SEROTYPE ANATUM

An Atlas of *Salmonella* in the United States, 1968-2011

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

ewport | Oranienburg | Panama | Poona | Reading | Saintpaul | Sandiego | Schwarzengrund | Senftenberg |
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| Blockely | Branderup | Derby | Enteritidis | Hadar | Heidelberg | I 4,[5],12:i:- | Infantis | Javiana | Litchfield

Salmonellosis is estimated to cause more than 1.2 million illnesses each year in the United States, with more than 23,000 hospitalizations and 450 deaths (1). *Salmonella* infections most often cause gastroenteritis, which can range from mild to severe. However, invasive infections can also occur and can be severe and life-threatening.

National surveillance for *Salmonella* infections was established in the United States in 1962. Clinical diagnostic laboratories submit *Salmonella* isolates from human clinical specimens to state and territorial public health laboratories, where they are confirmed and serotyped according to the Kauffmann-White scheme. Reports of these laboratory-confirmed *Salmonella* isolates are then submitted by state and territorial public health departments to the Centers for Disease Control and Prevention (CDC) (2). Unusual or untypable serotypes are forwarded to the National *Salmonella* Reference Laboratory at CDC for further characterization or confirmation; results are reported back to state and territorial public health laboratories. Serotyping provides a consistent subtyping scheme for that has changed little over time, permitting analysis of trends in surveillance data. In the United States, serotype-specific *Salmonella* surveillance is conducted to define endemic patterns of salmonellosis, to detect outbreaks, to identify temporal trends in disease transmission, and to monitor the impact of control efforts. This report summarizes 42 years of surveillance data on *Salmonella* isolates from humans, and includes analyses by age, sex, geography, and season.

In addition to reports of isolates from humans, reports of *Salmonella* isolates from animals and related sources (e.g., environment and feeds) are included in this report; these data come from the National Veterinary Services Laboratories (NVSL) of the United States Department of Agriculture's Food Safety and Inspection Service (USDA-FSIS). These isolates are submitted by veterinary diagnostic laboratories throughout the United States for serotyping (2). Clinical animal isolates (referred to as "clinical/non-human") are *Salmonella* isolates from animals with clinical signs consistent with salmonellosis; "non-clinical/non-human" isolates are *Salmonella* isolates identified through herd and flock monitoring and surveillance, feed sample testing, environmental testing, and USDA-FSIS food testing programs.

Explanation of Figures

Figures for this report were generated using data from a 42-year period, 1968 to 2011, for the top 30 serotypes.

Figure 1 shows the 3-month moving average rate of reported isolates (per 100,000 population) by month and year. Data points for each month are the mean of the rate of isolates from that month (determined by specimen collection date) and the preceding and subsequent months. This smoothing process reduces erratic fluctuations (reporting artifacts, random changes, or outbreaks) that could obscure real periodic changes and therefore helps reveals periodic occurrences that are useful for characterizing some serotypes.

Figure 2 shows the distribution of human isolates by specimen source. The graph has 6 different types or groups of sources. For each source type, the data graphed are the percentage of the total number of isolates reported for each source. Note that the Y-axis scale varies from serotype to serotype.

Figure 3 shows the distribution of isolates by month of specimen collection for each of 3 age groups: 0-4 years old, 5-29 years old, and 30+ years old. For each age group, the percentage of isolates reported in each month of the year is plotted.

Figure 4 shows the rate of isolates (per 100,000 population) by year for each of 3 age groups: 0-4 years old, 5-29 years old, and 30+ years old. Note that the Y-axis scale varies from serotype to serotype.

Figure 5 shows the median ages of persons whose specimens yielded isolates, by sex, for each month of the year.

Figure 6 shows the median ages of persons whose specimens yielded isolates, by sex, for each year of specimen collection. When interpreting this graph, it is important to bear in mind that, over this period, the average age of the US population increased.

Figure 7 shows the distribution by age group and sex of persons whose specimens yielded isolates. Age-groups are <1 , 1-4, 5-9, 10-19, 20-29, 30-39, 40-49, 50-59, 60-69, 70-79 and 80+ years old. For each age group the graph shows the percentage of the total number of isolates reported for each sex. These percentages are not adjusted for the unequal age group intervals. Note that the Y-axis scale varies from serotype to serotype.

Figure 8 summarizes data from NVSL for non-human sources from 1968 to 2011. Samples originating from non-human sources are tested for *Salmonella* for a variety of purposes; sampling is neither complete nor representative, and any interpretation of these data should consider these limitations.

Figures 9 through 14 show age-standardized rates of isolates per 100,000 population, by county, in 6 maps. Eight-year intervals were used for the analysis, except for the last two intervals, which are 7 and 6 years, respectively. Average rates for each county were determined by summing the total number of isolates from each time interval and dividing by the population, based on US census data for the midpoint of the interval. The county-specific rates were then standardized to the age distribution of the 2011 census. The data were categorized into four levels corresponding to quartiles of the overall serotype-specific incidences over the 42-year period. Counties for which data are not shown are those for which the state reported isolates of the serotype but did not provide county-level information or for which the state reported no isolates of the serotype (no infections with that serotype were diagnosed, or isolates were not fully serotyped). Maps represent US state and county designations on August 1, 2012. See Federal Information Processing Standards (FIPS) Publication 6-4 for full details on changes to counties and equivalent entities of the United States over time.

Data limitations

A major limitation of these data is that many cases of salmonellosis are not diagnosed and reported to the state health department; this may occur because the ill person does not seek medical care, the health care provider does not obtain a stool culture, or the culture results are not reported to public health officials. These factors lead to underreporting; it is estimated that 29.3 cases of salmonellosis occur for every one that is laboratory-confirmed and reported (1). A second important limitation is that, overall, 7.6% of specimens are reported with missing or incomplete serotype, which adds another source of potential bias to the data descriptions.

References

1. Scallan E, Hoekstra RM, Angulo FJ, Tauxe RV, Widdowson MA, Roy SL, Jones JL, Griffin PM. Foodborne illness acquired in the United States--major pathogens. Emerg Infect Dis. 2011 Jan;17(1):7-15.

2. Centers for Disease Control and Prevention (CDC). National *Salmonella* Surveillance Overview. Atlanta, Georgia: US Department of Health and Human Services, CDC, 2011. http://www.cdc.gov/nationalsurveillance/PDFs/NationalSalmSurveillOverview_508.pdf (accessed 10/25/2012)

3. National Veterinary Services Laboratory: http://www.aphis.usda.gov/animal_health/lab_info_services/about_nvsl.shtml (accessed 10/22/2012)

Suggested Citation

Centers for Disease Control and Prevention (CDC). An Atlas of Salmonella in the United States, 1968-2011: Laboratory-based Enteric Disease Surveillance. Atlanta, Georgia: US Department of Health and Human Services, CDC, 2013.

Salmonella serotype Anatum

Figure 1 - Rate of reported isolates per 100,000 population, 3-month moving average, by month and year, 1968-2011

N=10,702

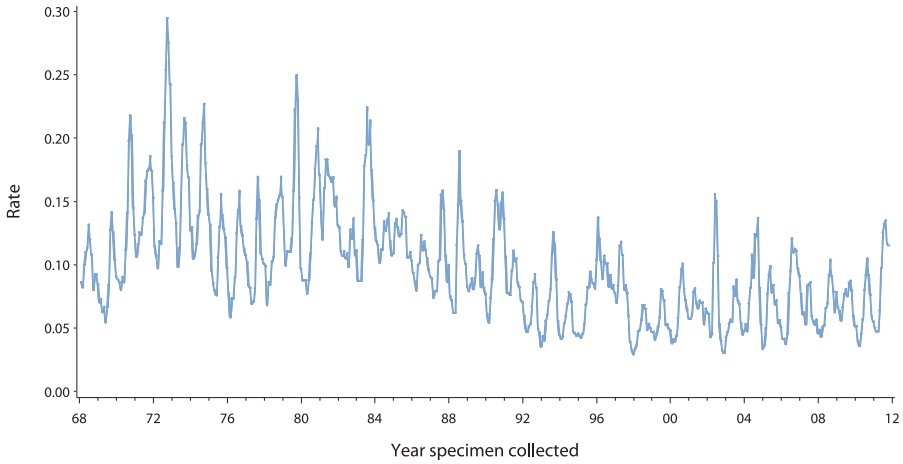


Figure 2 - Percentage of reported isolates, by specimen source, 1968-2011

N=10,702

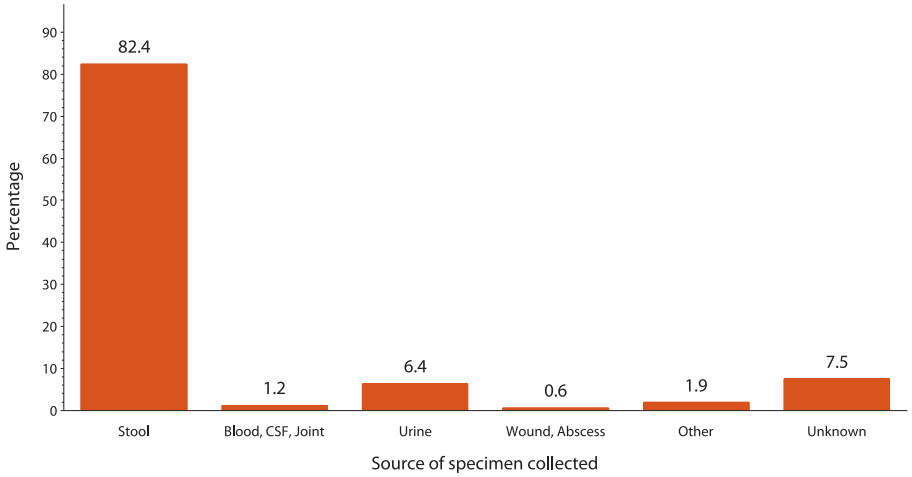


Figure 3 - Percentage of reported isolates, by age group and month, 1968-2011

N=8,487 Missing=2,215

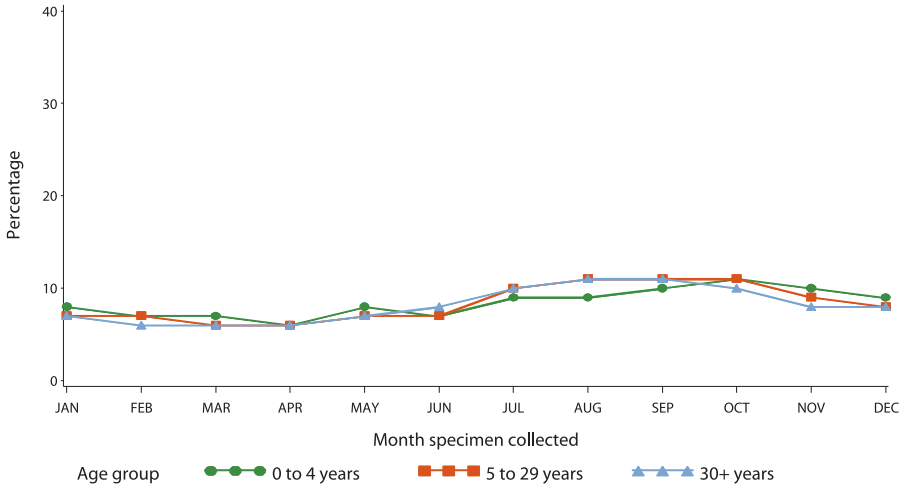


Figure 4 - Rate of reported isolates per 100,000 population, by age group and year, 1968-2011

N=8,487 Missing=2,215

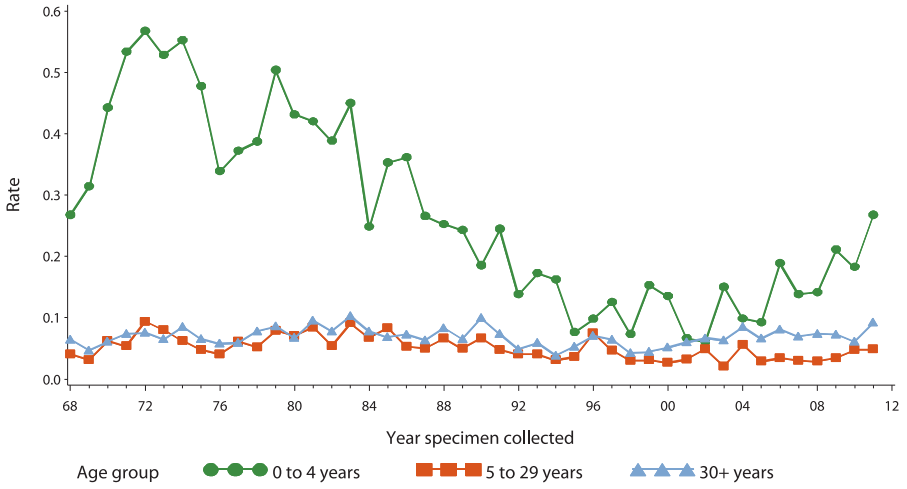


Figure 5 - Median age of persons whose specimens yielded isolates, by month, 1968-2011

N=8,487 Missing=2,402

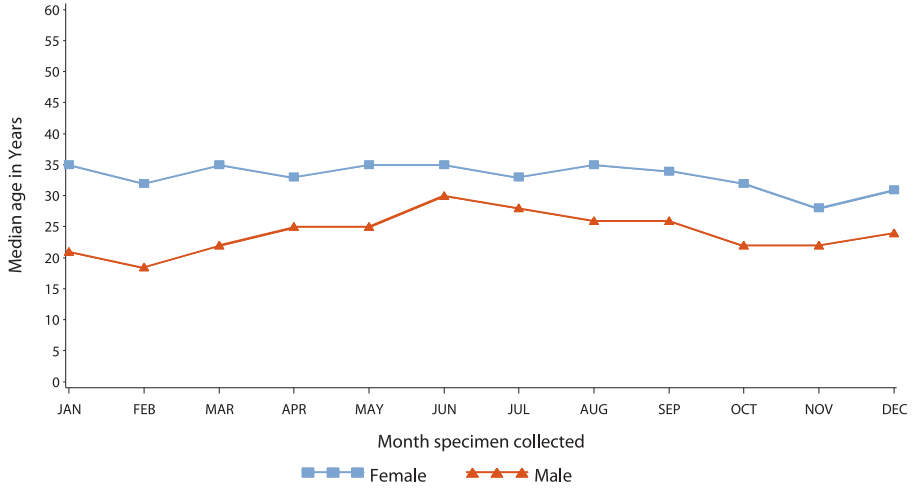


Figure 6 - Median age of persons whose specimens yielded isolates, by year, 1968-2011

N=8,487 Missing=2,402

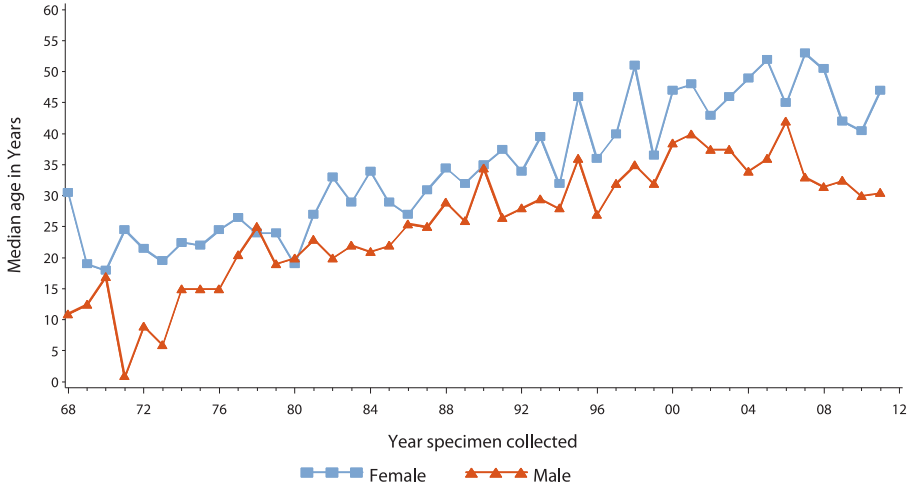


Figure 7 - Percentage of reported isolates, by age group and sex, 1968-2011

N=8,487 Missing=2,402

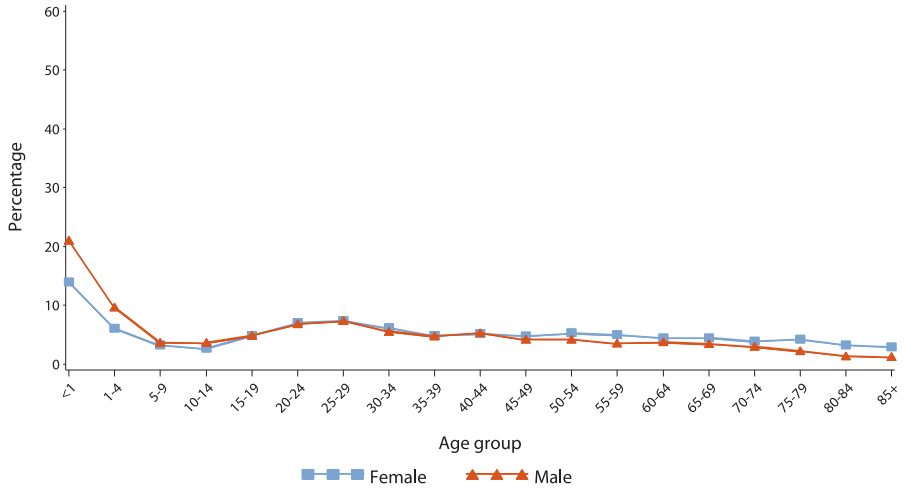
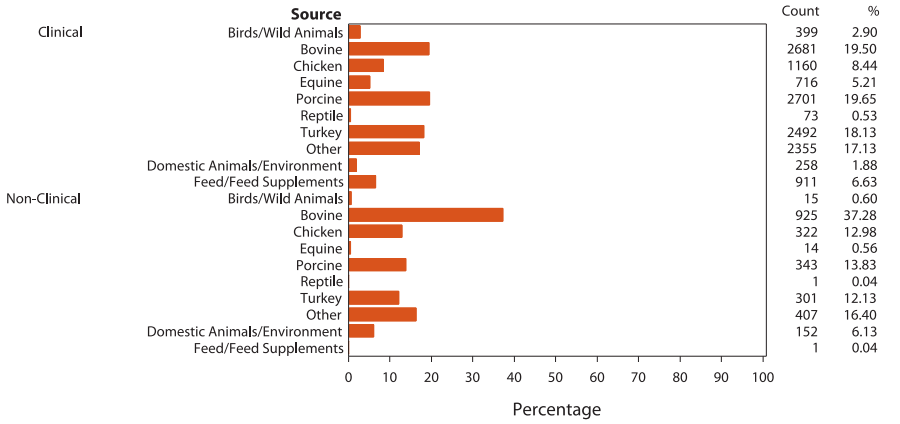


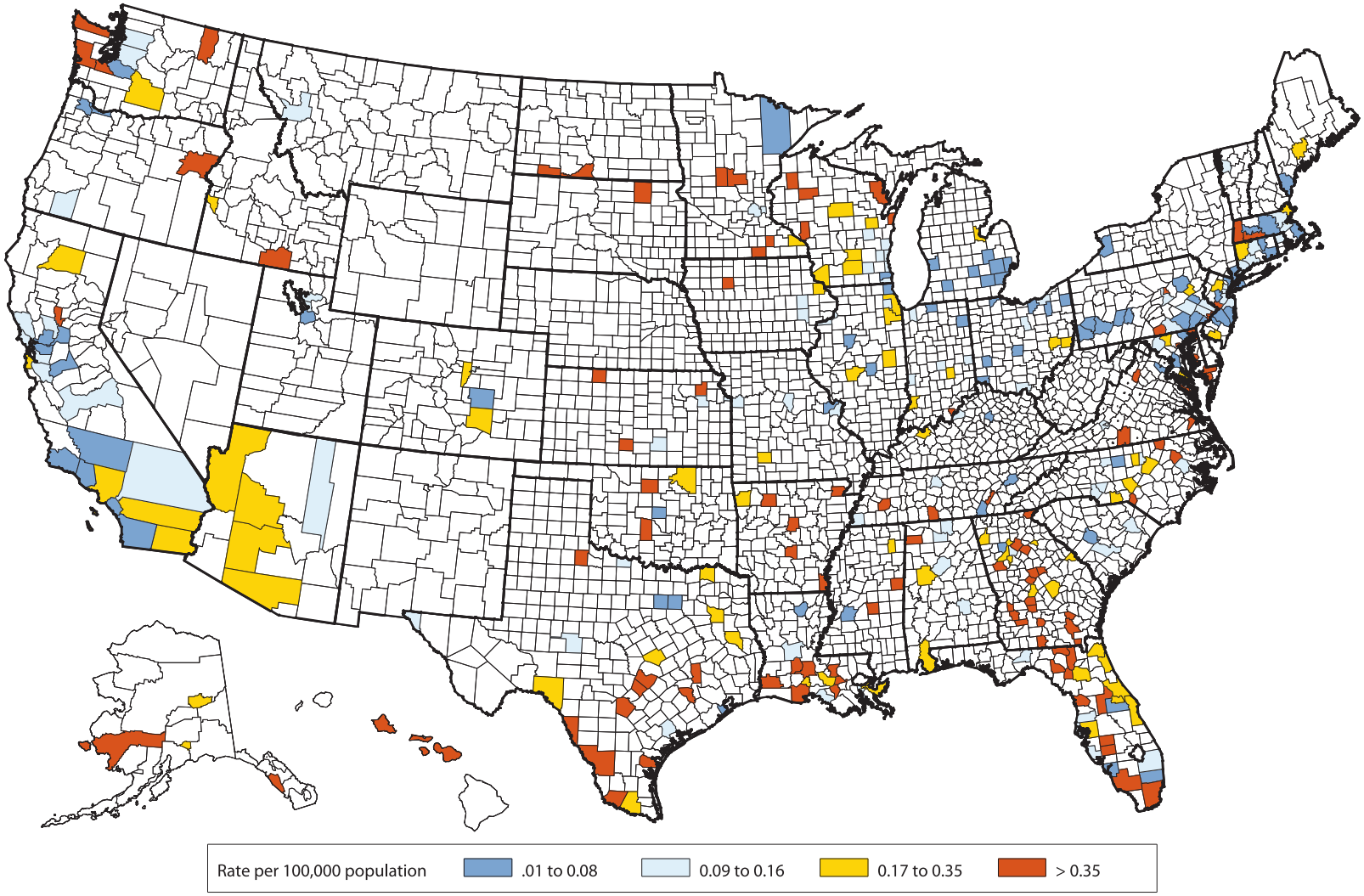
Figure 8 - Percentage of non-human isolates, by type and source, reported by the National Veterinary Services Laboratories, USDA-FSIS, 1968-2011

N=16,227



Salmonella serotype Anatum

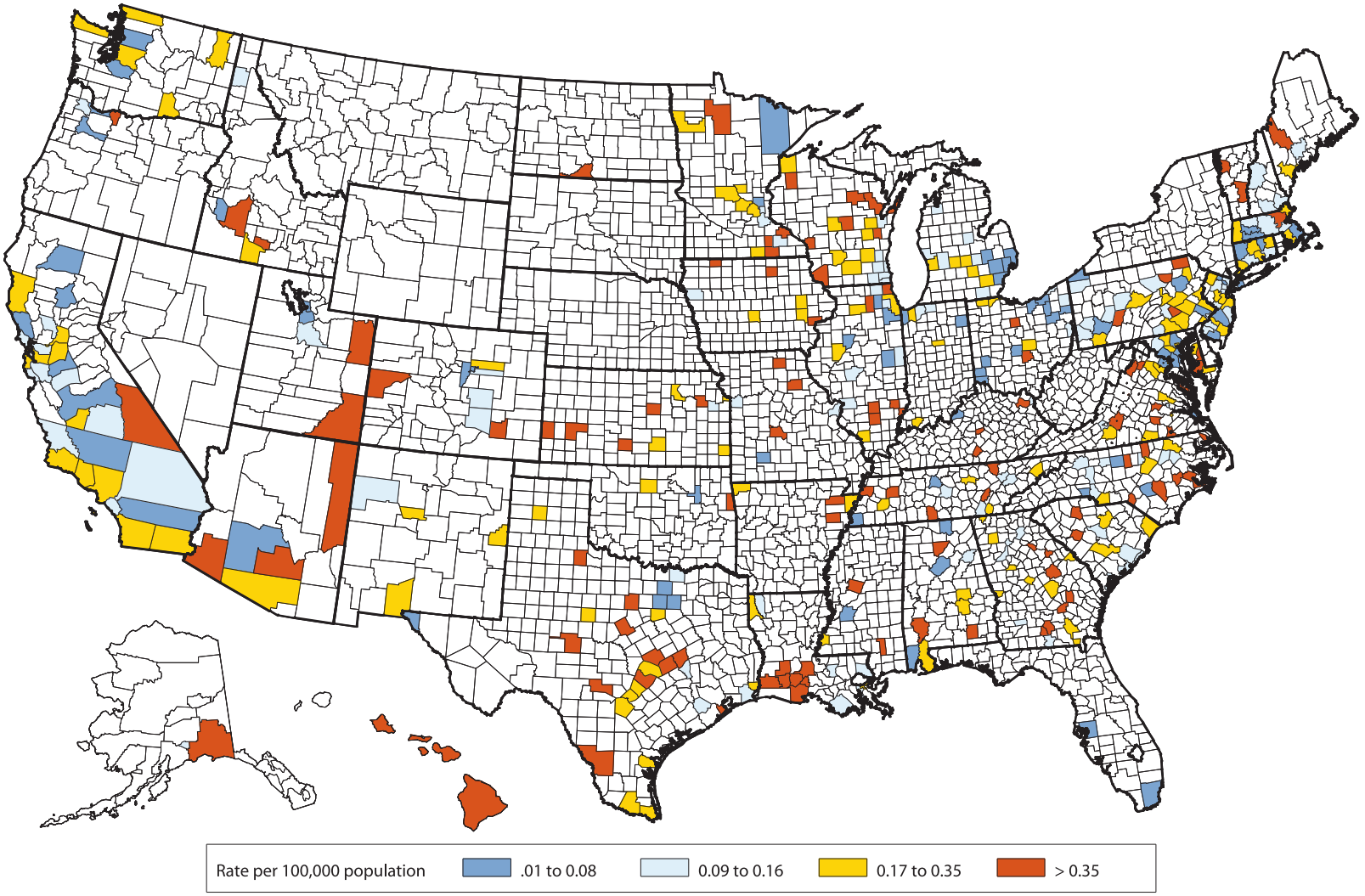
Figure 09 - Age-standardized rate per 100,000 population, by county, 1968 to 1975



Age standardization based on 2011 census

Maps represent US state and county designations on August 1,2012. See Federal Information Processing Standards (FIPS) Publication 6-4 for full details on changes to counties and equivalent entities of the United States over time. Blank counties are those for which the state reported isolates of the serotype but did not provide county-level information or the state reported no isolates of the serotype (no infections with that serotype or isolates not fully serotyped.)

Figure 10 - Age-standardized rate per 100,000 population, by county, 1976 to 1983

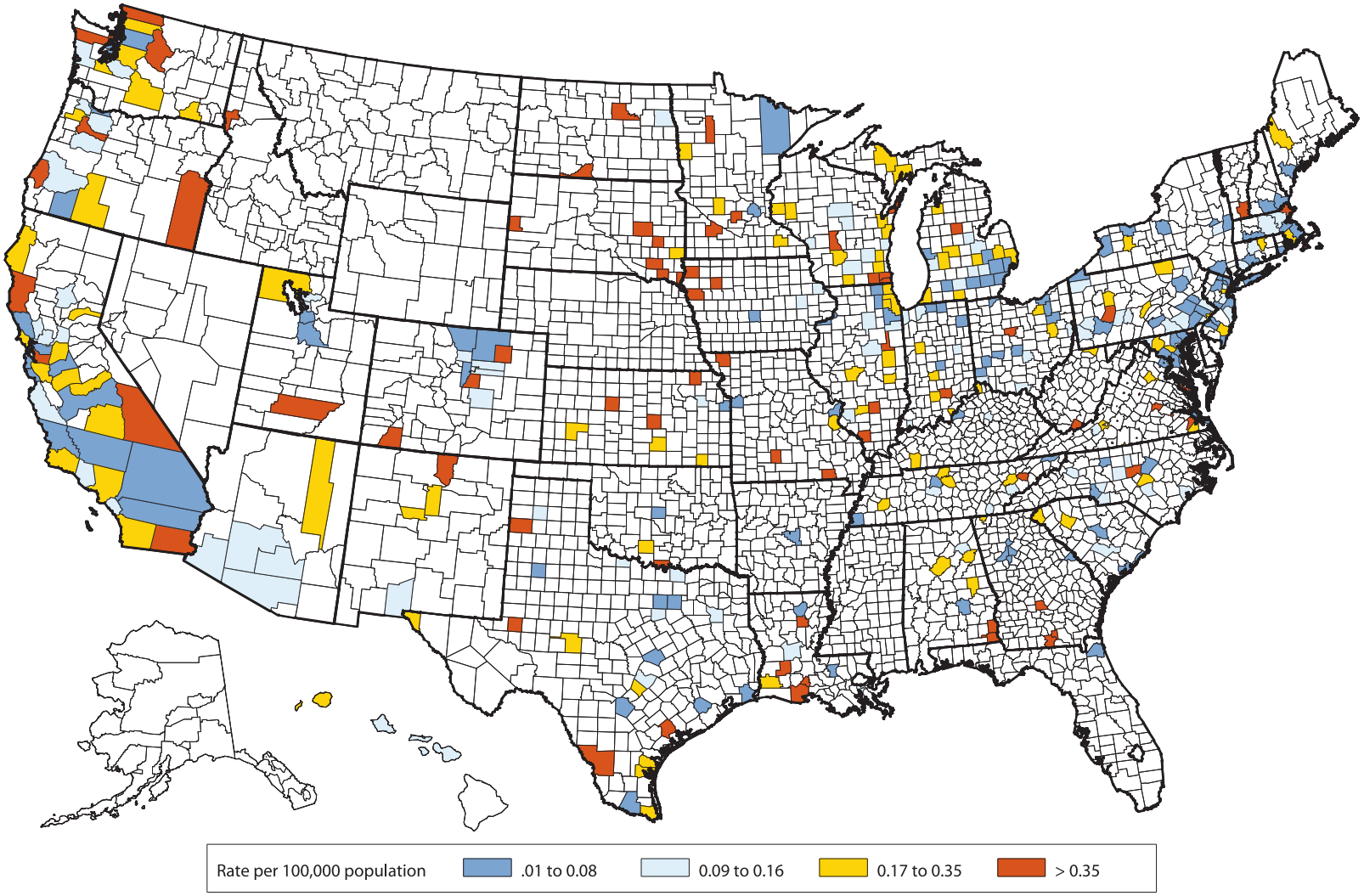


Age standardization based on 2011 census

Maps represent US state and county designations on August 1,2012. See Federal Information Processing Standards (FIPS) Publication 6-4 for full details on changes to counties and equivalent entities of the United States over time. Blank counties are those for which the state reported isolates of the serotype but did not provide county-level information or the state reported no isolates of the serotype (no infections with that serotype or isolates not fully serotyped.)

Salmonella serotype Anatum

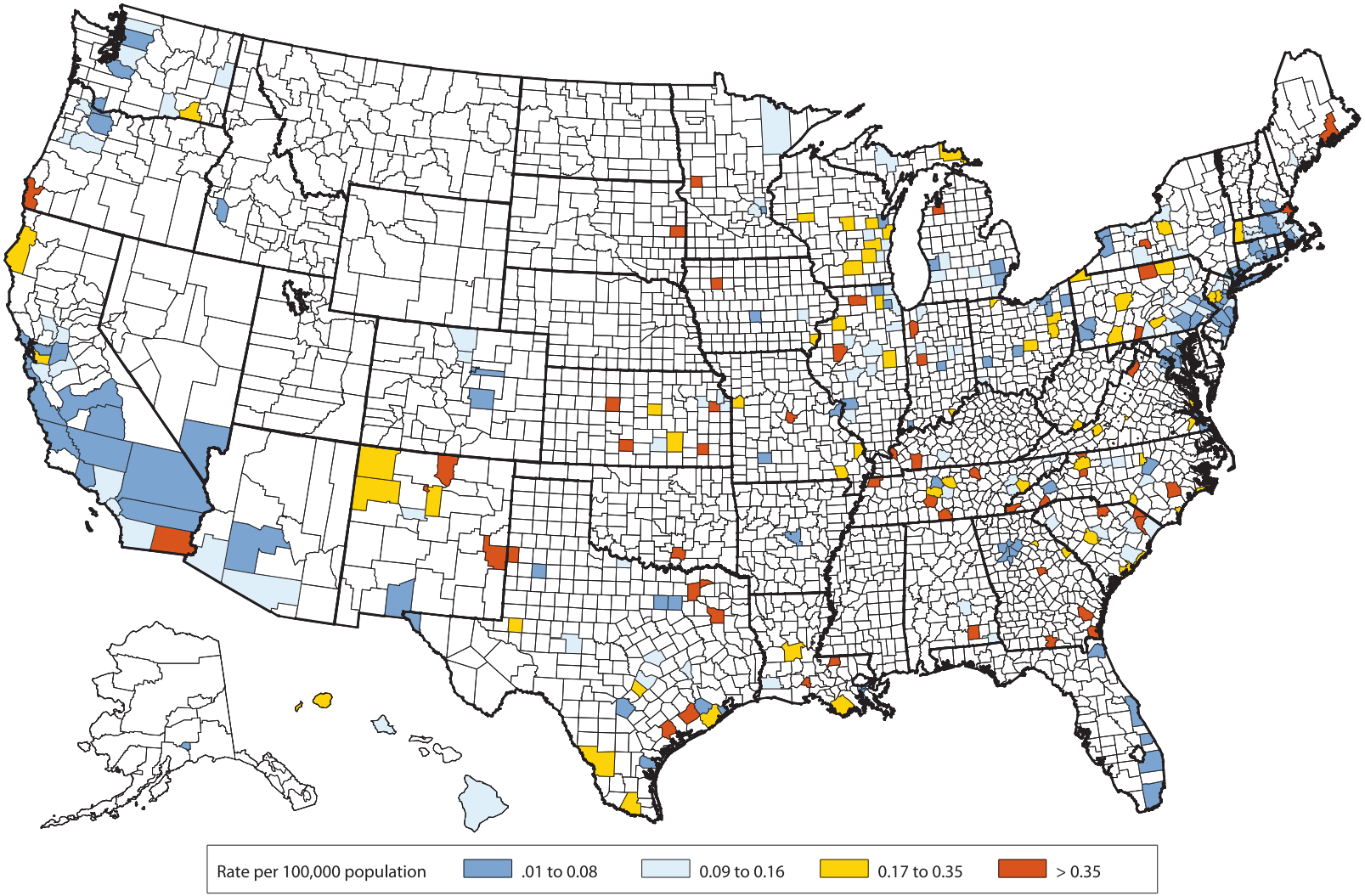
Figure 11 - Age-standardized rate per 100,000 population, by county, 1984 to 1991



Age standardization based on 2011 census

Maps represent US state and county designations on August 1,2012. See Federal Information Processing Standards (FIPS) Publication 6-4 for full details on changes to counties and equivalent entities of the United States over time.
Blank counties are those for which the state reported isolates of the serotype but did not provide county-level information or the state reported no isolates of the serotype (no infections with that serotype or isolates not fully serotyped.)

Figure 12 - Age-standardized rate per 100,000 population, by county, 1992 to 1998

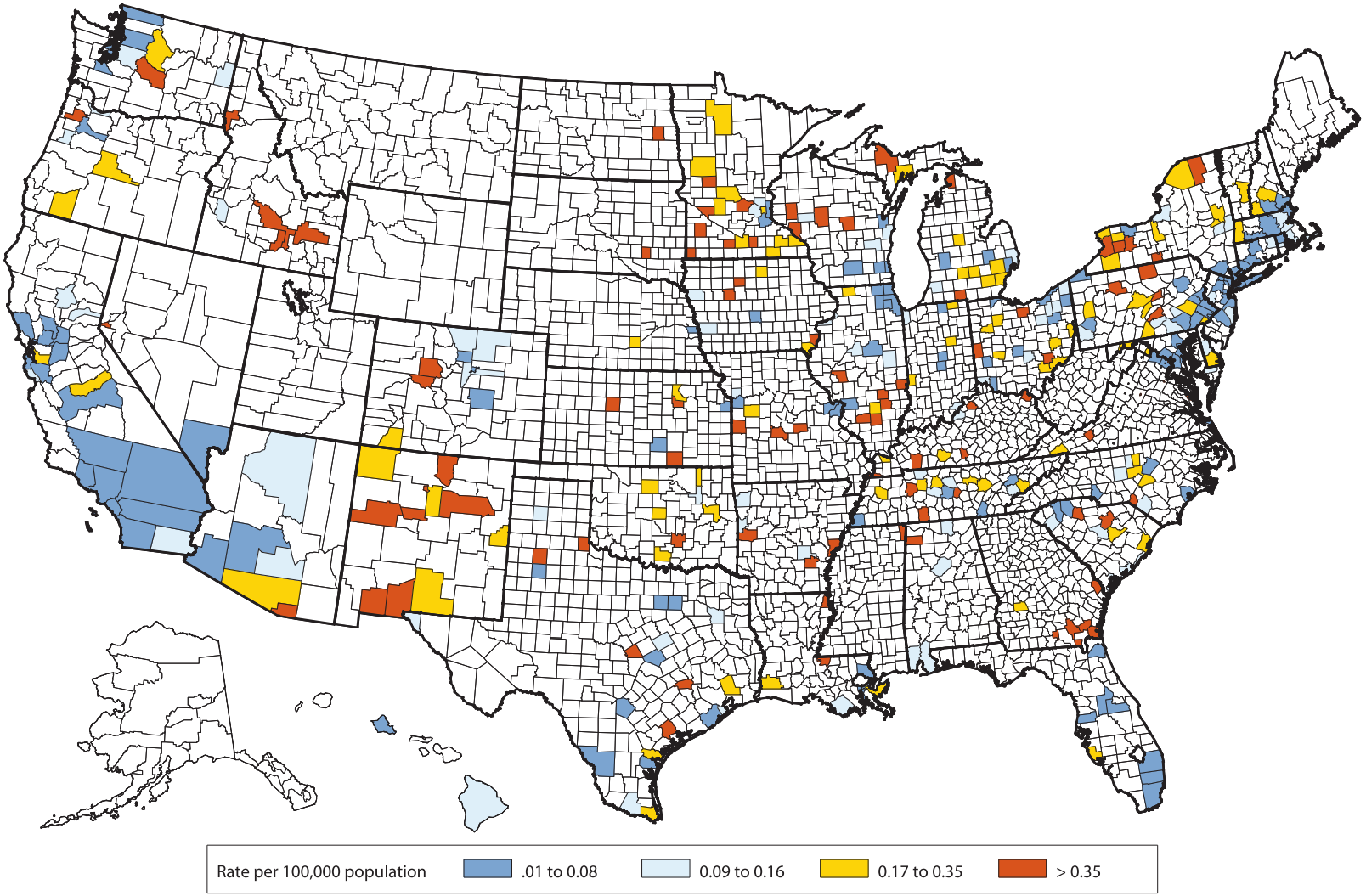


Age standardization based on 2011 census

Maps represent US state and county designations on August 1,2012. See Federal Information Processing Standards (FIPS) Publication 6-4 for full details on changes to counties and equivalent entities of the United States over time.
Blank counties are those for which the state reported isolates of the serotype but did not provide county-level information or the state reported no isolates of the serotype (no infections with that serotype or isolates not fully serotyped.)

Salmonella serotype Anatum

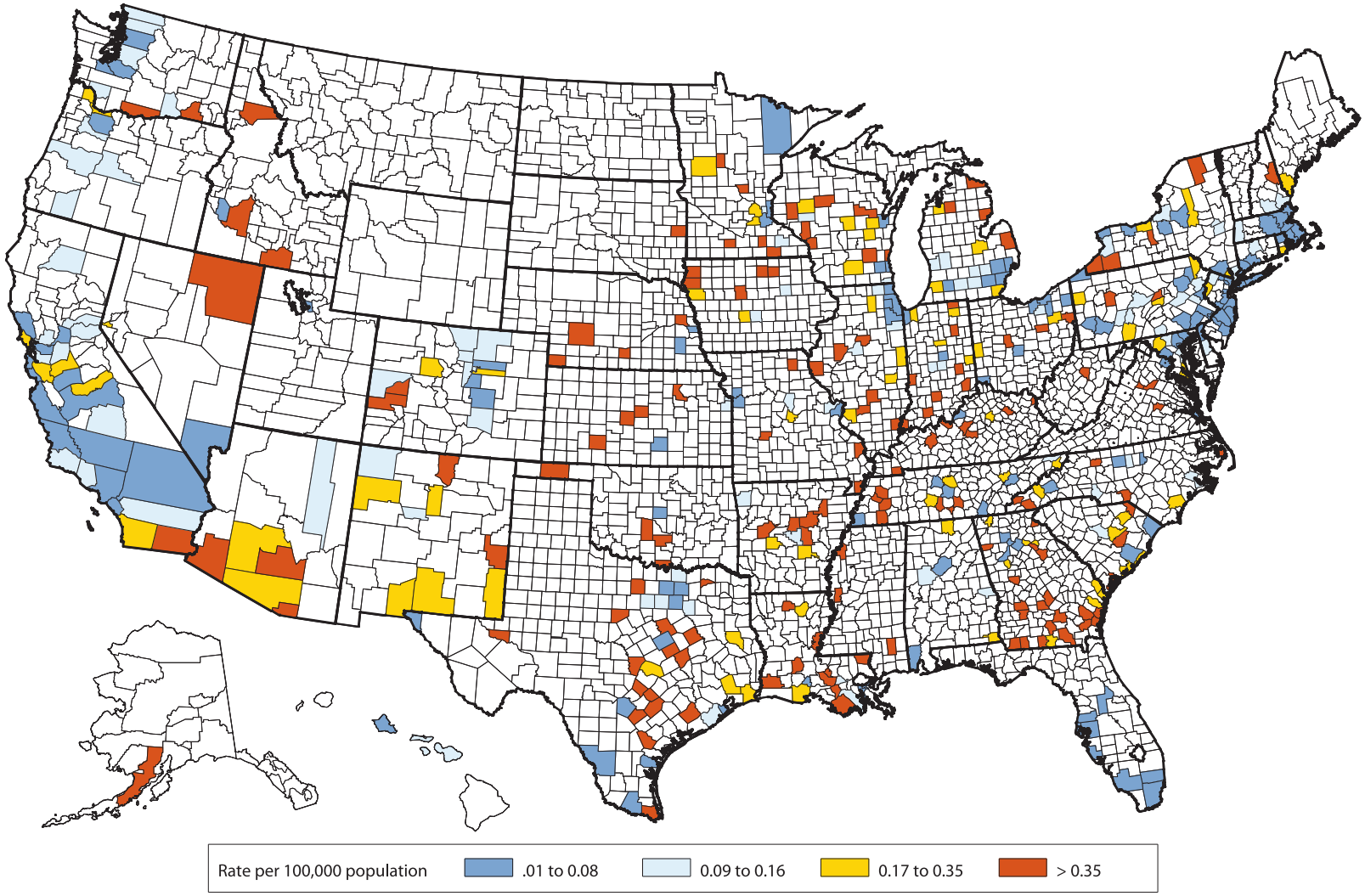
Figure 13 - Age-standardized rate per 100,000 population, by county, 1999 to 2005



Age standardization based on 2011 census

Maps represent US state and county designations on August 1,2012. See Federal Information Processing Standards (FIPS) Publication 6-4 for full details on changes to counties and equivalent entities of the United States over time. Blank counties are those for which the state reported isolates of the serotype but did not provide county-level information or the state reported no isolates of the serotype (no infections with that serotype or isolates not fully serotyped.)

Figure 14 - Age-standardized rate per 100,000 population, by county, 2006 to 2011



Age standardization based on 2011 census

Maps represent US state and county designations on August 1,2012. See Federal Information Processing Standards (FIPS) Publication 6-4 for full details on changes to counties and equivalent entities of the United States over time. Blank counties are those for which the state reported isolates of the serotype but did not provide county-level information or the state reported no isolates of the serotype (no infections with that serotype or isolates not fully serotyped.)

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