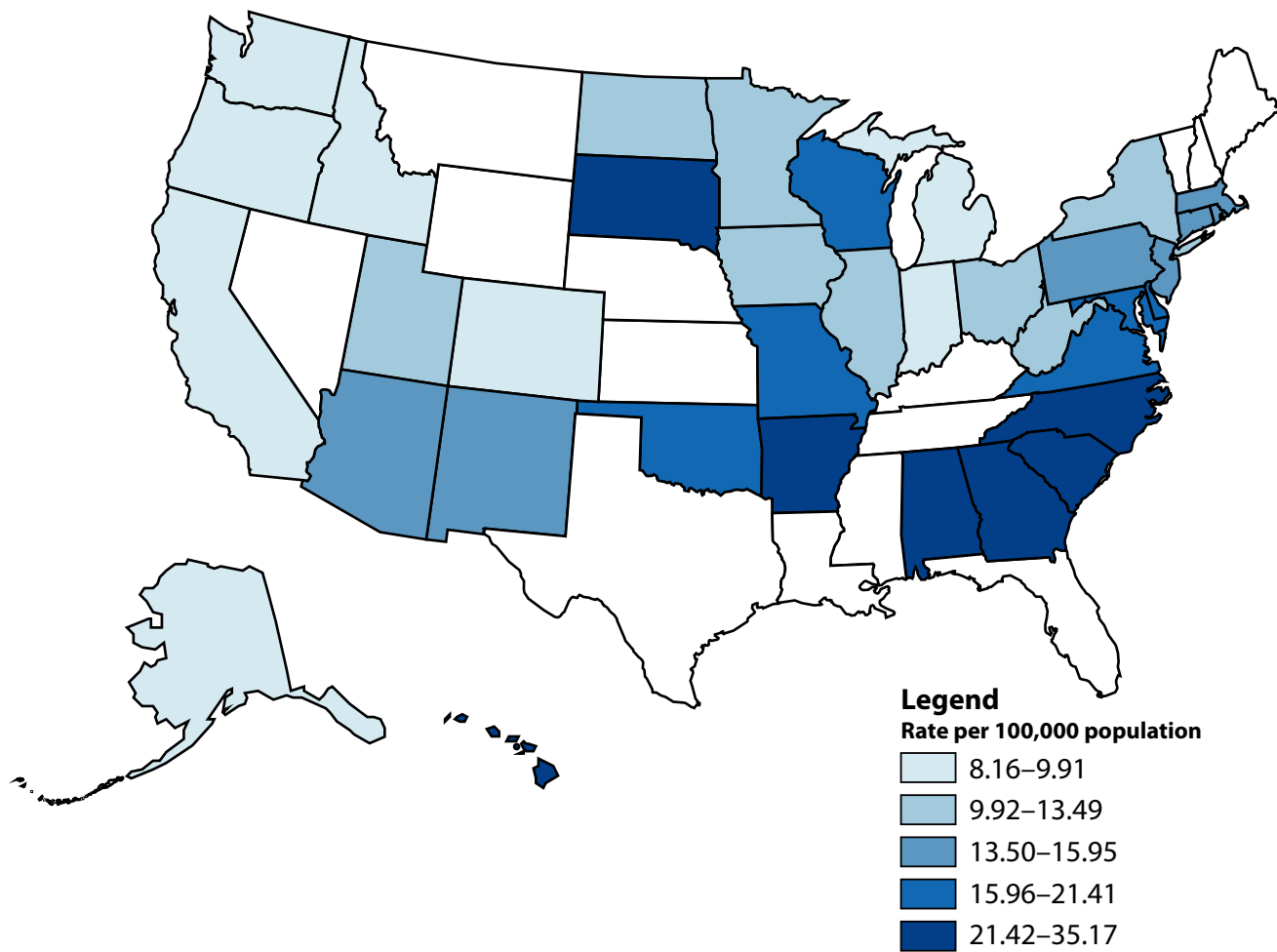
Legend
Rate per 100,000 population

- 8.16–9.91
- 9.92–13.49
- 13.50–15.95
- 15.96–21.41
- 21.42–35.17

* Unshaded reporting jurisdictions are those excluded from mapping because the number of laboratory-confirmed human *Salmonella* isolates reported to LEDS was less than 20% of the number of salmonellosis cases reported to the National Notifiable Diseases Surveillance System (NNDSS) (Florida, Kansas, Louisiana, Mississippi, New Hampshire, Nevada, Tennessee) or because the number of fully serotyped laboratory-confirmed human *Salmonella* isolates reported to LEDS was less than 20% of *Salmonella* isolates reported to LEDS (Kentucky, Maine, Montana, Nebraska, Texas, Vermont, Wyoming).

The reporting jurisdictions with the highest reported incidence rates of *Salmonella* infection (cases per 100,000 population) were Alabama (35.2), South Carolina (32.1), and North Carolina (27.6).

Figure 2b. Incidence rate of laboratory-confirmed human *Salmonella* serotype Enteritidis infection reported to CDC, by state, United States, 2011*
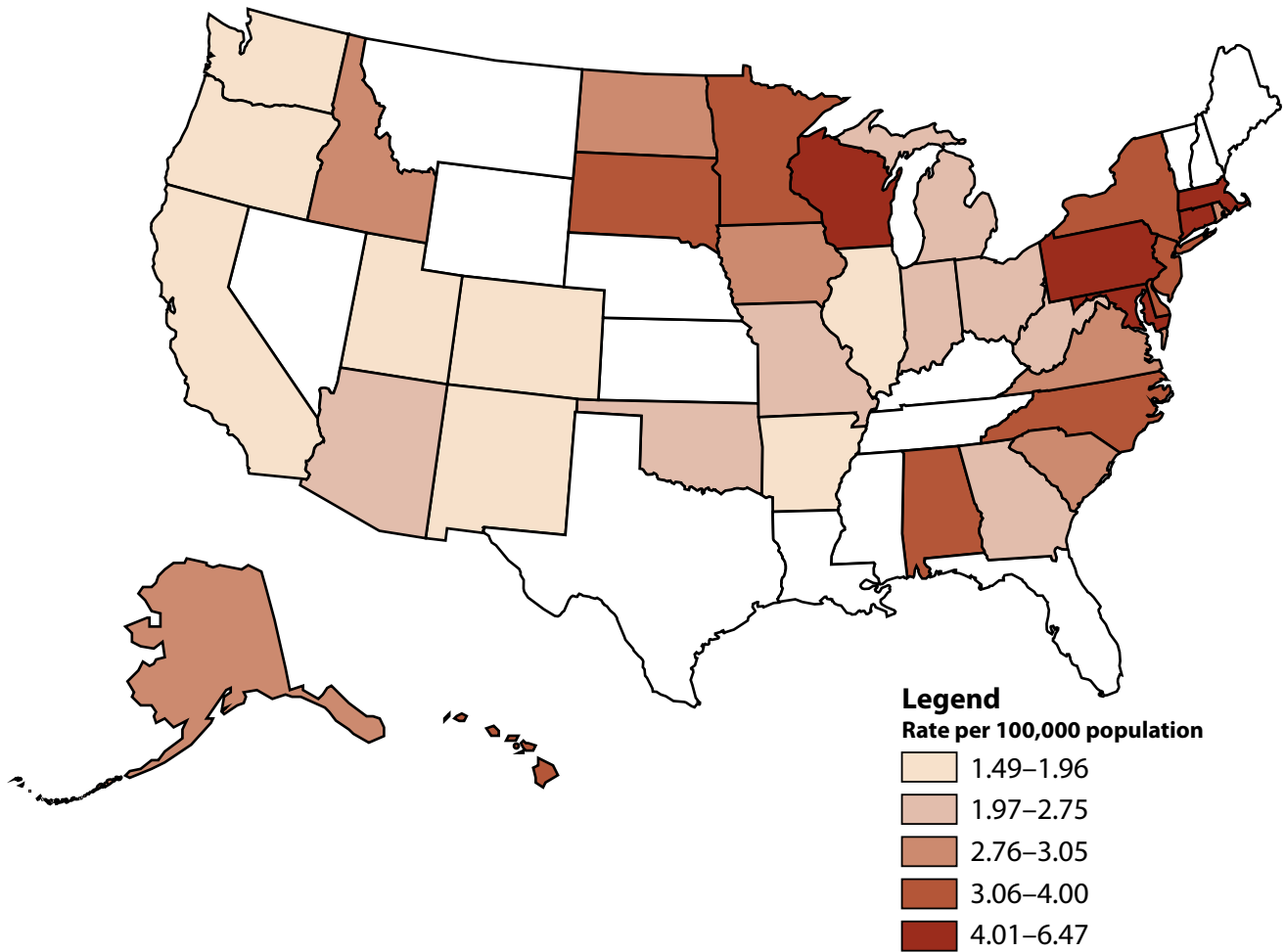
Legend
Rate per 100,000 population

- 1.49–1.96
- 1.97–2.75
- 2.76–3.05
- 3.06–4.00
- 4.01–6.47

*Unshaded reporting jurisdictions are those excluded from mapping because the number of laboratory-confirmed human *Salmonella* isolates reported to LEDS was less than 20% of the number of salmonellosis cases reported to the National Notifiable Diseases Surveillance System (NNDSS) (Florida, Illinois, Kansas, Louisiana, Nevada, South Carolina, Tennessee, Vermont) or because the number of fully serotyped laboratory-confirmed human *Salmonella* isolates reported to LEDS was less than 20% of *Salmonella* isolates reported to LEDS (Kentucky, Maine, Montana, Nebraska, Texas, Utah, Wyoming).

The reporting jurisdictions with the highest reported incidence rates of serotype Enteritidis infection (cases per 100,000 population) were the District of Columbia (6.5), Wisconsin (6.0), and Connecticut (5.8).
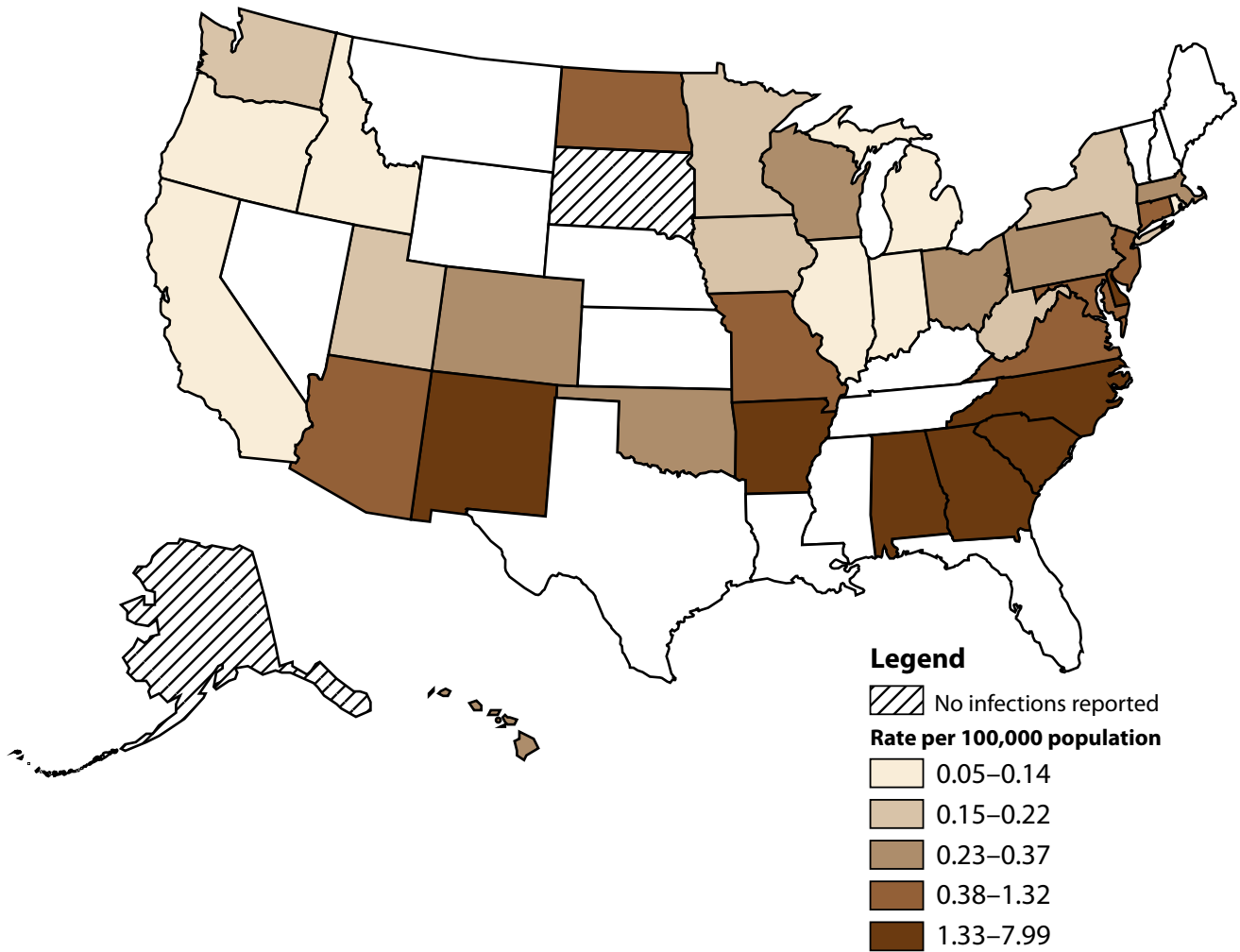
Figure 2c. Incidence rate of laboratory-confirmed human *Salmonella* serotype Typhimurium (including Typhimurium var. 5-) infection reported to CDC, by state, United States, 2011*

Legend
Rate per 100,000 population
- 0.97–1.34
- 1.35–2.01
- 2.02–2.34
- 2.35–3.12
- 3.13–8.62

*Unshaded reporting jurisdictions are those excluded from mapping because the number of laboratory-confirmed human *Salmonella* isolates reported to LEDS was less than 20% of the number of salmonellosis cases reported to the National Notifiable Diseases Surveillance System (NNDSS) (Florida, Illinois, Kansas, Louisiana, Nevada, South Carolina, Tennessee, Vermont) or because the number of fully serotyped laboratory-confirmed human *Salmonella* isolates reported to LEDS was less than 20% of *Salmonella* isolates reported to LEDS (Kentucky, Maine, Montana, Nebraska, Texas, Utah, Wyoming).

The reporting jurisdictions with the highest reported incidence rates of serotype Typhimurium (including Typhimurium var. 5-) infection (cases per 100,000 population) were South Dakota (8.6), Alabama (6.3), and Hawaii (5.7).

Figure 2d. Incidence rate of laboratory-confirmed human *Salmonella* serotype Newport infection reported to CDC, by state, United States, 2011*
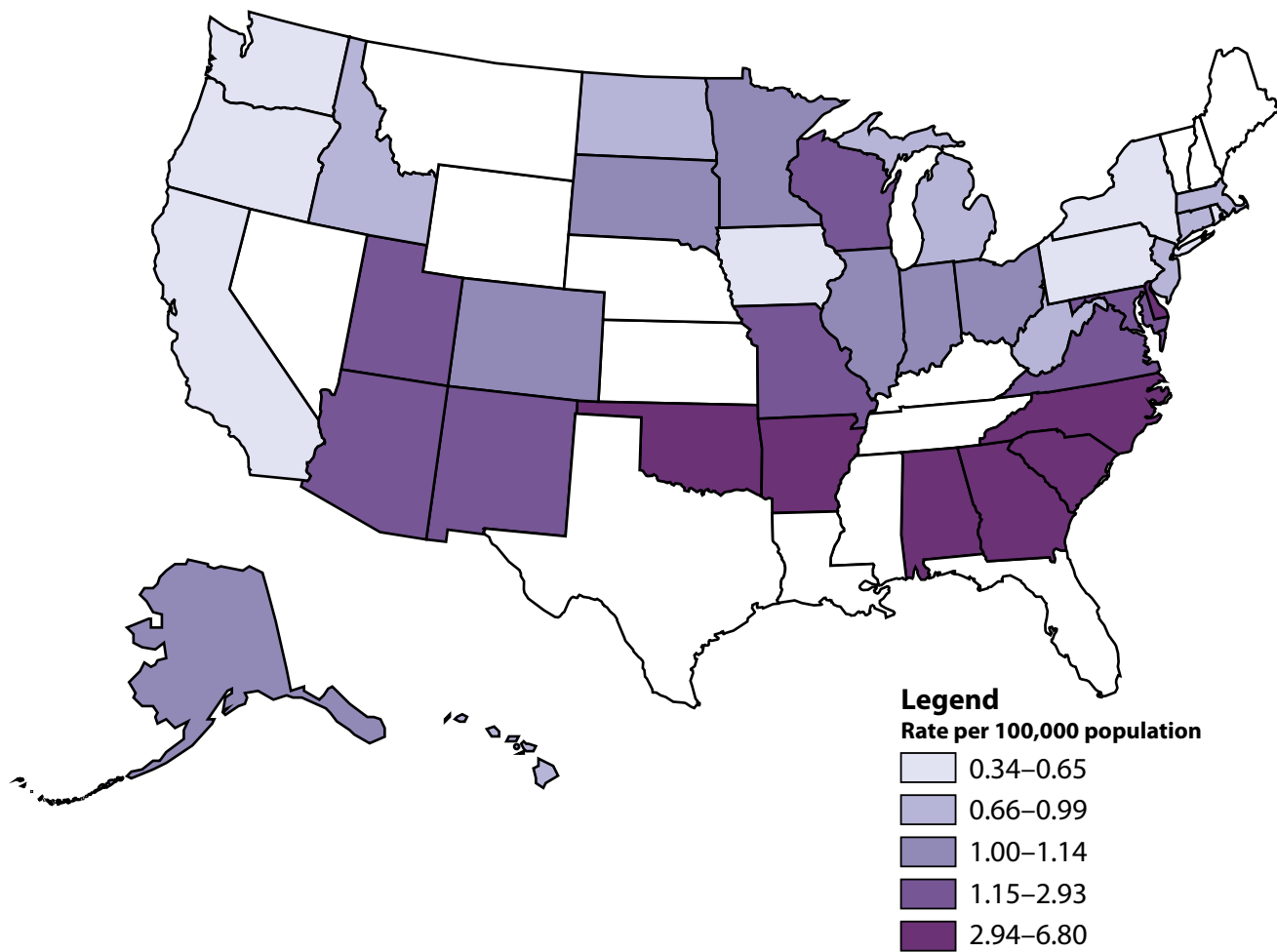
Legend
Rate per 100,000 population

- 0.34–0.65
- 0.66–0.99
- 1.00–1.14
- 1.15–2.93
- 2.94–6.80

*Unshaded reporting jurisdictions are those excluded from mapping because the number of laboratory-confirmed human *Salmonella* isolates reported to LEDS was less than 20% of the number of salmonellosis cases reported to the National Notifiable Diseases Surveillance System (NNDSS) (Florida, Illinois, Kansas, Louisiana, Nevada, South Carolina, Tennessee, Vermont) or because the number of fully serotyped laboratory-confirmed human *Salmonella* isolates reported to LEDS was less than 20% of *Salmonella* isolates reported to LEDS (Kentucky, Maine, Montana, Nebraska, Texas, Utah, Wyoming).

The reporting jurisdictions with the highest reported incidence rates of serotype Newport infection (cases per 100,000 population) were South Carolina (6.8), Arkansas (6.8), North Carolina (6.3).
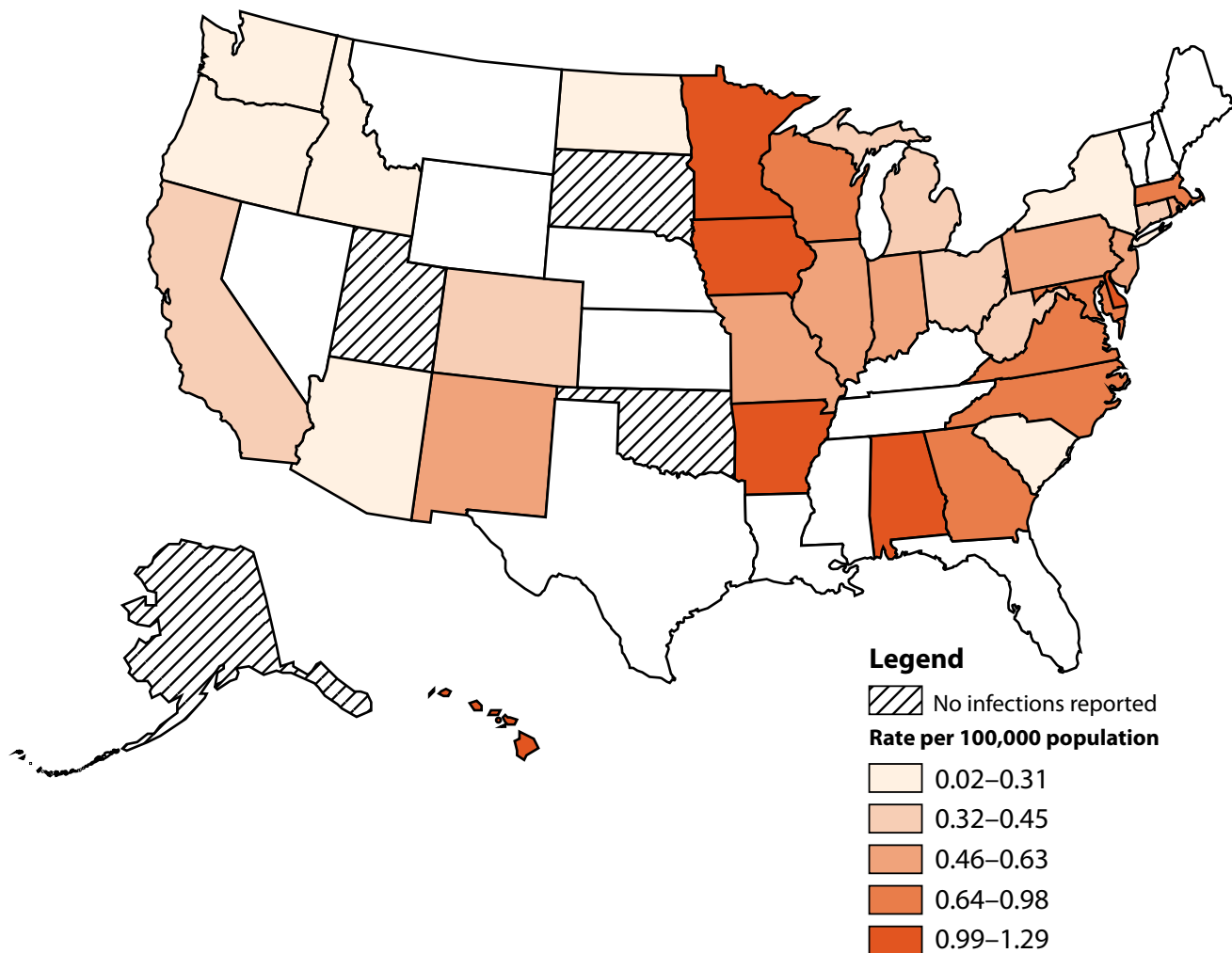
Figure 2e. Incidence rate of laboratory-confirmed human *Salmonella* serotype Javiana infection reported to CDC, by state, United States, 2011*

Legend

//// No infections reported

Rate per 100,000 population

- 0.05–0.14
- 0.15–0.22
- 0.23–0.37
- 0.38–1.32
- 1.33–7.99

*Unshaded reporting jurisdictions are those excluded from mapping because the number of laboratory-confirmed human *Salmonella* isolates reported to LEDS was less than 20% of the number of salmonellosis cases reported to the National Notifiable Diseases Surveillance System (NNDSS) (Florida, Illinois, Kansas, Louisiana, Nevada, South Carolina, Tennessee, Vermont) or because the number of fully serotyped laboratory-confirmed human *Salmonella* isolates reported to LEDS was less than 20% of *Salmonella* isolates reported to LEDS (Kentucky, Maine, Montana, Nebraska, Texas, Utah, Wyoming). Reporting jurisdictions shaded with grey lines are those that were not excluded from mapping but that reported no infections with this serotype.

The reporting jurisdictions with the highest reported incidence rates of serotype Javiana infection (cases per 100,000 population) were South Carolina (8.0), North Carolina (5.5), and Georgia (5.1).

Figure 2f. Incidence rate of laboratory-confirmed human *Salmonella* serotype I,4,[5],12:i:- infection reported to CDC, by state, United States, 2011*

Legend

◳ No infections reported

Rate per 100,000 population

☐ 0.02–0.31

☐ 0.32–0.45

☐ 0.46–0.63

☐ 0.64–0.98

☐ 0.99–1.29

*Unshaded reporting jurisdictions are those excluded from mapping because the number of laboratory-confirmed human *Salmonella* isolates reported to LEDS was less than 20% of the number of salmonellosis cases reported to the National Notifiable Diseases Surveillance System (NNDSS) (Florida, Illinois, Kansas, Louisiana, Nevada, South Carolina, Tennessee, Vermont) or because the number of fully serotyped laboratory-confirmed human *Salmonella* isolates reported to LEDS was less than 20% of *Salmonella* isolates reported to LEDS (Kentucky, Maine, Montana, Nebraska, Texas, Utah, Wyoming). Reporting jurisdictions shaded with grey lines are those that were not excluded from mapping but that reported no infections with this serotype.

The reporting jurisdictions with the highest reported incidence rates of serotype I,4,[5],12:i:- infection (cases per 100,000 population) were Minnesota (1.3), Iowa (1.2), and Alabama (1.1).
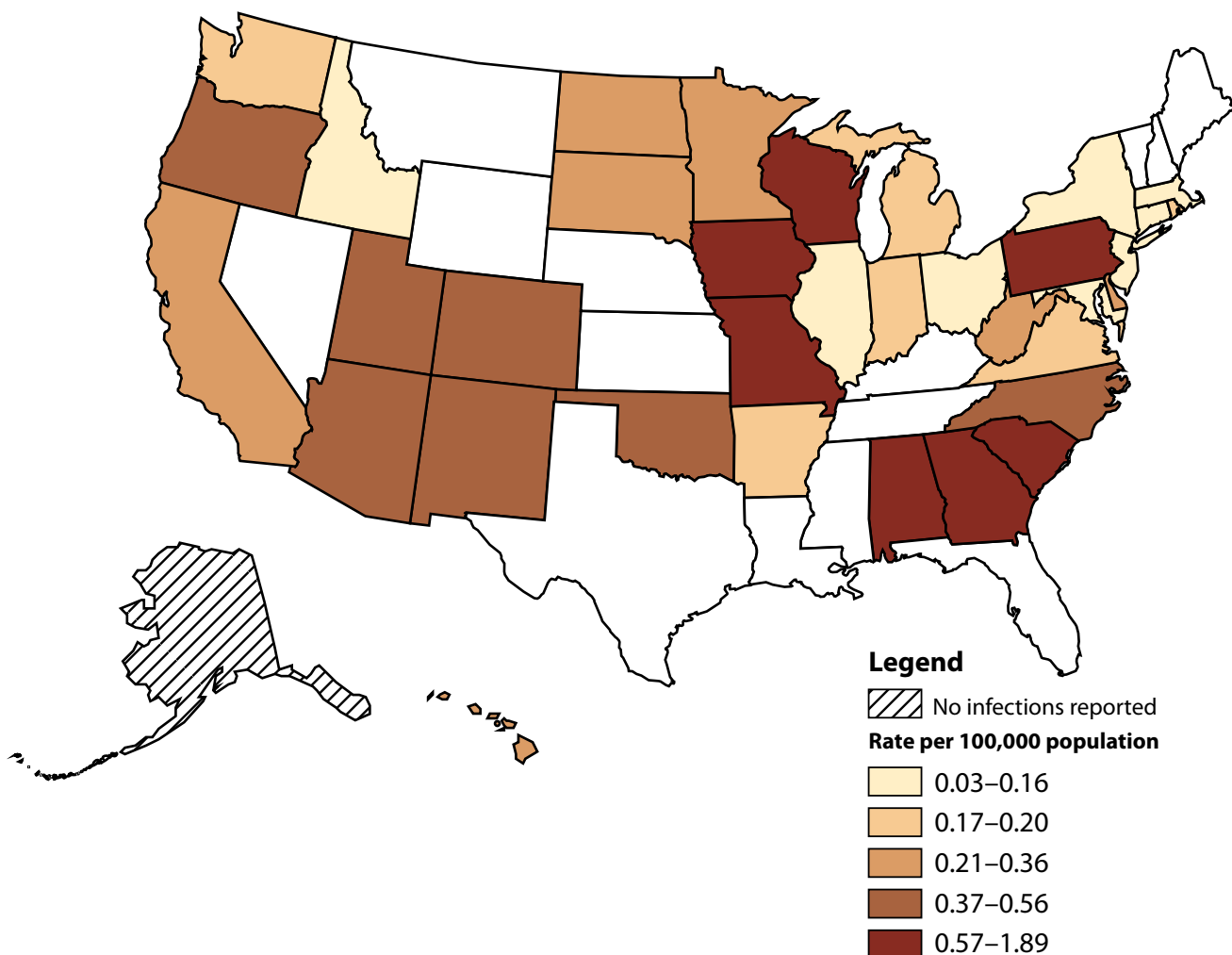
Figure 2g. Incidence rate of laboratory-confirmed human *Salmonella* serotype Heidelberg infection reported to CDC, by state, United States, 2011*
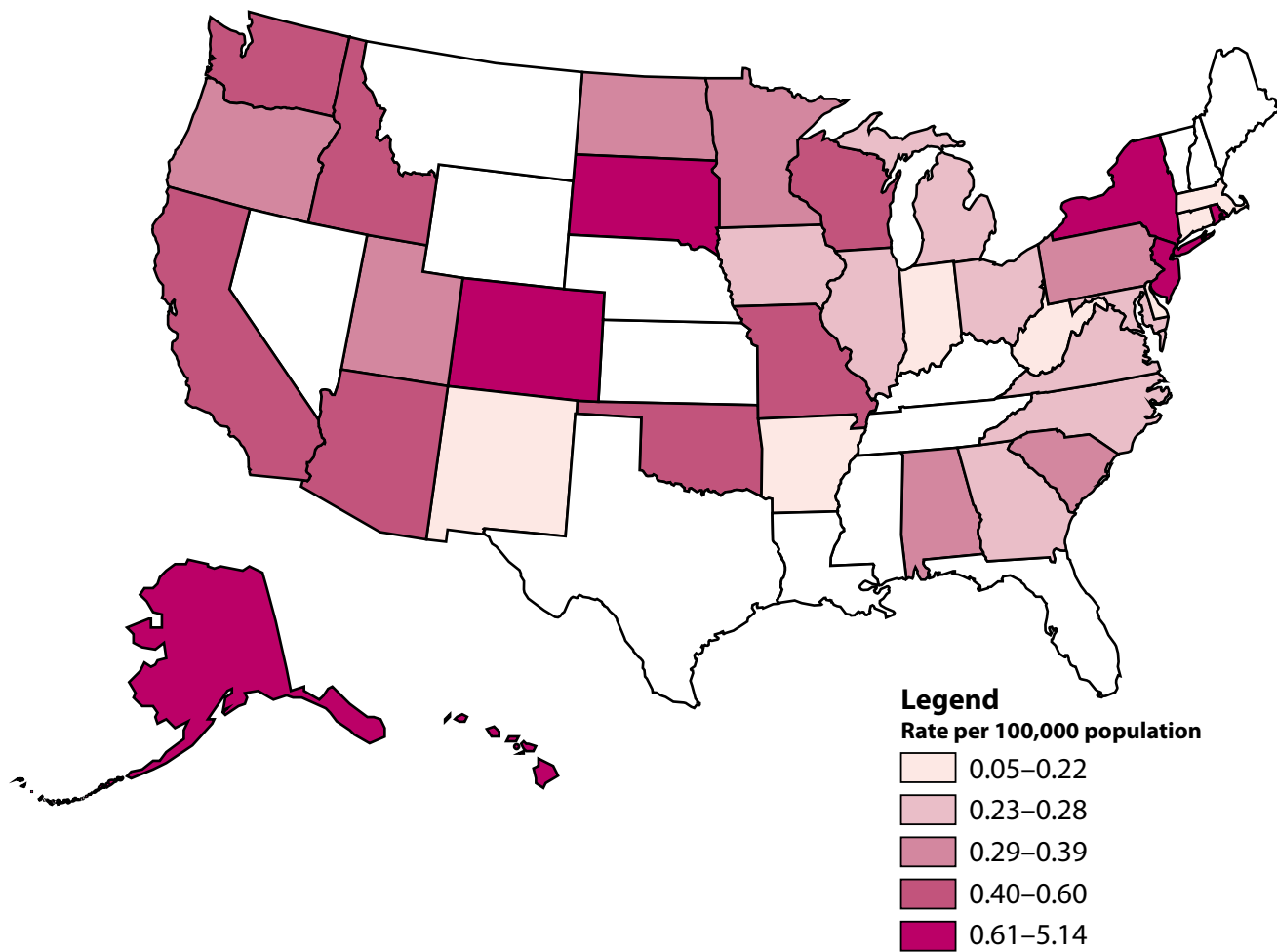
Legend
Rate per 100,000 population
- 0.05–0.22
- 0.23–0.28
- 0.29–0.39
- 0.40–0.60
- 0.61–5.14

*Unshaded reporting jurisdictions are those excluded from mapping because the number of laboratory-confirmed human *Salmonella* isolates reported to LEDS was less than 20% of the number of salmonellosis cases reported to the National Notifiable Diseases Surveillance System (NNDSS) (Florida, Illinois, Kansas, Louisiana, Nevada, South Carolina, Tennessee, Vermont) or because the number of fully serotyped laboratory-confirmed human *Salmonella* isolates reported to LEDS was less than 20% of *Salmonella* isolates reported to LEDS (Kentucky, Maine, Montana, Nebraska, Texas, Utah, Wyoming).

The reporting jurisdictions with the highest reported incidence rates of serotype Heidelberg infection (cases per 100,000 population) were Rhode Island (5.1), Hawaii (1.3), and New Jersey (1.1).

Figure 2h. Incidence rate of laboratory-confirmed human *Salmonella* serotype Montevideo infection reported to CDC, by state, United States, 2011*

Legend

▨	No infections reported

Rate per 100,000 population

	0.03–0.16
	0.17–0.20
	0.21–0.36
	0.37–0.56
	0.57–1.89

*Unshaded reporting jurisdictions are those excluded from mapping because the number of laboratory-confirmed human *Salmonella* isolates reported to LEDS was less than 20% of the number of salmonellosis cases reported to the National Notifiable Diseases Surveillance System (NNDSS) (Florida, Illinois, Kansas, Louisiana, Nevada, South Carolina, Tennessee, Vermont) or because the number of fully serotyped laboratory-confirmed human *Salmonella* isolates reported to LEDS was less than 20% of *Salmonella* isolates reported to LEDS (Kentucky, Maine, Montana, Nebraska, Texas, Utah, Wyoming). Reporting jurisdictions shaded with grey lines are those that were not excluded from mapping but that reported no infections with this serotype.

The reporting jurisdictions with the highest reported incidence rates of serotype Montevideo infection (cases per 100,000 population) were Alabama (1.9), Pennsylvania (1.2), and South Carolina (1.0).

Figure 3. Incidence rate of laboratory-confirmed human *Salmonella* infection reported to CDC, by age group and sex, United States, 2011 (n=45,828)
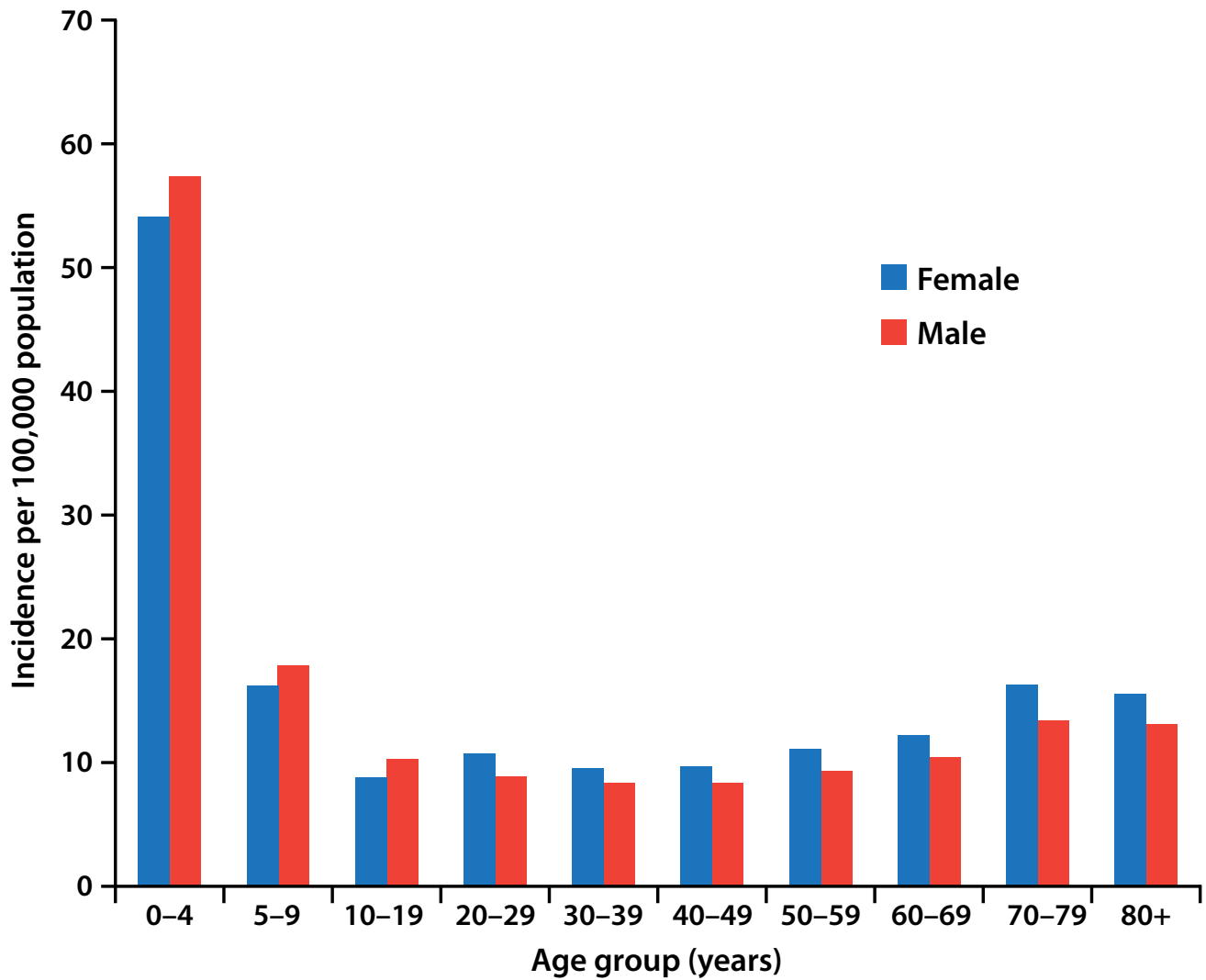
During 2011, the highest incidence rate of *Salmonella* infections was in children under 5 years old. From ages 0 to 19, males had a higher incidence rate of *Salmonella* infections than females; from age 20 to 80+, females had a higher incidence rate of *Salmonella* infections than males.

Figure 4. Number of laboratory-confirmed human *Salmonella* infections reported to CDC, by month of specimen collection, United States, 2011 and average number during 2001 to 2010
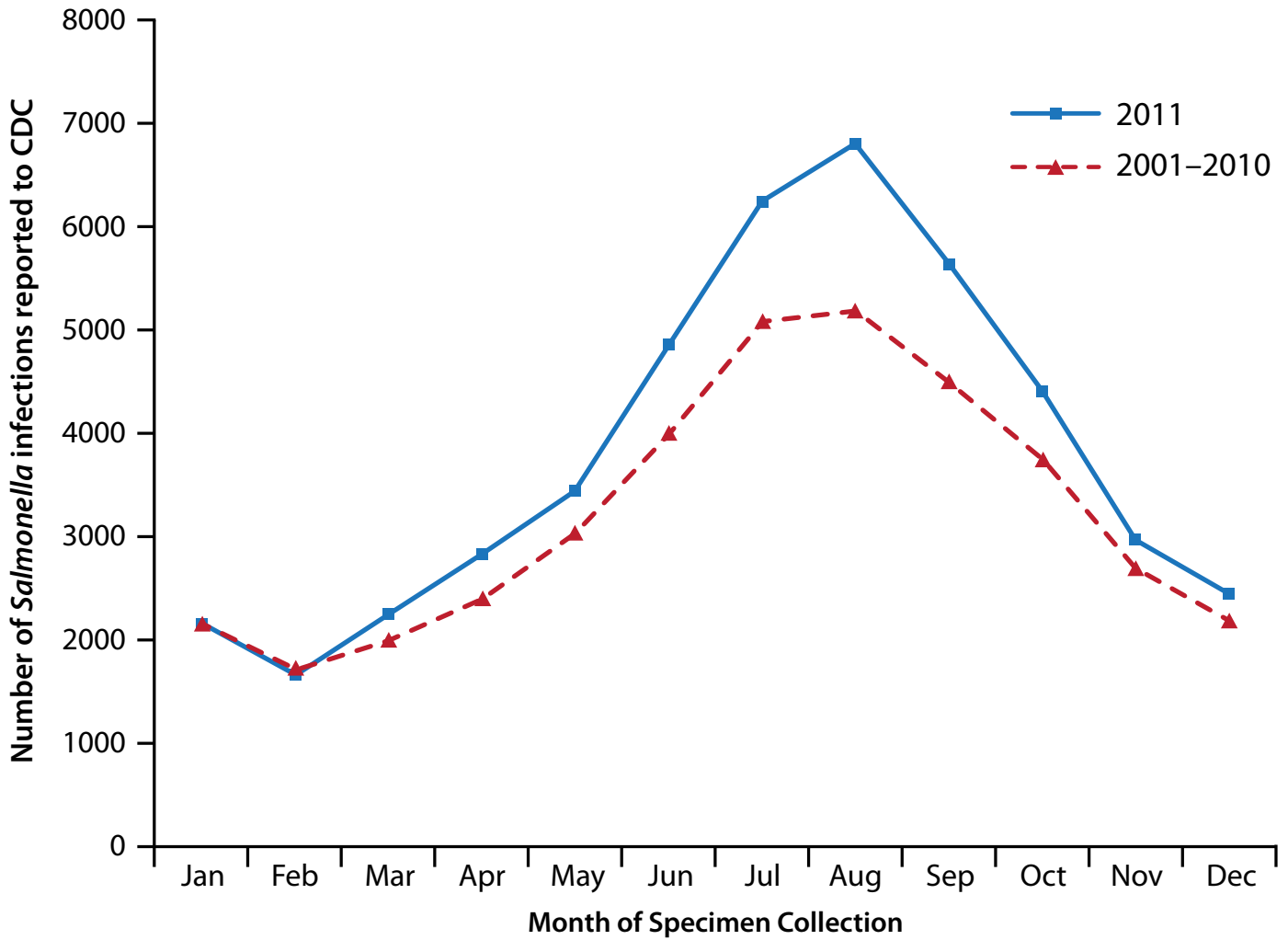
Compared with the previous 10 years (2001-2010), more *Salmonella* infections were reported in 2011. During 2011, reports of *Salmonella* infections showed seasonality similar to the average reported during 2001 to 2010, with a summer peak and the largest number of infections reported in August.

Human Surveillance Data: National Notifiable Diseases Surveillance System (NNDSS)

The National Notifiable Disease Surveillance System (NNDSS) collects and compiles reports of nationally notifiable infectious diseases, including salmonellosis. This system includes reports of laboratory-confirmed cases and probable cases (clinically compatible cases with an epidemiological link to a confirmed case).

The report for 2011 was not available when this was written. Reports are available at http://www.cdc.gov/mmwr/mmwr_nd/index.html

Human Antimicrobial Resistance Data: National Antimicrobial Resistance Monitoring System (NARMS)

The National Antimicrobial Resistance Monitoring System (NARMS) monitors antimicrobial resistance among enteric bacteria (including *Salmonella*) isolated from humans. As of March 2013, the 2011 NARMS annual report was not yet available. The report for 2011 was not available when this was written. Reports are available at http://www.cdc.gov/narms/reports.html

Human Outbreak Data: Foodborne Disease Outbreak Surveillance System (FDOSS) and Waterborne Disease Outbreak Surveillance System (WBDOSS)

The Foodborne Disease Outbreak Surveillance System (FDOSS) collects reports of foodborne disease outbreaks from local, state, tribal, and territorial public health agencies. The report for 2011 was not available when this was written. Reports are available at http://www.cdc.gov/outbreaknet/surveillance_data.html.

The Waterborne Disease and Outbreak Surveillance System (WBDOSS) collects reports of waterborne disease outbreaks associated with drinking water and recreational water from local, state, tribal, and territorial public health agencies. The report for 2011 was not available when this was written. Reports are available at http://www.cdc.gov/healthywater/statistics/wbdoss/surveillance.html.

Non-human Surveillance Data: National Veterinary Services Labortories (NVSL)

The data in tables 3, 4, and 5 come from the National Veterinary Services Laboratories (NVSL) of the United States Department of Agriculture's Animal and Plant Health Inspection Service (USDA-APHIS). Isolates from *Salmonella* infections are submitted to NVSL by veterinary diagnostic laboratories throughout the United States for serotyping. Clinical animal infections (referred to as "clinical/non-human") are *Salmonella* infections from animals with clinical signs of illness; "non-clinical/non-human" infections are *Salmonella* infections identified through herd and flock monitoring and surveillance, feed sample testing, environmental testing, and USDA-FSIS food testing programs.

Table 3a. Laboratory-confirmed *Salmonella* isolates from clinical non-human sources submitted to the National Veterinary Services Laboratories (NVSL) for typing, with the 20 most frequently reported serotypes listed individually, 2011

	Clinical Non-human 2011		
Rank	**Serotype**	**Reported**	**Percent**
1	Typhimurium*	954	19.7
2	Dublin	323	6.7
3	Cerro	283	5.8
4	Agona	272	5.6
5	Derby	218	4.5
6	Newport	213	4.4
7	Infantis	194	4.0
8	Enteritidis	178	3.7
9	Montevideo	173	3.6
10	I 4,[5],12:i:-	170	3.5
11	Heidelberg	167	3.4
12	Anatum	121	2.5
13	Senftenberg	114	2.4
14	Kentucky	96	2.0
15	Mbandaka	65	1.3
16	Worthington	59	1.2
17	Ohio	53	1.1
18	Johannesburg	49	1.0
19	Muenchen	47	1.0
20	Javiana	45	0.9
	Sub Total	**3794**	**78.3**
	All Other Serotyped	959	19.8
	Rough, mucoid, and/or nonmotile isolates	90	1.9
	Sub Total	**1049**	**21.7**
	Total	**4843**	**100**

Note:
  * Typhimurium includes var. 5- (formerly var. Copenhagen)
** Choleraesuis includes var. Decatur and Kunzendorf

Table 3b. Laboratory-confirmed *Salmonella* isolates from non-clinical non-human sources submitted to the National Veterinary Services Laboratories (NVSL) for typing, with the 20 most frequently reported serotypes listed individually, 2011

Non-Clinical Non-human 2010			
Rank	**Serotype**	**Reported**	**Percent**
1	Kentucky	668	10.2
2	Enteritidis	521	8.0
3	Senftenberg	458	7.0
4	Typhimurium*	353	5.4
5	Derby	350	5.4
6	Mbandaka	299	4.6
7	Heidelberg	291	4.5
8	Anatum	194	3.0
9	Infantis	164	2.5
10	Hadar	160	2.5
11	Agona	157	2.4
12	Schwarzengrund	144	2.2
13	Tennessee	127	1.9
14	Saintpaul	122	1.9
15	I 4,[5],12:i:-	114	1.7
16	Muenster	107	1.6
17	Newport	97	1.5
18	Montevideo	91	1.4
19	Johannesburg	87	1.3
20	Worthington	82	1.3
	Sub Total	**4586**	**70.3**
	All Other Serotyped	1763	27.0
	Rough, mucoid, and/or nonmotile isolates	173	2.7
	Sub Total	**1936**	**29.7**
	Total	**6522**	**100**

Note:
* Typhimurium includes var. 5- (formerly var. Copenhagen)

Table 4. Laboratory-confirmed *Salmonella* isolates from clinical non-human animal sources (bovine, chicken, porcine, and turkey) submitted to the National Veterinary Services Laboratories (NVSL) for typing, for the top 4 serotypes causing human illness in 2011, by source.

Serotype	Human Rank, 2011	Non-Human (clinical) Sources			
		Bovine (%)	Chicken (%)	Porcine (%)	Turkey (%)
Enteritidis	1	5.6	67.4	2.8	0.6
Typhimurium (including Typhimurium var. 5-)	2	20.3	1.8	62.7	0.7
Newport	3	40.9	0.5	5.6	0
Javiana	4	0	0	4.4	0

Table 5. Laboratory-confirmed *Salmonella* isolates from non-clinical non-human animal sources (bovine, chicken, porcine, and turkey) submitted to the National Veterinary Services Laboratories (NVSL) for typing, for the top 4 serotypes causing human illness in 2011, by source.

Serotype	Human Rank, 2011	Non-Human (non-clinical) Sources			
		Bovine (%)	Chicken (%)	Porcine (%)	Turkey (%)
Enteritidis	1	0	92.1	0.8	0.2
Typhimurium (including Typhimurium var. 5-)	2	0.9	38.2	40.0	11.3
Newport	3	1.0	62.9	4.1	1.0
Javiana	4	0	42.4	0	12.1

References

1. Centers for Disease Control and Prevention (CDC). National *Salmonella* Surveillance Overview. Atlanta, Georgia: US Department of Health and Human Services, CDC, 2011.

2. Ryan CA, Nickels MK, Hargrett-Bean NT, et al. Massive outbreak of antimicrobial-resistant salmonellosis traced to pasteurized milk. JAMA. 1987 Dec 11;258(22):3269-74.

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NCEZID Atlanta:
For more information please contact Centers for Disease Control and Prevention
1600 Clifton Road NE, Atlanta, GA 30333 MS C-09
Telephone: 1-404-639-2206
Email: cdcinfo@cdc.gov