

National Enteric Disease Surveillance: *Salmonella* Annual Report, 2012

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 isolates from laboratory-confirmed human *Salmonella* infections 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. 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 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 2012. For maps (Figures 2a to 2i), some states were plotted using a gray color gradient if

- the number of laboratory-confirmed human *Salmonella* isolates reported to LEDS was less than 80% of the number of salmonellosis cases reported to the National Notifiable Diseases Surveillance System (NNDSS):
 - » Five reporting jurisdictions reported fewer than 80% of cases in NNDSS to LEDS: Florida, Indiana, Kansas, Nevada, and Vermont
- the number of fully serotyped laboratory-confirmed human *Salmonella* isolates reported to LEDS was fewer than 80% of all *Salmonella* isolates reported to LEDS:
 - » Ten reporting jurisdictions reported full serotype information for fewer than 80% of all isolates: Maine, Vermont, Wyoming, Texas, Nebraska, Kentucky, Ohio, Montana, Utah, and New Mexico.

LEDS is capable of identifying reported isolates by serotype, which is essential for many public health functions; NNDSS does not collect serotype names. In 2012, the conventions used to report serotype names were changed. Ancillary O antigen type is no longer listed in the serotype name. For example, isolates reported as serotype Typhimurium var. 5- are combined with serotype Typhimurium and serotypes Anatum var. 15+ and Anatum var. 15+, 34+ are combined with serotype Anatum. This change was made to simplify the serotype names, to improve the accuracy of the data because ancillary O antigen type is not consistently reported, and because routine use of pulsed-field gel electrophoresis (PFGE) analysis has reduced the epidemiologic utility of ancillary O antigen type. A complete list of variants and their parents affected by this change is in Appendix 6.

Table 1. Laboratory-confirmed human *Salmonella* infections reported to CDC, with the 20 most frequently reported serotypes listed individually, United States, 2012

Rank	Serotype	Number Reported	Percent
1	Enteritidis	7111	14.5
2	Typhimurium	5704	11.6
3	Newport	5115	10.4
4	Javiana	2883	5.9
5	I 4,[5],12:i:-	1745	3.6
6	Montevideo	1203	2.5
7	Infantis	1128	2.3
8	Muenchen	1042	2.1
9	Heidelberg	983	2.0
10	Bareilly	895	1.8
11	Braenderup	830	1.7
12	Thompson	823	1.7
13	Saintpaul	777	1.6
14	Oranienburg	758	1.5
15	Mississippi	655	1.3
16	Paratyphi B var. L(+) tartrate+	498	1.0
17	Anatum	403	0.8
18	Typhi	365	0.7
19	Agona	339	0.7
20	Berta	301	0.6
	Subtotal	33558	68.5
	Other serotyped *	6987	14.3
	Unknown serotype	6297	12.8
	Partially serotyped	1902	3.9
	Rough, mucoid, and/or nonmotile	260	0.5
	Subtotal	15446	31.5
	Total	49004	100

* Listed in Appendix 3.

State public health laboratories reported 49,004 laboratory-confirmed *Salmonella* infections to CDC through LEDS.

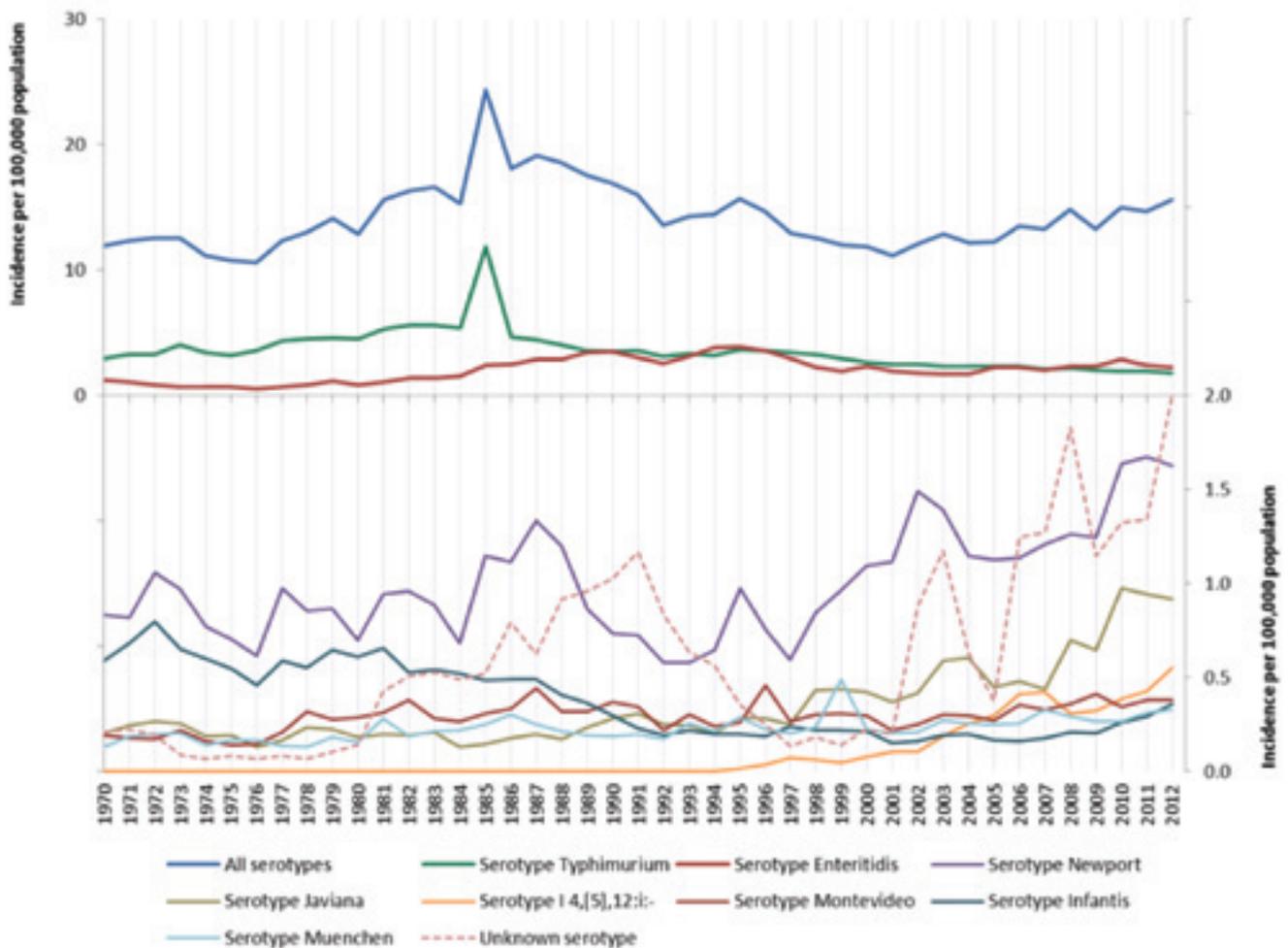
- The top 4 serotypes in 2012 were Enteritidis (15%), Typhimurium (12%), Newport (10%), and Javiana (6%).

Table 2. Laboratory-confirmed human *Salmonella* infections reported to CDC, percentage change among the 20 most frequently reported serotypes, comparing 2002, 2007, and 2012

Rank			Serotype	Number Reported			Percent Change		
2002	2007	2012		2002	2007	2012	2002 vs 2007	2007 vs 2012	2002 vs 2012
2	2	1	Enteritidis	5144	6152	7111	20	16	38
1	1	2	Typhimurium	7140	6279	5704	-12	-9	-20
3	3	3	Newport	4300	3653	5115	-15	40	19
5	5	4	Javiana	1201	1331	2883	11	117	140
17	6	5	I 4,[5],12:i:-	304	1273	1745	319	37	474
6	7	6	Montevideo	728	1003	1203	38	20	65
10	12	7	Infantis	472	540	1128	14	109	139
8	8	8	Muenchen	607	999	1042	65	4	72
4	4	9	Heidelberg	1985	1610	983	-19	-39	-50
23	23	10	Bareilly	183	249	895	36	259	389
13	11	11	Braenderup	389	589	830	51	41	113
11	17	12	Thompson	442	414	823	-6	99	86
9	13	13	Saintpaul	548	520	777	-5	49	42
7	9	14	Oranienburg	609	695	758	14	9	24
16	15	15	Mississippi	315	472	655	50	39	108
12	18	16	Paratyphi B var. L(+) tartrate+	441	412	498	-7	21	13
21	26	17	Anatum	222	210	403	-5	92	82
19	16	18	Typhi	293	450	365	54	-19	25
15	14	19	Agona	340	512	339	51	-34	0
18	29	20	Berta	300	191	301	-36	58	0

In 2012, serotype I 4,[5],12:i:- had the largest increase (474%) since 2002, but this increase was due at least in part to increased recognition and changes in reporting practice (1). Serotype Bareilly had the second largest increase (389%); most of this increase occurred after 2007. A large outbreak of serotype Bareilly infections in 2012 was associated with raw scraped tuna.

Figure 1. Incidence rate of laboratory-confirmed human *Salmonella* infection reported to CDC (all serotypes and serotypes with more than 1000 infections reported in 2012), United States, 1970-2012



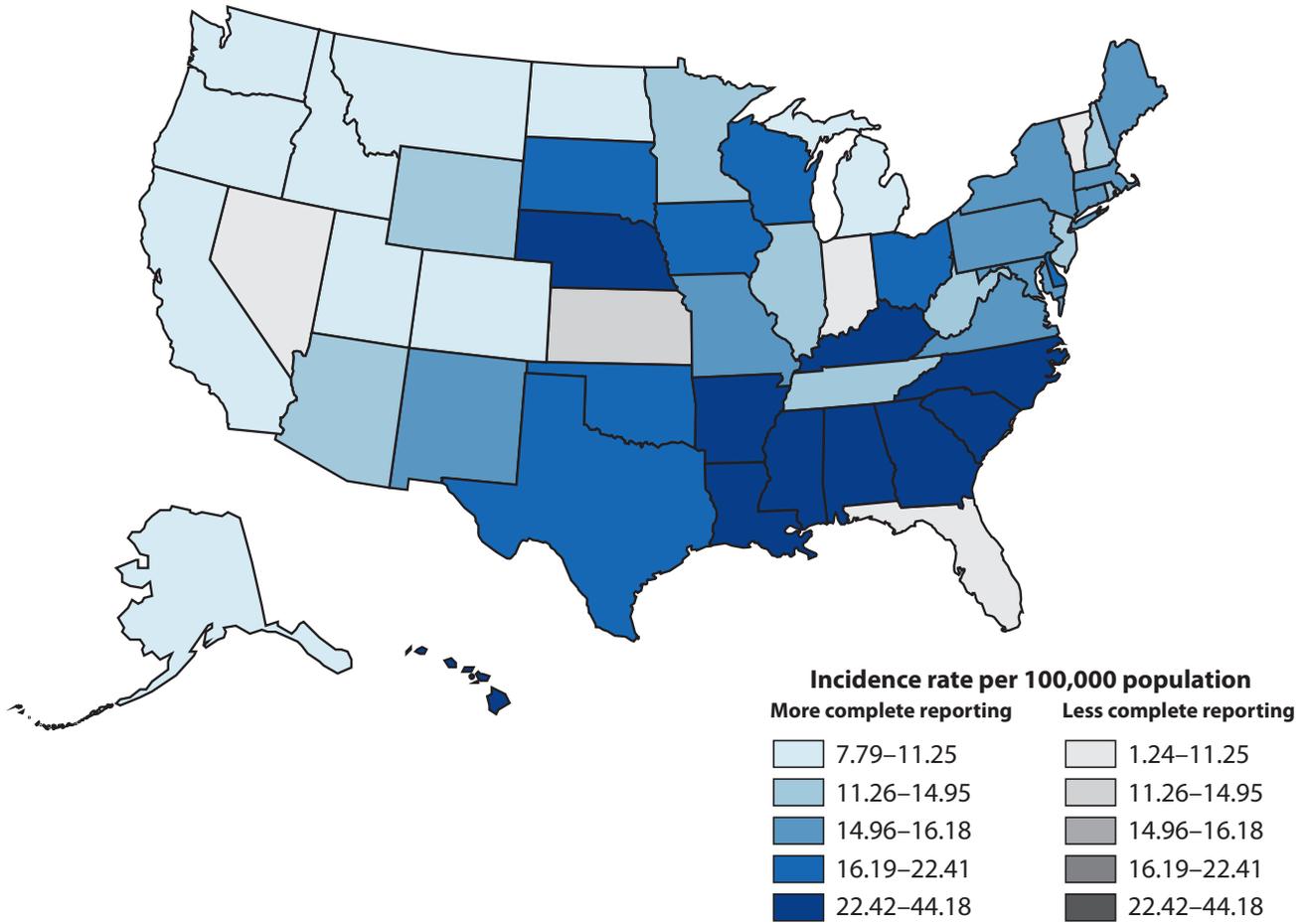
The top panel of this graph shows the yearly incidence rates of infection with *Salmonella* (all serotypes) and with serotypes Typhimurium and Enteritidis from 1970 to 2012.

- Since 1970, the incidence rate of infection with all *Salmonella* has been driven largely by the incidence rate of infection with serotypes Typhimurium and Enteritidis.
- The spike in incidence rate in 1985 reflects an outbreak of serotype Typhimurium infections associated with pasteurized milk (2).

The bottom panel of this graph shows the yearly incidence rates of infection with all other serotypes of *Salmonella* with more than 1000 infections reported in 2012. This includes serotypes Newport, Javiana, I 4,[5],12:i:-, Montevideo, Infantis, Muenchen, and infections with an unknown serotype.

- 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 rate of infection with isolates of unknown serotype has been increasing, likely due to serotyping not being performed on these isolates.

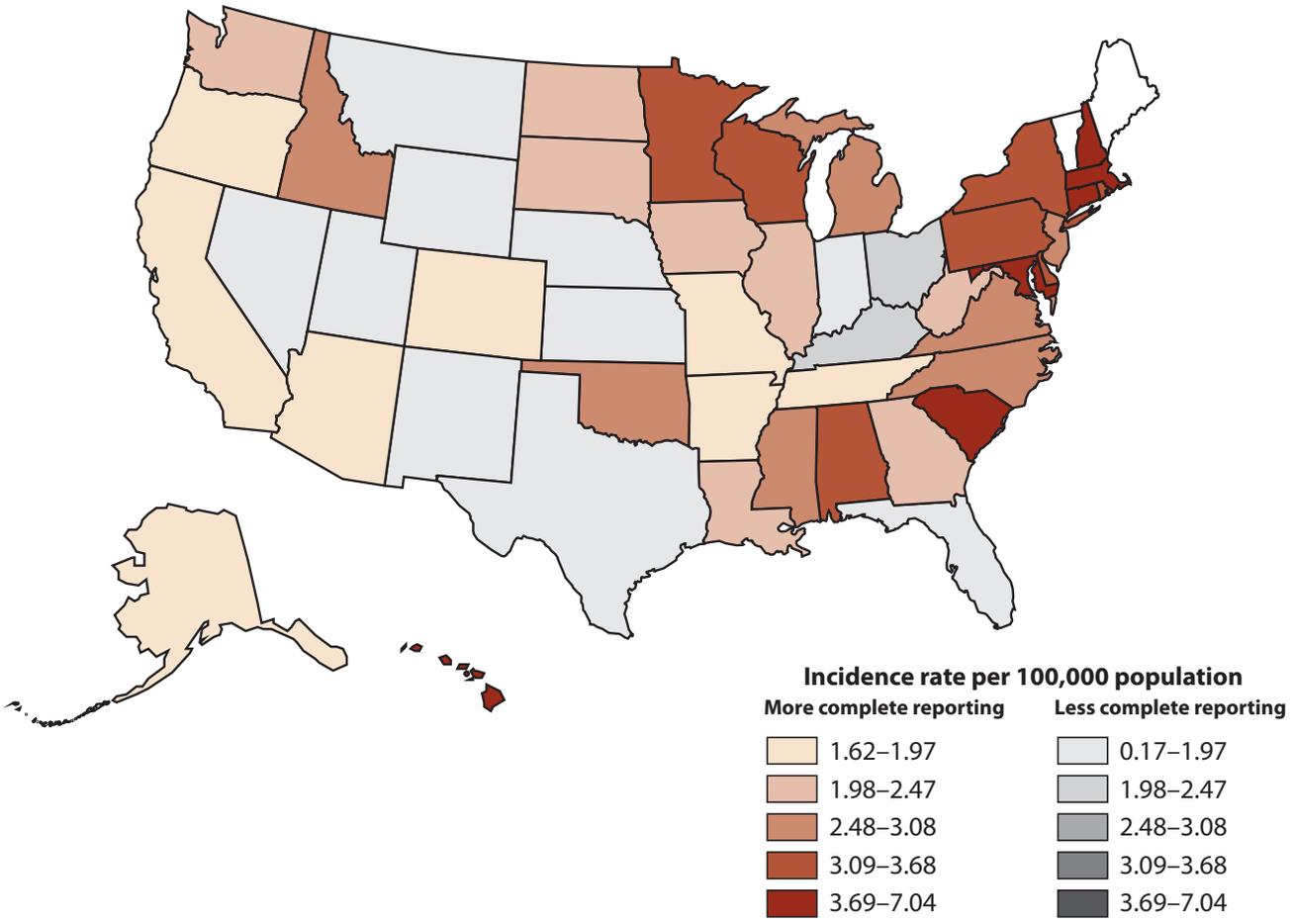
Figure 2a. Incidence rate of laboratory-confirmed human *Salmonella* infection reported to CDC (all serotypes), by reporting jurisdiction, United States, 2012*



* Reporting jurisdictions are colored in shades of gray if the number of laboratory-confirmed human *Salmonella* isolates reported to LEDSS was less than 80% of the number of salmonellosis cases reported to the National Notifiable Diseases Surveillance System (NNDSS).

The jurisdictions with the highest reported incidence rates of *Salmonella* infection (cases per 100,000 population) were South Carolina (44.2), Nebraska (39.3) and Mississippi (33.7).

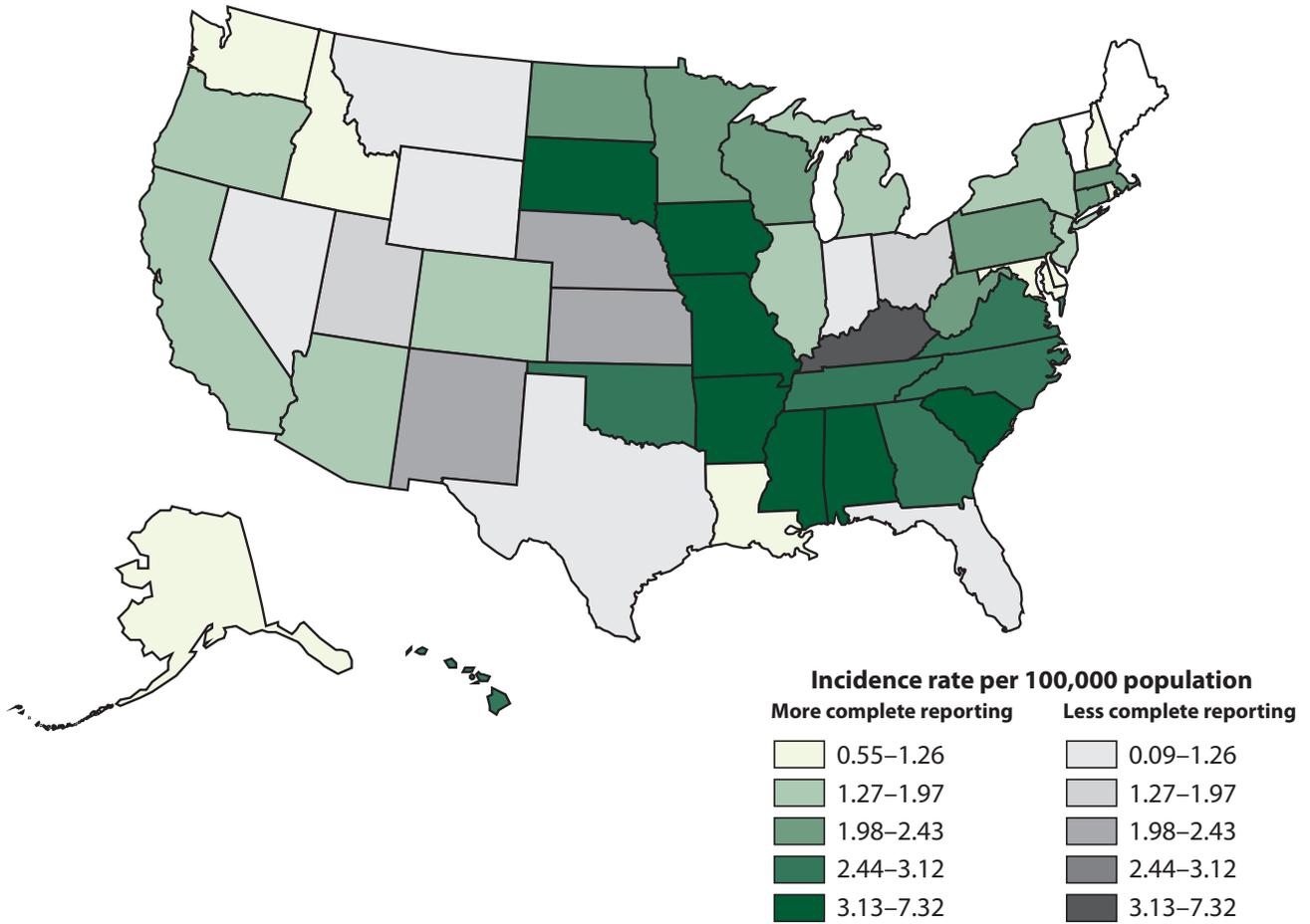
Figure 2b. Incidence rate of laboratory-confirmed human *Salmonella* serotype Enteritidis infection reported to CDC, by reporting jurisdiction, United States, 2012*



* Reporting jurisdictions are colored in shades of gray if i) the number of laboratory-confirmed human *Salmonella* isolates reported to LEDS was less than 80% of the number of salmonellosis cases reported to the National Notifiable Diseases Surveillance System (NNDSS), or ii) the number of fully serotyped laboratory-confirmed human *Salmonella* isolates reported to LEDS was less than 80% of all *Salmonella* isolates reported to LEDS. Unshaded jurisdictions are those that reported no laboratory-confirmed human *Salmonella* serotype Enteritidis isolates (Maine and Vermont).

The jurisdictions with the highest reported incidence rates of serotype Enteritidis infection (cases per 100,000 population) were Hawaii (7.0), District of Columbia (4.7), and Maryland (4.2).

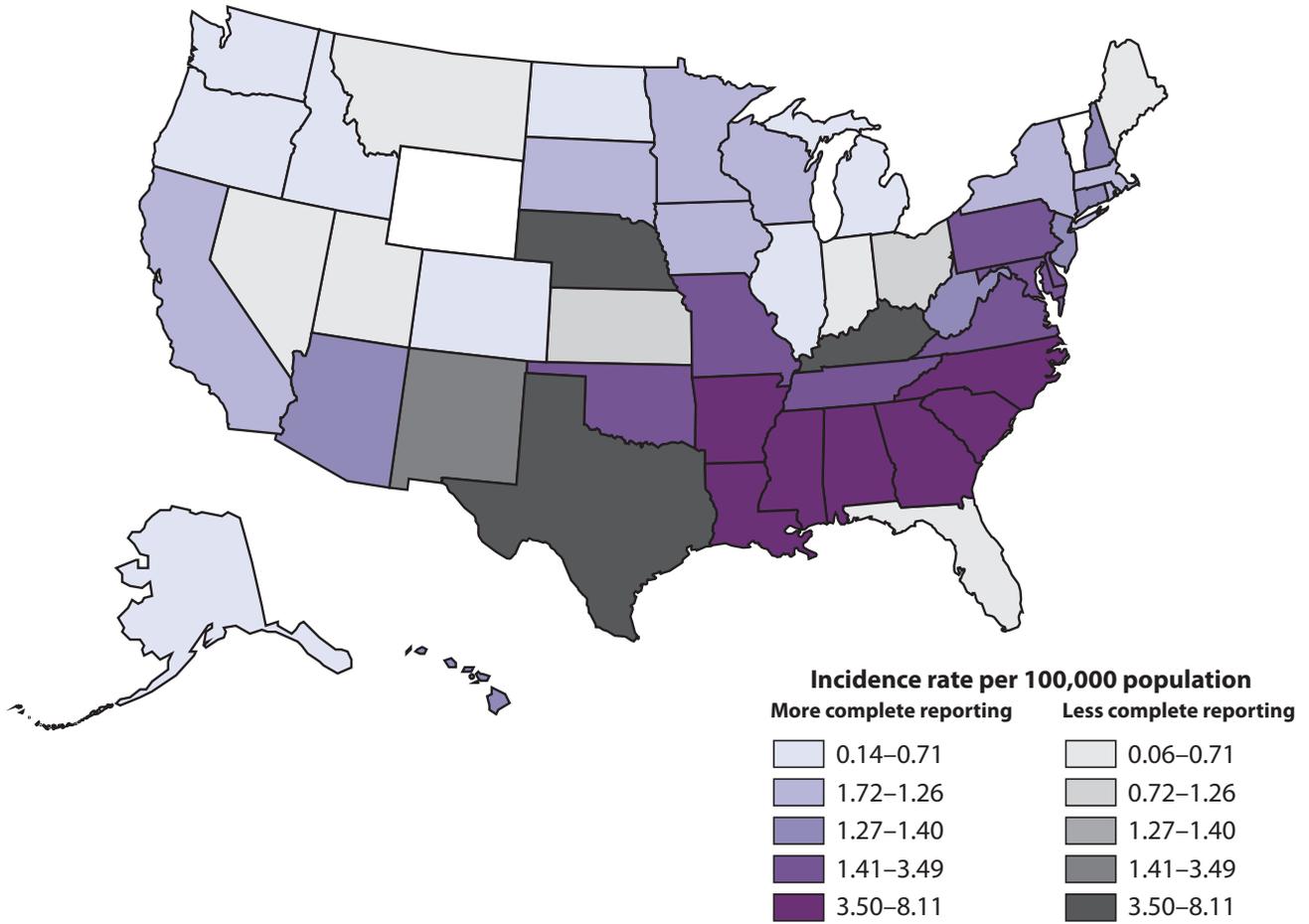
Figure 2c. Incidence rate of laboratory-confirmed human *Salmonella* serotype Typhimurium infection reported to CDC, by reporting jurisdiction, United States, 2012*



* Reporting jurisdictions are colored in shades of gray if i) the number of laboratory-confirmed human *Salmonella* isolates reported to LEDS was less than 80% of the number of salmonellosis cases reported to the National Notifiable Diseases Surveillance System (NNDSS), or ii) the number of fully serotyped laboratory-confirmed human *Salmonella* isolates reported to LEDS was less than 80% of all *Salmonella* isolates reported to LEDS. Unshaded jurisdictions are those that reported no laboratory-confirmed human *Salmonella* serotype Typhimurium isolates (Maine and Vermont).

The jurisdictions with the highest reported incidence rates of serotype Typhimurium infection (cases per 100,000 population) were South Dakota (7.3), Mississippi (6.6), and Alabama (5.1).

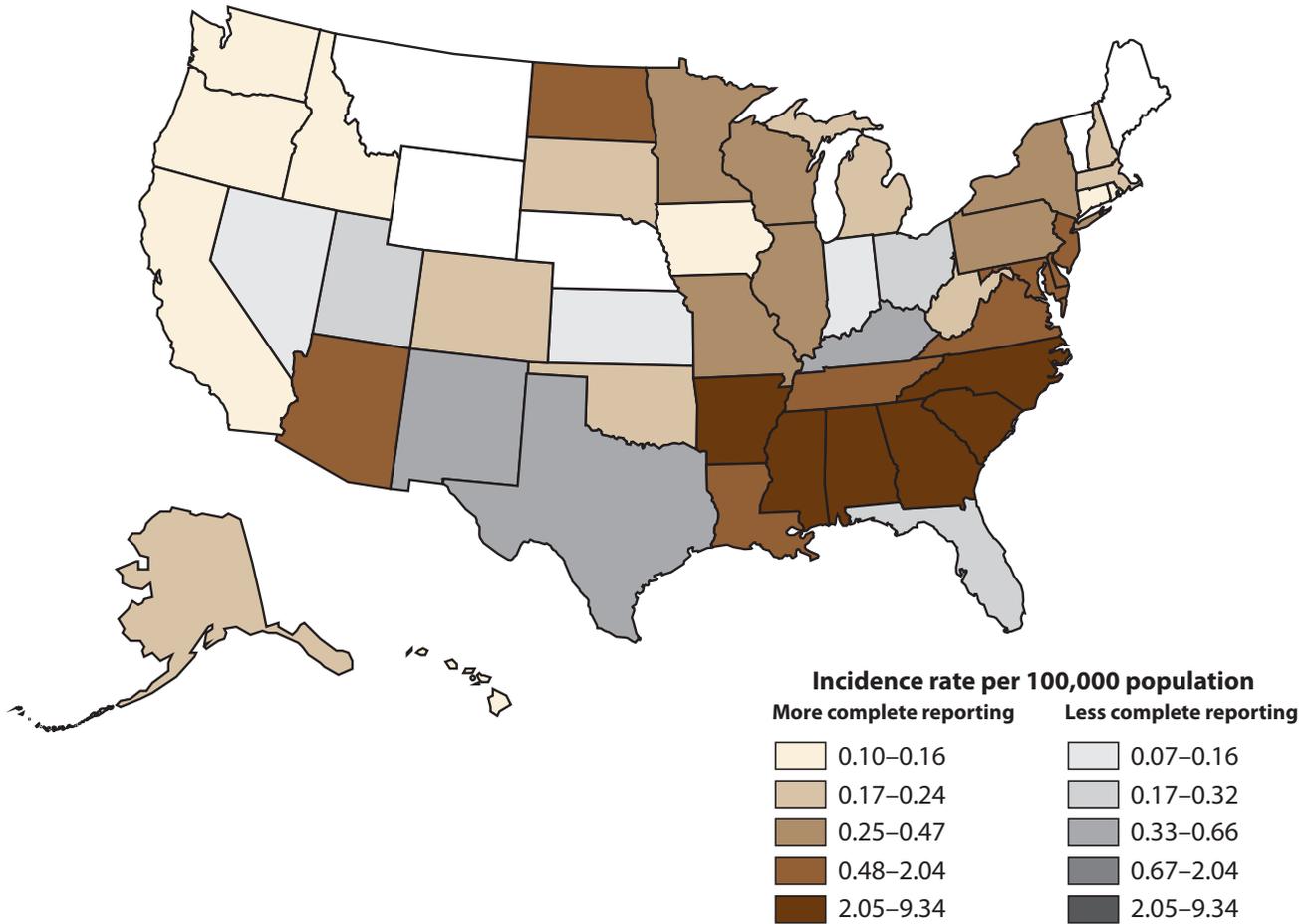
Figure 2d. Incidence rate of laboratory-confirmed human *Salmonella* serotype Newport infection reported to CDC, by reporting jurisdiction, United States, 2012*



* Reporting jurisdictions are colored in shades of gray if i) the number of laboratory-confirmed human *Salmonella* isolates reported to LEDS was less than 80% of the number of salmonellosis cases reported to the National Notifiable Diseases Surveillance System (NNDSS), or ii) the number of fully serotyped laboratory-confirmed human *Salmonella* isolates reported to LEDS was less than 80% of all *Salmonella* isolates reported to LEDS. Unshaded jurisdictions are those that reported no laboratory-confirmed human *Salmonella* serotype Newport isolates (Vermont and Wyoming).

The jurisdictions with the highest reported incidence rates of serotype Newport infection (cases per 100,000 population) were South Carolina (8.1), Arkansas (6.2), Mississippi (5.7).

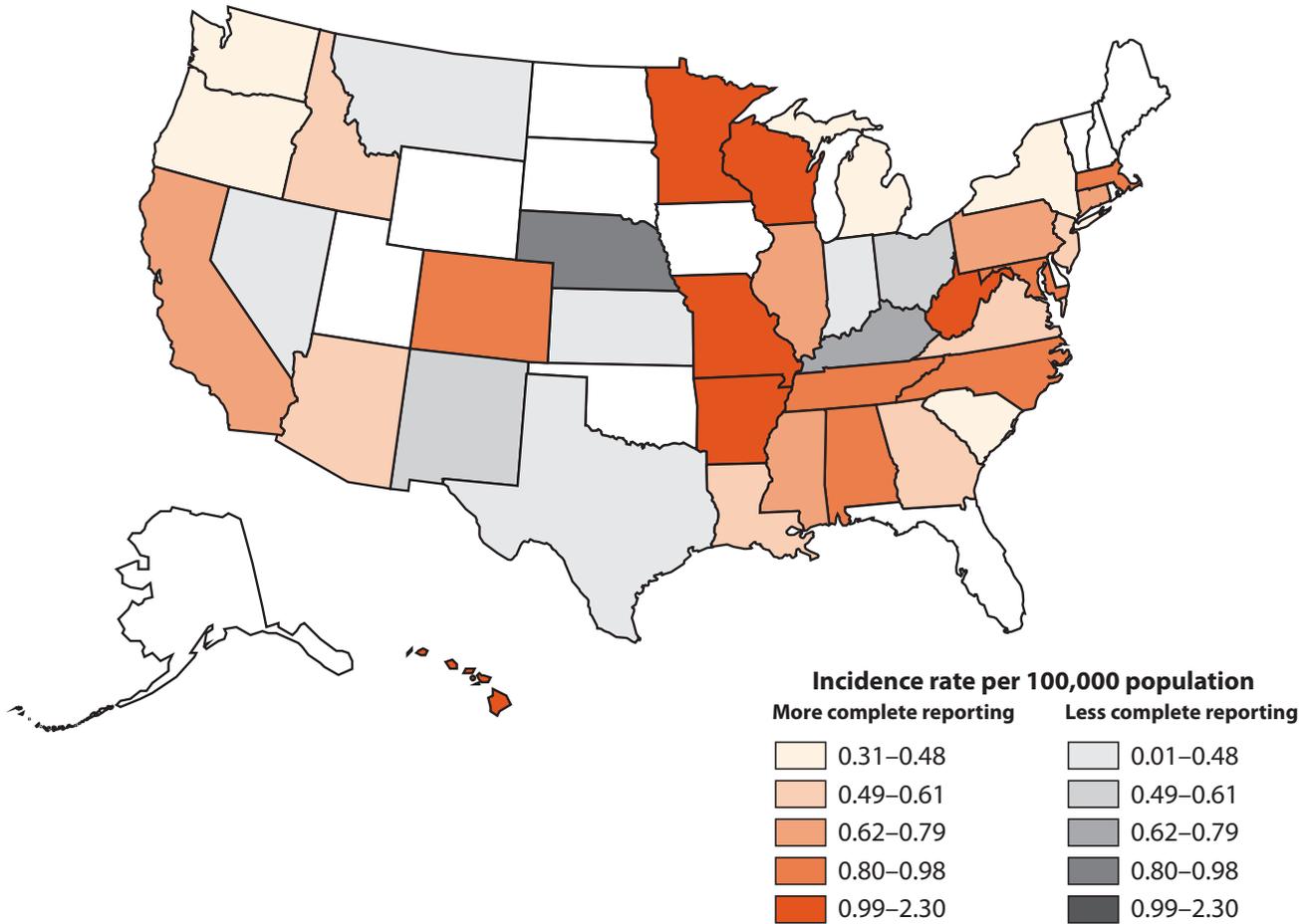
Figure 2e. Incidence rate of laboratory-confirmed human *Salmonella* serotype Javiana infection reported to CDC, by reporting jurisdiction, United States, 2012*



* Reporting jurisdictions are colored in shades of gray if i) the number of laboratory-confirmed human *Salmonella* isolates reported to LEDS was less than 80% of the number of salmonellosis cases reported to the National Notifiable Diseases Surveillance System (NNDSS), or ii) the number of fully serotyped laboratory-confirmed human *Salmonella* isolates reported to LEDS was less than 80% of all *Salmonella* isolates reported to LEDS. Unshaded jurisdictions are those that reported no laboratory-confirmed human *Salmonella* serotype Javiana isolates (District of Columbia, Maine, Montana, Nebraska, Rhode Island, Vermont, and Wyoming).

The jurisdictions with the highest reported incidence rates of serotype Javiana infection (cases per 100,000 population) were South Carolina (9.3), Georgia (5.9), and Mississippi (4.9).

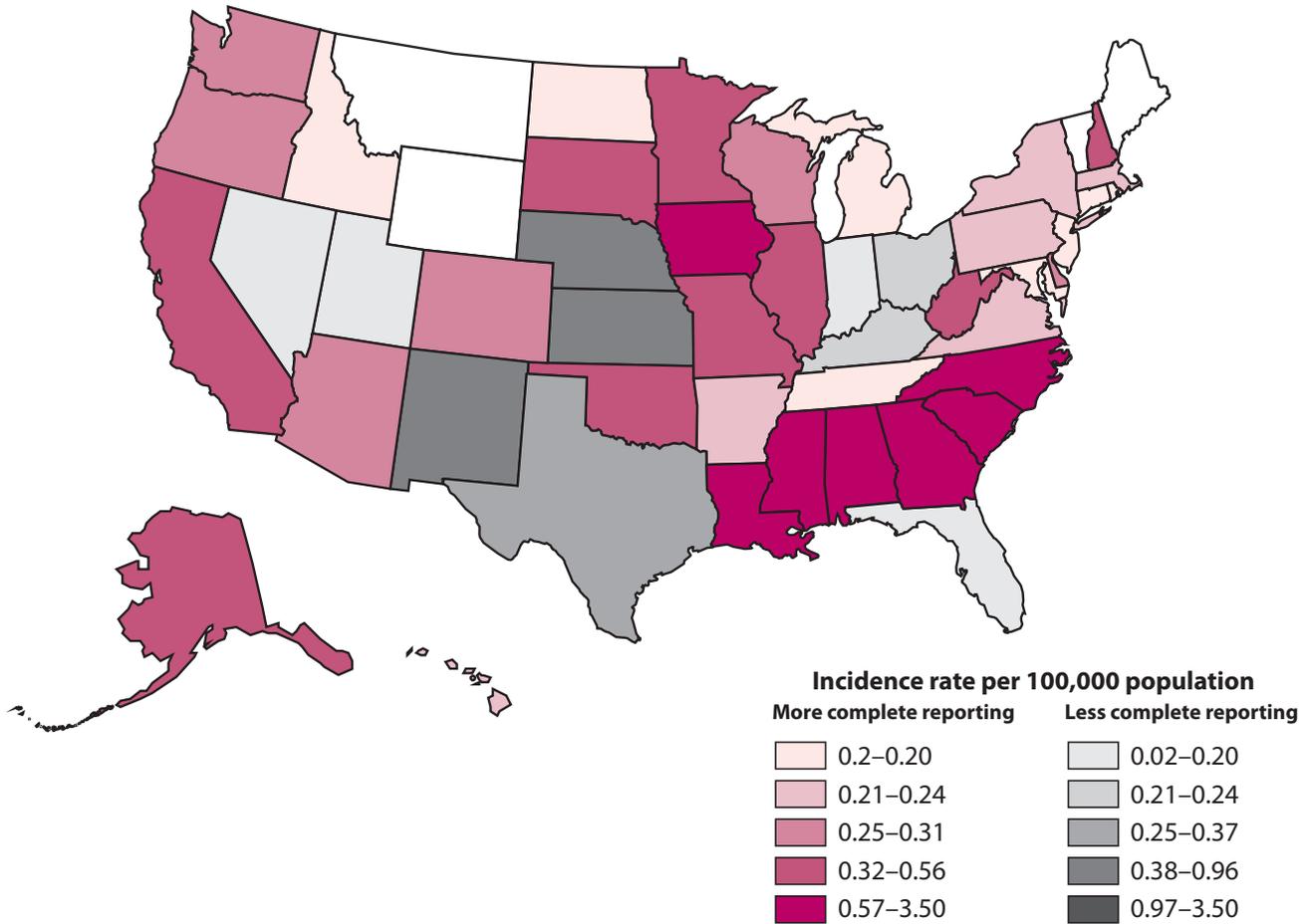
Figure 2f. Incidence rate of laboratory-confirmed human *Salmonella* serotype I 4,[5],12:i:- infection reported to CDC, by reporting jurisdiction, United States, 2012*



* Reporting jurisdictions are colored in shades of gray if i) the number of laboratory-confirmed human *Salmonella* isolates reported to LEDS was less than 80% of the number of salmonellosis cases reported to the National Notifiable Diseases Surveillance System (NNDSS), or ii) the number of fully serotyped laboratory-confirmed human *Salmonella* isolates reported to LEDS was less than 80% of all *Salmonella* isolates reported to LEDS. Unshaded jurisdictions are those that reported no laboratory-confirmed human *Salmonella* serotype I 4,[5],12:i:- isolates (Alaska, Delaware, Florida, Iowa, Maine, North Dakota, Oklahoma, New Hampshire, South Dakota, Utah, Vermont, and Wyoming).

The reporting jurisdictions with the highest reported incidence rates of serotype I,4,[5],12:i:- infection (cases per 100,000 population) were Hawaii (2.3), Montana (1.3), and West Virginia (1.3).

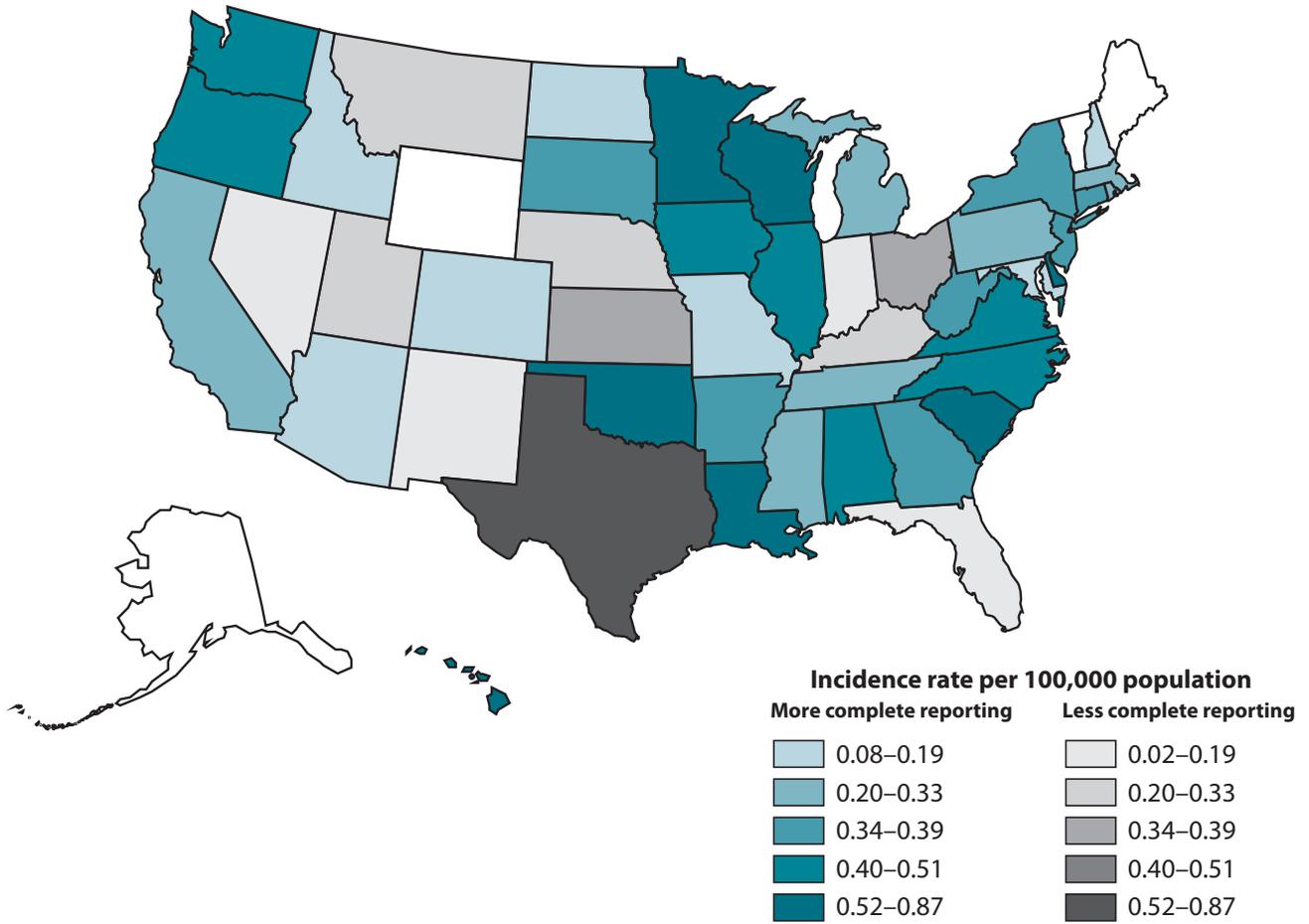
Figure 2g. Incidence rate of laboratory-confirmed human *Salmonella* serotype Montevideo infection reported to CDC, by reporting jurisdiction, United States, 2012*



* Reporting jurisdictions are colored in shades of gray if i) the number of laboratory-confirmed human *Salmonella* isolates reported to LEDS was less than 80% of the number of salmonellosis cases reported to the National Notifiable Diseases Surveillance System (NNDSS), or ii) the number of fully serotyped laboratory-confirmed human *Salmonella* isolates reported to LEDS was less than 80% of all *Salmonella* isolates reported to LEDS. Unshaded jurisdictions are those that reported no laboratory-confirmed human *Salmonella* serotype Montevideo isolates (District of Columbia, Maine, Montana, Vermont, and Wyoming).

The reporting jurisdictions with the highest reported incidence rates of serotype Montevideo infection (cases per 100,000 population) were Louisiana (3.5), Alabama (1.7), and South Carolina (1.5).

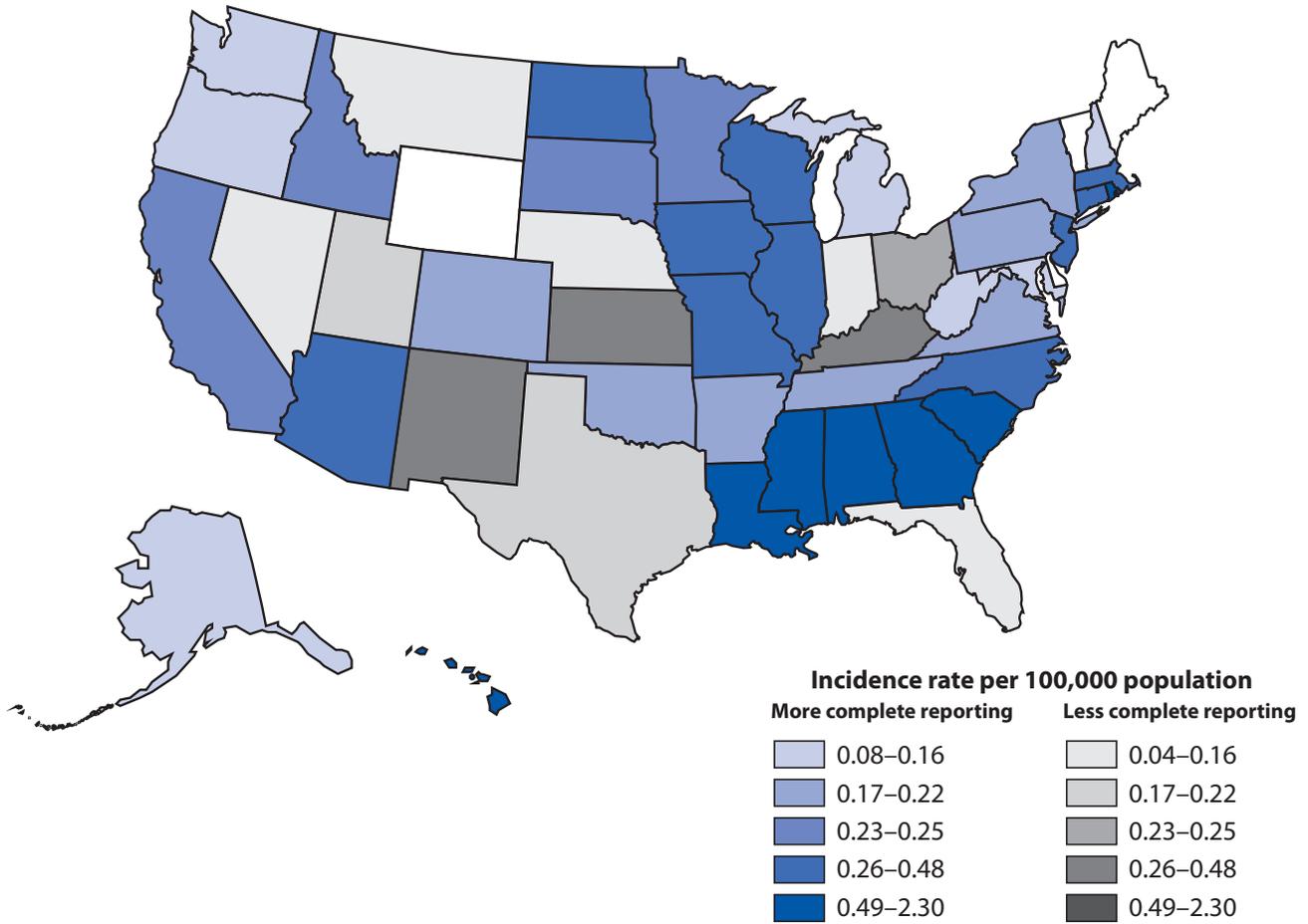
Figure 2h. Incidence rate of laboratory-confirmed human *Salmonella* serotype Infantis infection reported to CDC, by reporting jurisdiction, United States, 2012*



* Reporting jurisdictions are colored in shades of gray if i) the number of laboratory-confirmed human *Salmonella* isolates reported to LEDS was less than 80% of the number of salmonellosis cases reported to the National Notifiable Diseases Surveillance System (NNDSS), or ii) the number of fully serotyped laboratory-confirmed human *Salmonella* isolates reported to LEDS was less than 80% of all *Salmonella* isolates reported to LEDS. Unshaded jurisdictions are those that reported no laboratory-confirmed human *Salmonella* serotype Infantis isolates (Alaska, Maine, Vermont, and Wyoming).

The reporting jurisdictions with the highest reported incidence rates of serotype Infantis infection (cases per 100,000 population) were Delaware (0.8), Hawaii (0.8), and Oklahoma (0.8).

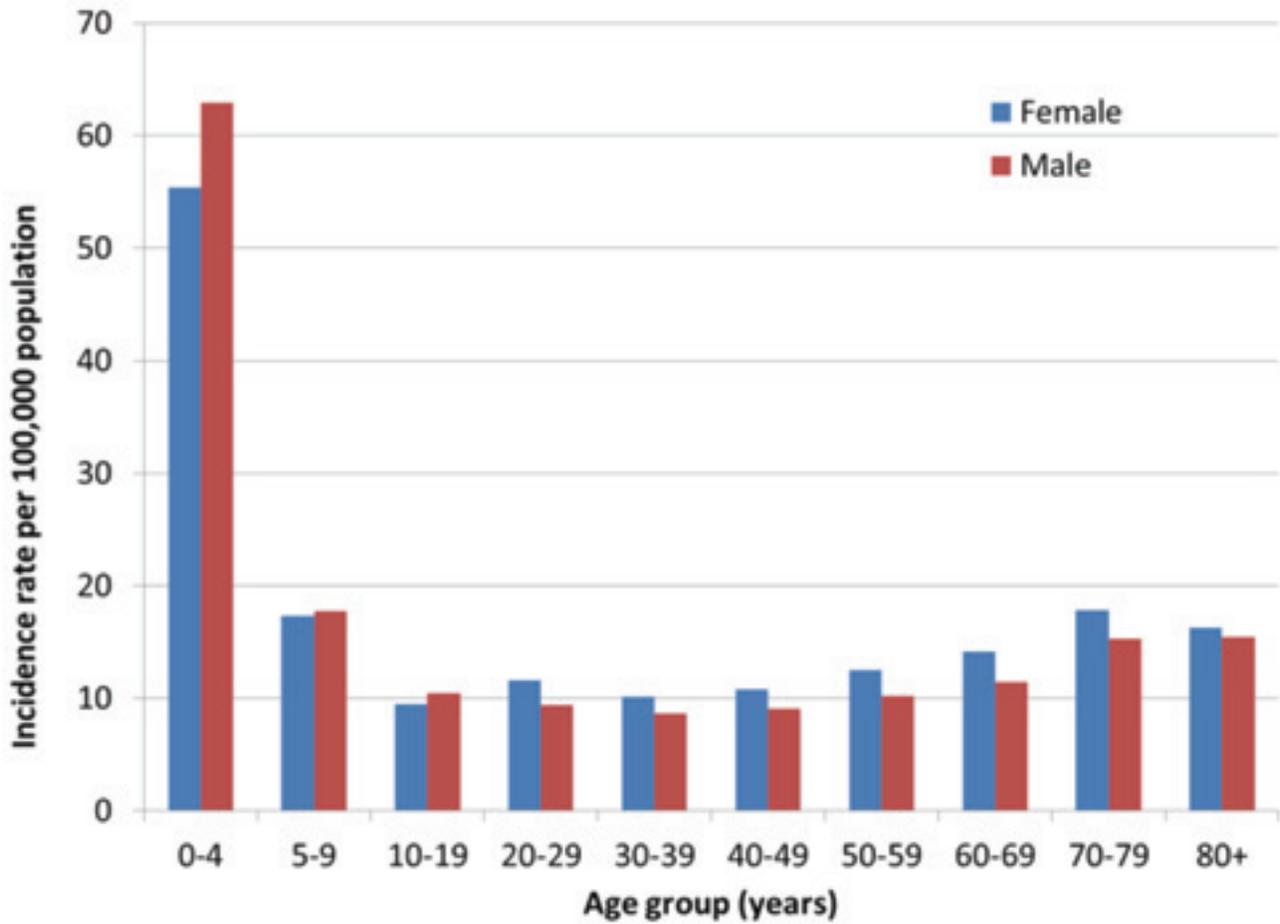
Figure 2i. Incidence rate of laboratory-confirmed human *Salmonella* serotype Muenchen infection reported to CDC, by reporting jurisdiction, United States, 2012*



* Reporting jurisdictions are colored in shades of gray if i) the number of laboratory-confirmed human *Salmonella* isolates reported to LEDS was less than 80% of the number of salmonellosis cases reported to the National Notifiable Diseases Surveillance System (NNDSS), or ii) the number of fully serotyped laboratory-confirmed human *Salmonella* isolates reported to LEDS was less than 80% of all *Salmonella* isolates reported to LEDS. Unshaded jurisdictions are those that reported no laboratory-confirmed human *Salmonella* serotype Muenchen isolates (Delaware, District of Columbia, Maine, Vermont, and Wyoming).

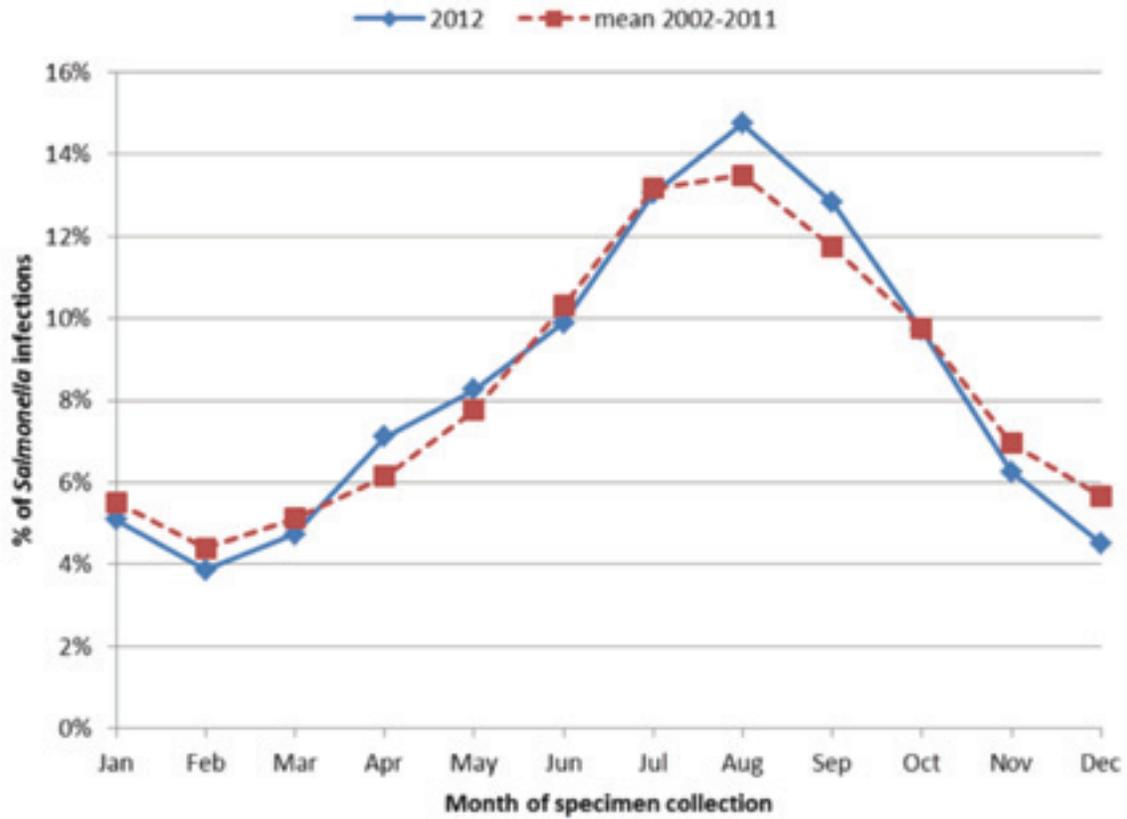
The reporting jurisdictions with the highest reported incidence rates of serotype Muenchen infection (cases per 100,000 population) were Hawaii (2.3), South Carolina (2.2), and Alabama (1.5).

Figure 3. Incidence rate of laboratory-confirmed human *Salmonella* infection reported to CDC, by age group and sex, United States, 2012 (n=46,097 with age and sex information reported)



During 2012, 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 than females. From age 20 to 80+, females had a higher incidence rate of *Salmonella* infections than males.

Figure 4. Percentage of laboratory-confirmed *Salmonella* infections reported to CDC, by month of specimen collection, United States, 2012 and mean percentage during 2002 to 2011



During 2012, reports of *Salmonella* infections showed seasonality similar to the mean reported from 2002 to 2011.

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 2012 report is 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.

The 2012 report is available at <http://www.cdc.gov/narms/reports/index.html>.

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

The Foodborne Disease Outbreak Surveillance System (FDOSS) collects reports of foodborne disease outbreaks from local, state, tribal, and territorial public health agencies.

The 2012 report is available at <http://www.cdc.gov/foodsafety/fdoss/data/annual-summaries/index.html>.

The Waterborne Disease and Outbreak Surveillance System (WBD OSS) 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 2012 was not yet available when this report was written.

Reports are available at <http://www.cdc.gov/healthywater/surveillance/surveillance-reports.html>.

Non-human Surveillance Data: National Veterinary Services Laboratories (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. In mid-2012, USDA-FSIS began molecular serotyping; those results are not sent to CDC or NVSL and are not included in this summary.

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, 2012

Clinical Non-human 2012			
Rank	Serotype	Reported	Percent
1	Typhimurium	951	19.8
2	Dublin	254	5.3
3	Agona	245	5.1
4	Derby	231	4.8
5	Newport	229	4.8
6	Cerro	189	3.9
7	Enteritidis	181	3.8
8	Infantis	167	3.5
9	I 4,5,12:i:-	161	3.4
10	Heidelberg	154	3.2
11	Montevideo	150	3.1
12	Anatum	134	2.8
13	Senftenberg	121	2.5
14	I 4,12:i:-	116	2.4
15	Muenchen	73	1.5
16	Kentucky	67	1.4
17	Mbandaka	67	1.4
18	Worthington	54	1.1
19	Ohio	49	1.0
20	Johannesburg	48	1.0
	Subtotal	3641	75.9
	All other serotyped	1059	22.1
	Rough, mucoid, and/or nonmotile isolates	94	2.0
	Subtotal	1153	24.1
	Total	4794	100

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, 2012

Non-Clinical Non-human 2012			
Rank	Serotype	Reported	Percent
1	Kentucky	1050	14.9
2	Enteritidis	932	13.2
3	Heidelberg	837	11.9
4	Senftenberg	643	9.1
5	Typhimurium	423	6.0
6	Mbandaka	316	4.5
7	Montevideo	184	2.6
8	Thompson	153	2.2
9	Muenster	150	2.1
10	Braenderup	140	2.0
11	Schwarzengrund	135	1.9
12	Newport	131	1.9
13	Anatum	122	1.7
14	Hadar	110	1.6
15	Infantis	110	1.6
16	Liverpool	88	1.3
17	Cerro	87	1.2
18	Agona	80	1.1
19	Dublin	61	0.9
20	Muenchen	61	0.9
	Subtotal	5813	82.5
	All other serotyped	1165	16.5
	Rough, mucoid, and/or nonmotile isolates	6	0.1
	Unknown	58	0.8
	Subtotal	1229	17.4
	Total	7042	100

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 2012, by source

Serotype	Human Rank, 2012	Non-Human (clinical) Sources			
		Bovine (%)	Chicken (%)	Porcine (%)	Turkey (%)
Enteritidis	1	1.1	74.6	2.8	1.7
Typhimurium	2	18.0	1.3	50.6	2.7
Newport	3	34.5	2.6	4.4	0.0
Javiana	4	4.4	0.0	26.1	4.4

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 2012, by source

Serotype	Human Rank, 2012	Non-Human (non-clinical) Sources			
		Bovine (%)	Chicken (%)	Porcine (%)	Turkey (%)
Enteritidis	1	0.0	47.6	0.0	0.2
Typhimurium	2	9.0	27.0	2.1	1.4
Newport	3	6.1	48.9	0.8	10.7
Javiana	4	0.0	47.1	0.0	5.9

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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APPENDICES (separate document, listed here for reference)

- Appendix 1. Laboratory-confirmed *Salmonella* infections reported to CDC by age group and sex, 2012
- Appendix 2. Laboratory-confirmed *Salmonella* infections reported to CDC by serotype and reporting jurisdiction, 2012
- Appendix 3. Laboratory-confirmed *Salmonella* infections reported to CDC by serotype and year, 2002-2012
- Appendix 3a. Partially serotyped laboratory-confirmed *Salmonella* infections reported to CDC by serogroup and year, 2002-2012
- Appendix 4. Laboratory-confirmed *Salmonella* isolates from clinical non-human sources reported to the National Veterinary Services Laboratories (NVSL) for typing, by serotype and source, 2012
- Appendix 5. Laboratory-confirmed *Salmonella* isolates from non-clinical non-human sources reported to the National Veterinary Services Laboratories (NVSL) for typing, by serotype and source, 2012
- Appendix 6. *Salmonella* serotypes affected by naming convention changes, 2012