

Salmonellosis

Salmonellosis is a Class B Disease and must be reported to the state within one business day.

Salmonellosis is an infection caused by gram-negative bacteria called *Salmonella*. As of 2004, more than 2500 serovars of *Salmonella* have been described; some of these are pathogenic for both animals and humans. The primary habitats of *Salmonella* are the intestinal tracts of mammals (cattle, swine, rodents, dogs and cats), birds (poultry), reptiles (lizards, iguanas and turtles), amphibians (frogs and toads), and insects. The majority of *Salmonella* have a wide range of possible hosts.

Epidemiology

The main mode of transmission of *Salmonella* is ingestion of bacteria from contaminated food or water. Direct contact with animals and human carriers has also been implicated. The most frequent sources of salmonella infection are contaminated poultry, eggs, meat, dairy products, fruits and vegetables. Up to ninety percent of *Salmonella* infections in the U.S. are food-borne in origin. The typical food-borne transmission is the result of two events: the first is the contamination of the food product; the second is the handling that allows sufficient bacterial growth to reach an infectious dose.

Direct contact with infected animals is a route of transmission for a few cases. In urban areas, household pets may be sources of infection. In 2009, a multi-state outbreak of *Salmonella* Typhimurium was associated with exposure to aquatic frogs. Pet turtles, lizards, snakes, salamanders and other reptiles as well as aquarium fish have been responsible for some sporadic cases. Pet birds may also be a source.

Neonates are at a greater risk for fecal-oral transmission secondary to achlorhydria and ingesting large amounts of milk and formula with a large buffering capacity. A mother who has not properly washed her hands may deliver a low dose of *Salmonella* to the baby; however, this low dose could pass through the stomach easily and cause infection.

Food handlers who are infected with *Salmonella* may contaminate foods they prepare when they do not wash their hands after using the restroom, infecting others who consume the contaminated food. Some food-borne outbreaks included food handlers who have been infected with *Salmonella* while preparing the food. However, they were probably infected from the food rather than being the cause of the food-borne outbreak. During routine surveillance, very few cases have been reported among food handlers.

Incidence

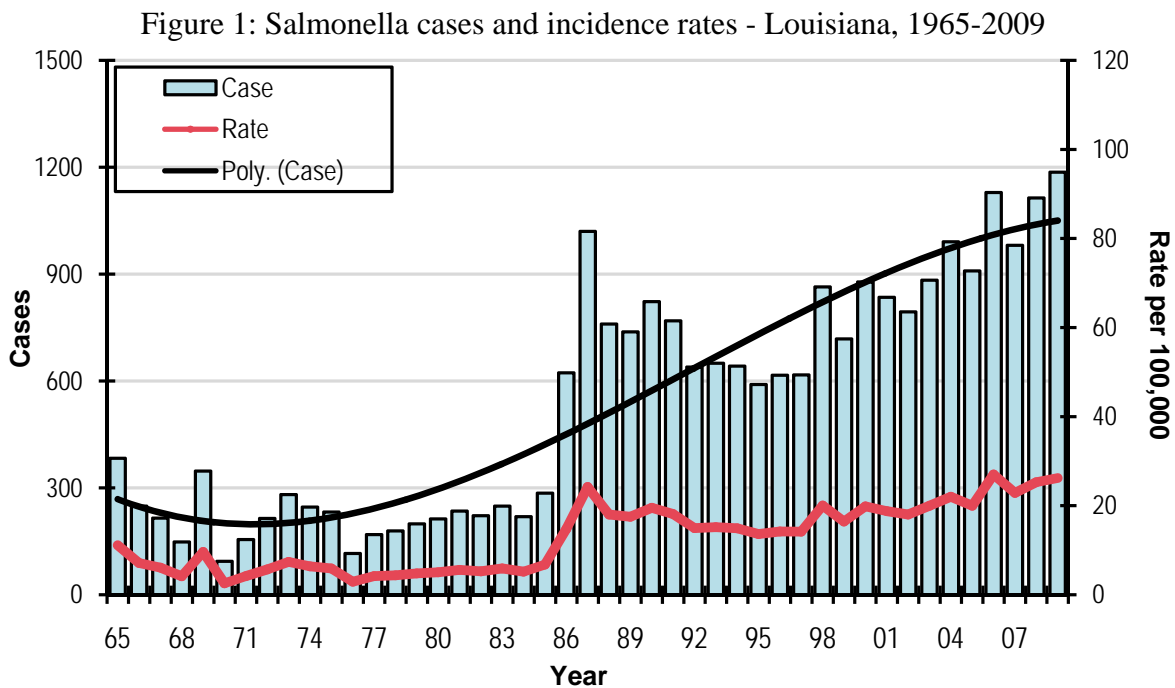
In the United States, an estimated 1.4 million people are infected with non-typhoid *Salmonella* annually.

According to FoodNet data, incidence rates for *Salmonella* (2009) in the U.S. are as follows:

- The incidence rate reported among all age groups combined was 15.19 per 100,000 population.
- The highest incidence rate reported was among children aged less than four years of age and was 72.93 per 100,000 population.
- In comparison with the time period 1996 to 1998, relative rates of Salmonella infections have decreased by ten percent in 2009.

Rates observed in Louisiana are in the same order of magnitude as in the U.S., twenty-six per 100,000 in 2009.

The increase in the general rate for Salmonella observed in the late 1980s occurred among infants, adolescents and the older population. The impression is that these increases are the result of better reporting since a similar increase was observed for Shigella, a disease with a different epidemiological pattern. (Figure 1)

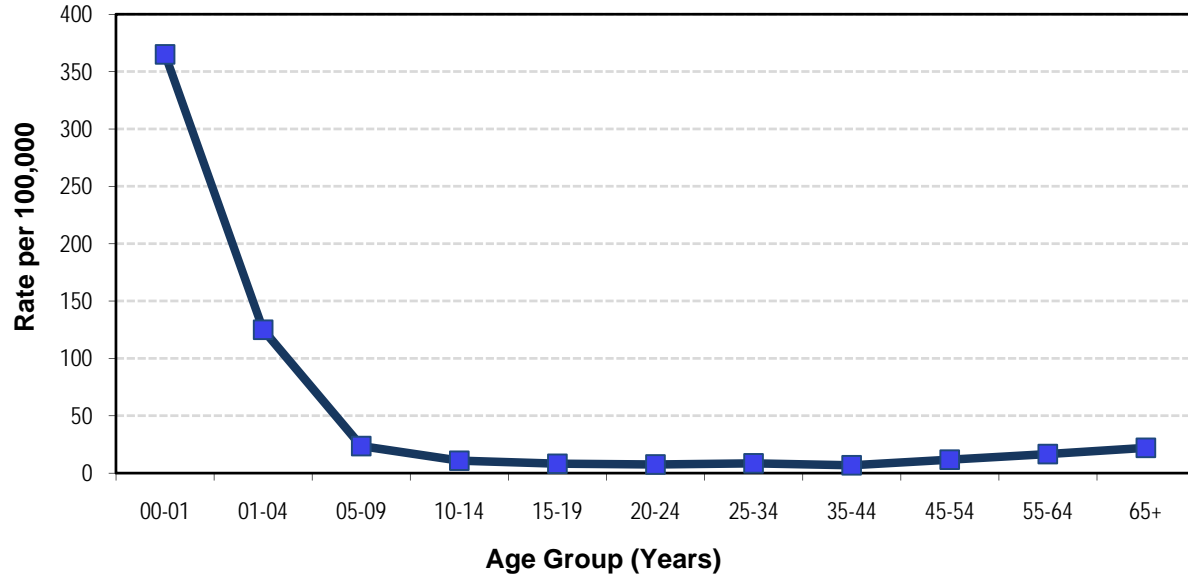


Age Distribution

Salmonella isolate submission is most common for cases in infants (0 to 1 year of age), and in children (1 to 5 years old). The high rate of identification in these young age groups may result from the prompt seeking of medical care when symptoms become evident among infants and young children and the more frequent stool culture orders from children when healthcare workers investigate a diarrheal illness. These practices result in over-sampling of the child population. Most Salmonella infections in children occur outside of child care environments,

with only 1.1 percent of cases among infants and children being associated with a day care. There are no gender differences in disease occurrence. (Figure 2)

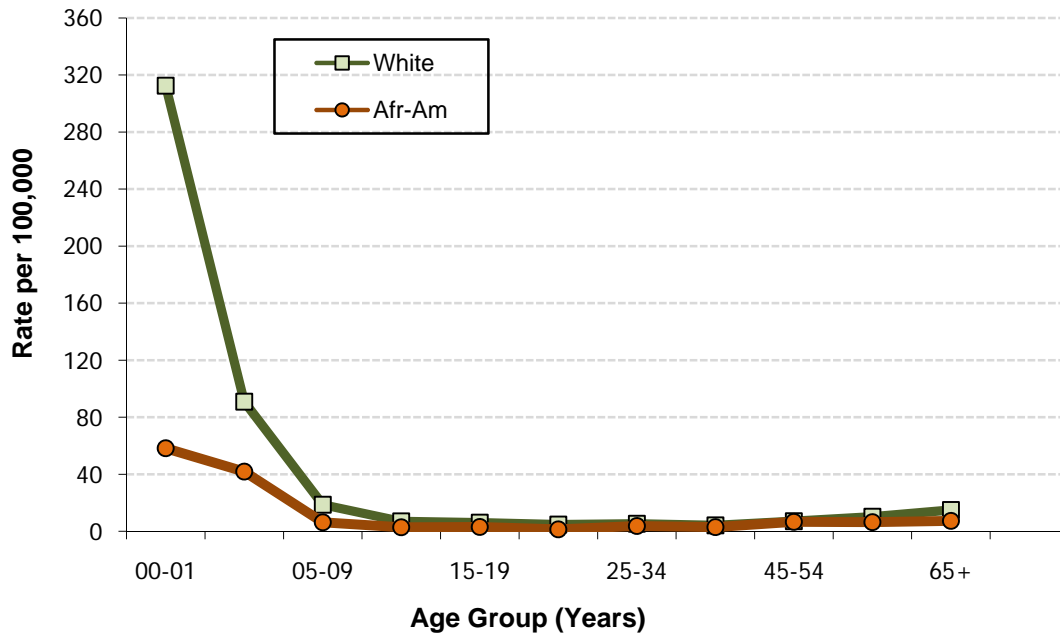
Figure 2: Salmonella average incidence rates by age - Louisiana, 2005-2009



Race Distribution

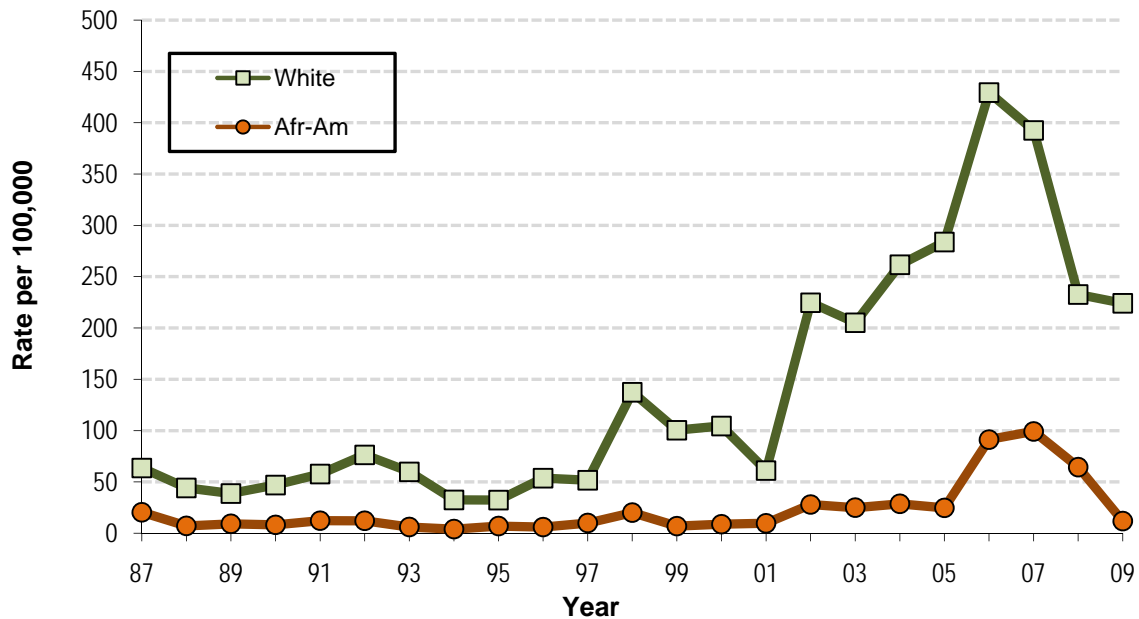
Whites have higher reported rates of Salmonella infection than African-Americans. (Figure 3)

Figure 3: Salmonella average incidence rates by age and race – Louisiana, 2005-2009



The increases in reported Salmonella cases observed in the late 1980's and throughout the 1990's that have occurred particularly among infants may be explained by greater access to medical care. (Figure 4)

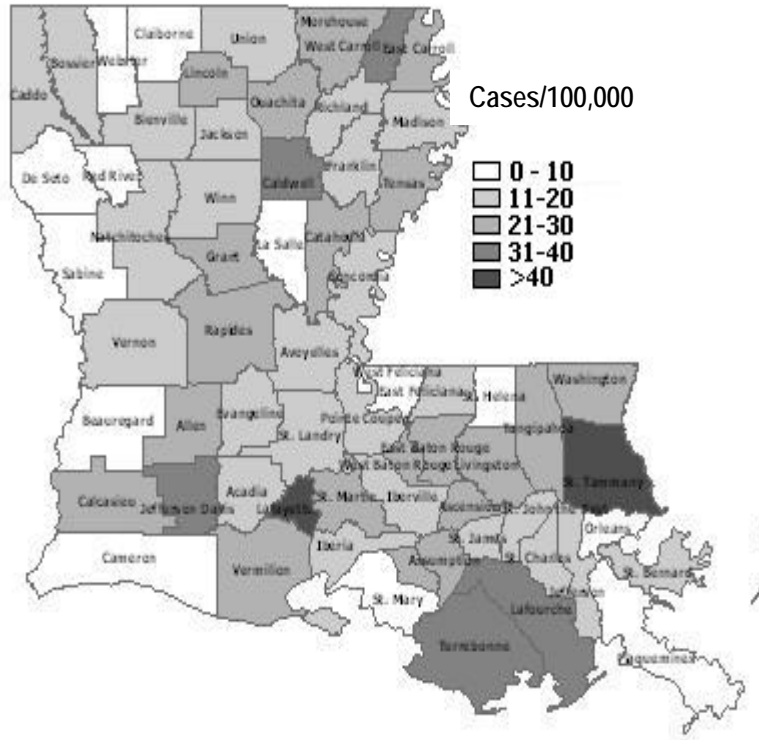
Figure 4: Salmonella incidence rates among infants (0-1 years) – Louisiana, 1987-2009



Geographical Distribution

The geographic distribution of Salmonella reflects reporting practices rather than true differences in incidence. For example, because Terrebonne and the surrounding parishes are served by a medical facility that is very good at culturing and reporting Salmonella, the rates in the Terrebonne area are consistently high. (Figure 5)

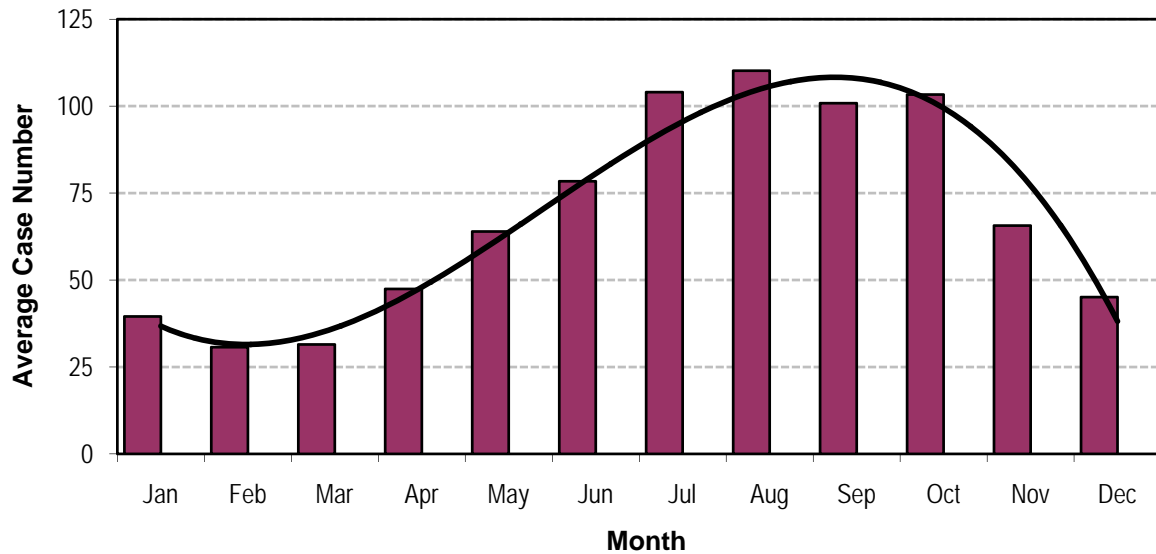
Figure 5: Salmonella average incidence rates by parish - Louisiana, 2003-2008



Seasonal Pattern

There is a clear seasonal pattern in the occurrence of Salmonella infection with a peak from summer through fall. (Figure 6)

Figure 6: Salmonella average cases by month - Louisiana, 1987-2009



Better growth of *Salmonella* at higher temperatures leads to higher concentration of *Salmonella* in the food supply in the warmer months. Inadequate cooking practices are also more common during these months (picnics, barbecues). This seasonal distribution is observed throughout all age groups.

Serotypes

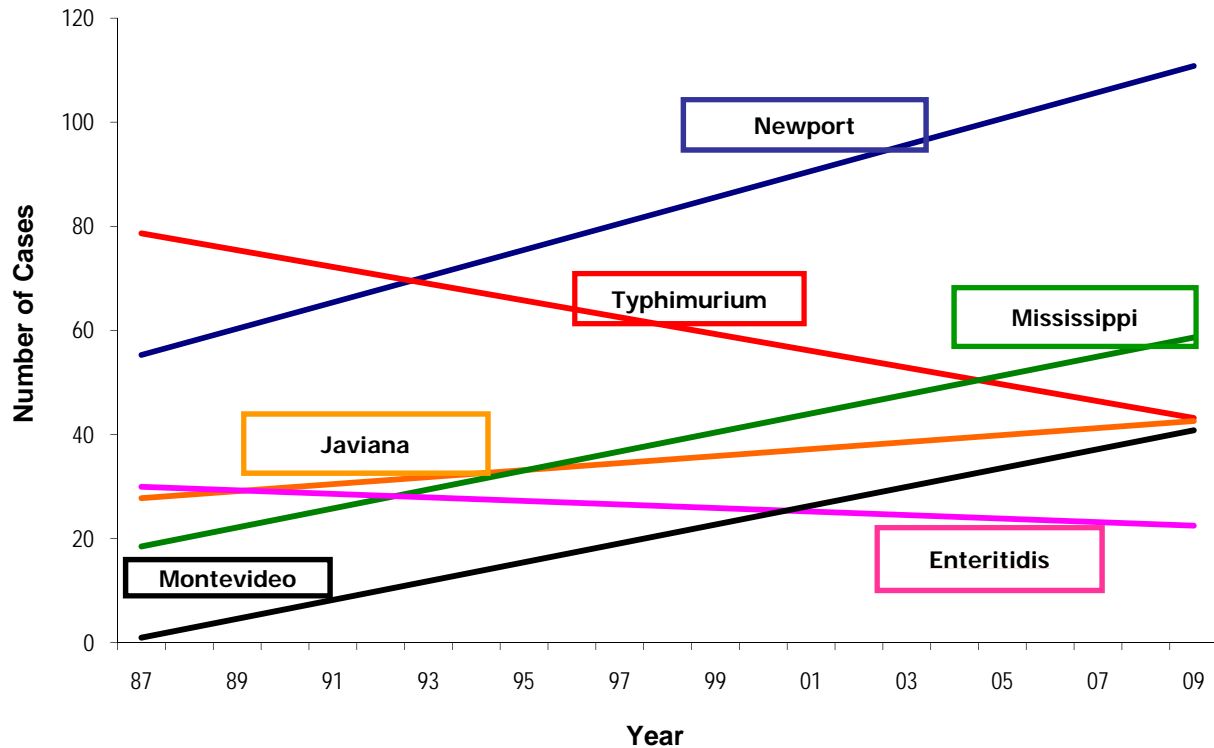
CDC adopted the Kaufmann-White Scheme for designation of *Salmonella* serotypes on January 1, 2003. The genus *Salmonella* (family – Enterobacteriaceae) is divided into two species, *Salmonella enterica* and *Salmonella bongori*. *Salmonella enterica* is further subdivided into six subspecies that are designated by names or Roman numerals. Under the Kauffmann-White Scheme, subspecies I serotypes are named; subspecies II through VI serotypes are identified by formula. *Salmonella enterica* subspecies I includes the majority of serotypes that can infect humans. Within *S. enterica* there are over 2500 serotypes based on analysis of the somatic antigen (O) and flagellar antigen (H). Each serotype is given a name, for example, *S. enterica* serotype *typhimurium*, is often abbreviated as *S. typhimurium*. Of the more than 2,500 serotypes, some 200 can infect humans. The most common serotypes cultured in Louisiana for the period 1987 to 2009 are presented in Table 1.

Table 1: *Salmonella* common serotypes - Louisiana, 1987 – 2009

Serotype	Total
NEWPORT	1941
TYPHIMURIUM	1404
MISSISSIPPI	900
JAVIANA	819
ENTERITIDIS	605
MONTEVIDEO	491
HEIDELBERG	432
MUENCHEN	230
GIVE	193
BRANDEDERUP	170
ORANIENBURG	163
GAMIARA	154
INFANTIS	128
BAREILLY	128
RUBISLAW	128
HADAR	127
AGONA	112
THOMPSON	107
ADELAIDE	99
ANATUM	89
LITCHFIELD	70
SAINT PAUL	58
BRANDENBURG	50

Salmonella newport, *S. javiana* and *S. mississippi* are increasing in numbers along with *S. montevideo*. (Figure 7)

Figure 7: Salmonella trends – serotype isolates in reported cases - Louisiana, 1987-2009



With the exception of *Salmonella typhimurium*, all serotypes show the same seasonal distribution (higher numbers in the summer and autumn). *S. typhimurium*, however, remains more constant throughout the year. It is also nationally the most commonly isolated serotype since 1997.

There have been clusters among rare serotypes: *Salmonella adelaide* from 1999 to 2002, *S. infantis* in 1998, *S. gamiara* from 1996 to 1998, *S. muenchen* from 1996 to 1998, *S. branderup* in 1996, *S. anatum* in 1996, *S. brandenburg* in 1994, and Oranienburg in 1991, 1998, and 2003. In the last four years there were clusters among the following rare serotypes: *S. infantis* in 2008, and 2009, *S. Gamiara* in 2006, 2008, and 2009, *S. meunchin* in 2008 and 2009, *S. branderup* in 2006-2009, and *S. oranienburg* in 2006, 2008, and 2009. (Table 2)

Table 2: Salmonella, clusters of serotypes in reported cases - Louisiana, 1987-2009

Serotype	Total	87-89	90-94	95-99	00-05	06	07	08	09
Adelaide	99	1	1	12	84				1
Infantis	128	15	18	36	29	8		10	12
Gamiara	154	16	15	39	48	16	1	12	7
Meunchin	230	0	10	55	107	0		23	35
Branderup	170	9	24	27	53	21	13	8	15
Anatum	89	10	8	19	34	4	1	7	6
Brandenburg	50	5	26	14	4				1
Oranienburg	163	13	19	24	44	10		12	41

Hospitalization surveillance

Hospitalization surveillance is based on the Louisiana Inpatient Hospital Discharge Data (LaHIDD). In 1997, the Louisiana legislature mandated the reporting of hospital discharge data. LaHIDD serves as the state registry containing hospital discharge data submitted to the Department of Health and Hospitals (DHH). The Office of Public Health (OPH) is responsible for making the data available to OPH sections as needed. The data is available with a delay of two years. The Infectious Disease Epidemiology Section uses these data sets for the surveillance of infectious diseases in hospitals. LaHIDD data sets contain demographic information (names, gender, age, date of birth, address, admit diagnosis, discharge diagnoses (main plus eight more diagnoses), procedures (main plus five), charges, length of stay and hospital name. The diagnoses and procedures are coded with ICD-9 codes. Repeat hospitalizations are not included.

Records of patients with Salmonella were extracted using the following ICD9 codes whether in the main diagnosis or in the eight additional secondary diagnoses:

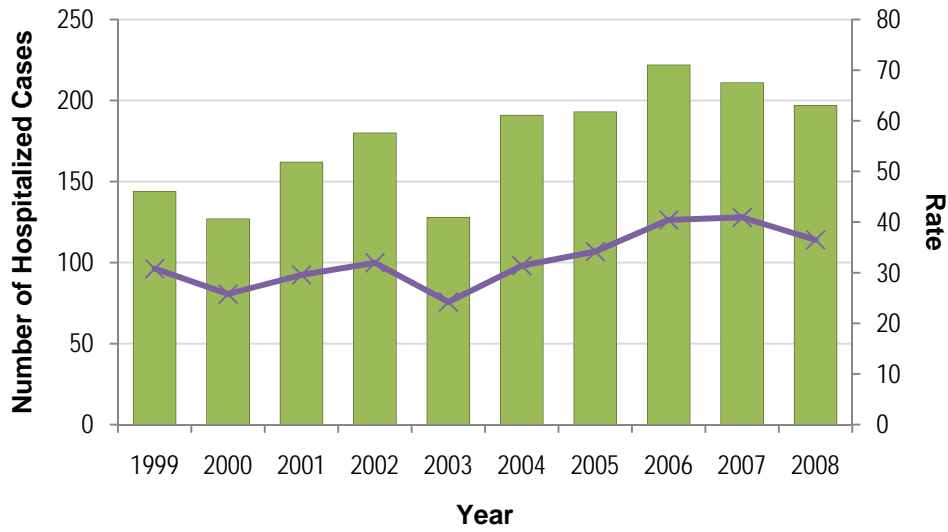
CODE	DISEASE
003	OTHER SALMONELLA INFECTIONS
003.0	SALMONELLA GASTROENTERITIS
003.1	SALMONELLA SEPTICEMIA
003.2	LOCALIZED SALMONELLA INFECTIONS
003.20	LOCALIZED SALMONELLA INFECTION, UNSPECIFIED
003.21	SALMONELLA MENINGITIS
003.22	SALMONELLA PNEUMONIA
003.23	SALMONELLA ARTHRITIS
003.24	SALMONELLA OSTEOMYELITIS
003.29	OTHER LOCALIZED SALMONELLA INFECTIONS
003.8	OTHER SPECIFIED SALMONELLA INFECTIONS
003.9	SALMONELLA INFECTION, UNSPECIFIED

Hospitalization Numbers, Rates and Trends

The following statistics are based on unduplicated patients.

Hospitalization rates due to salmonella have been slowly increasing over the period from 1999 to 2008. Peak hospitalization rates were seen in 2006 and 2007 with a rate of 40 hospitalizations per 100,000. The lowest hospitalization rate occurred in 2003 with 24 hospitalizations per 100,000. (Figure 8)

Figure 8: Salmonella hospitalizations and rates per 100,000 population Louisiana, 1999-2008

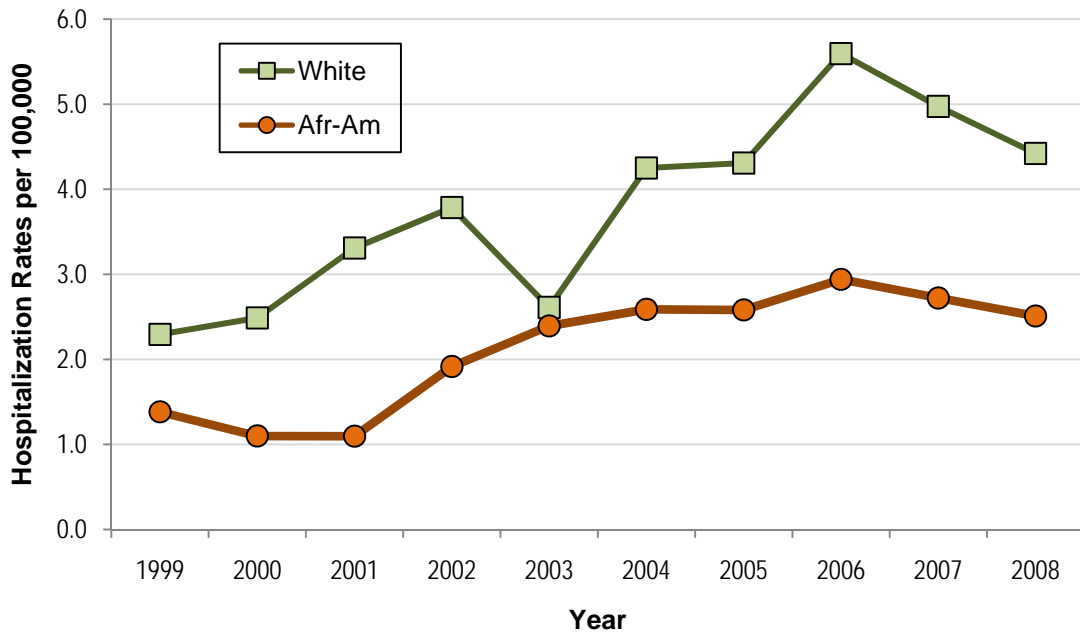


Race

Rates were calculated for Whites and African-Americans only. Numbers for other race and ethnic groups are small and the population count may be inaccurate. A good proportion of cases do not have race reported.

Hospitalization rates due to salmonella for both African-Americans and Whites have been generally increasing since 1999. While the data for White cases shows a sharp decrease in 2003, the African-American rate for hospitalization showed no such reduction. Through the entire period from 1999-2008, more Whites had been hospitalized per year for Salmonella than African-Americans. Peak hospitalization rates for both race categories were seen in 2006. (Figure 9)

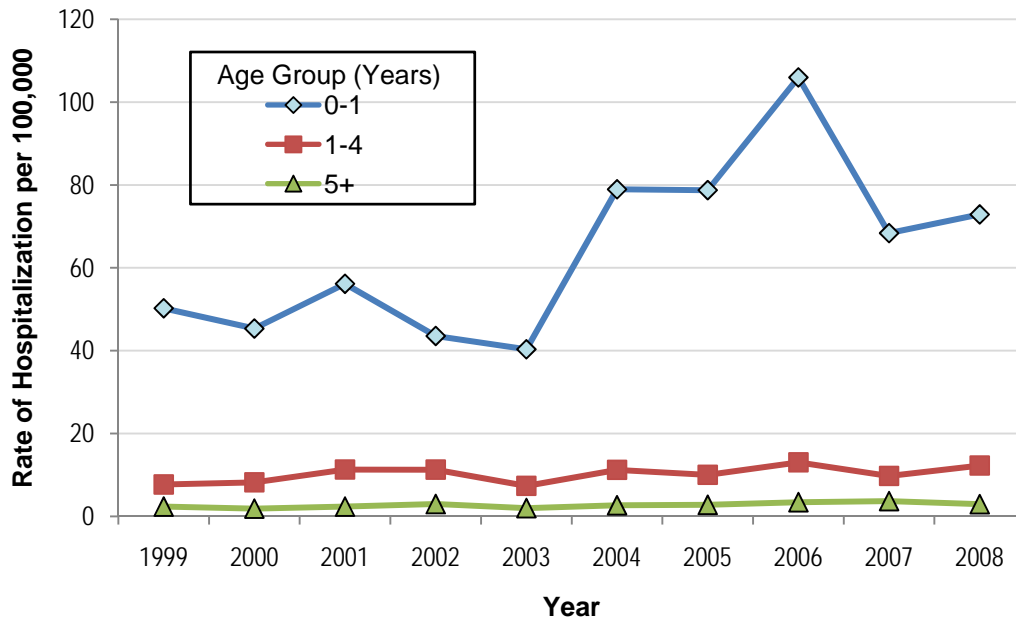
Figure 9: Hospitalization rates for Salmonella by race – Louisiana, 1997-2008



Age Group

During the period from 1999 to 2008, newborns to one year of age consistently had the highest rates of hospitalization with Salmonella compared to all other age groups. A spike in rates was observed for the years 2004 to 2006, and although 2007 and 2008 hospitalization rates decreased from the 2006 high, the rate has still not returned to the previous rates seen in the period from 1999 to 2003. (Figure 10)

Figure 10: Hospitalization rates for Salmonella by age group – Louisiana, 1999-2008

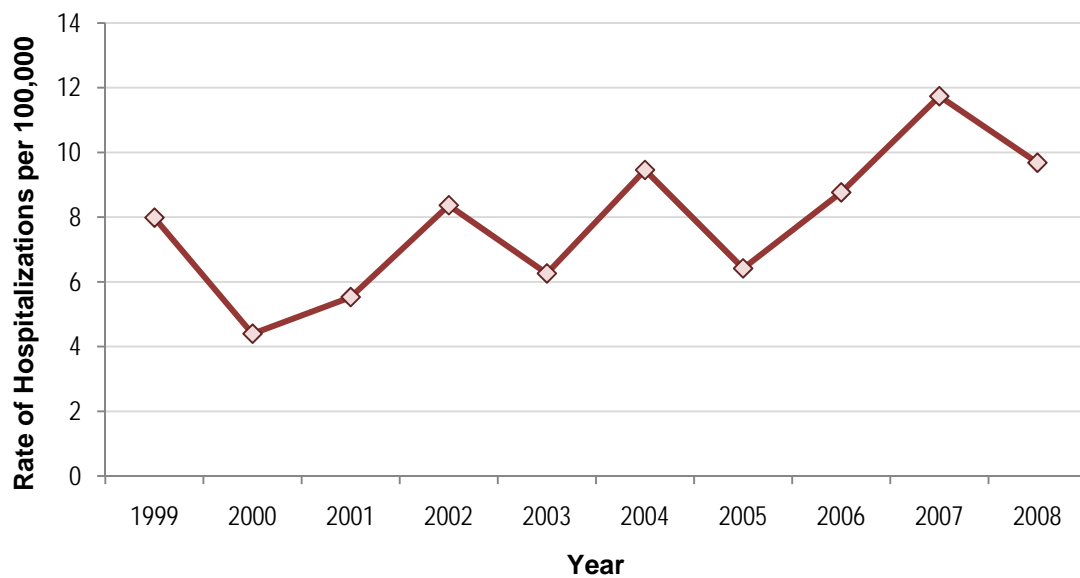


The one year-old to four year-old age group experienced its highest rate of Salmonella hospitalizations in 2006 (a rate of 13.04 per 100,000).

The hospitalization rates for all other age groups (ages 5 and above) remained between 1.8 and 3.7 per 100,000 from 1999 to 2008.

There seems to be an increasing trend in hospitalizations for persons sixty-five years and older, with the highest rate of hospitalization in 2007 (a rate of 11.74 per 100,000 hospitalizations). (Figure 11)

Figure 11: Hospitalization rates for 65 and older with Salmonella – Louisiana, 1999-2008



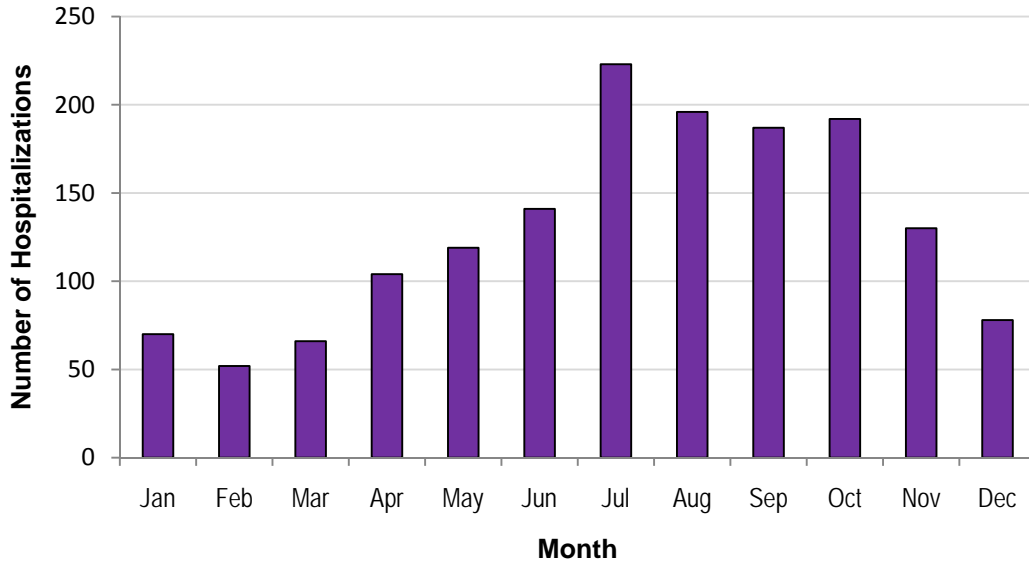
Diagnosis

From 1999 to 2008, the highest categories for hospital admissions with a diagnosis of Salmonella were Salmonella gastroenteritis (61.2%), followed by unspecified Salmonella infection (24.5%). Septicemia made up over six percent of hospitalizations due to Salmonella; other Salmonella infections made up almost six percent of Salmonella hospital admissions.

Seasonality

Cumulative data for the years 1999 to 2008 shows that Salmonella hospitalization rates have a seasonal component. Admissions began to increase over the months of April, May and June, reached a peak in July and remained high throughout October before decreasing again. February was the month with fewest Salmonella cases. (Figure 12)

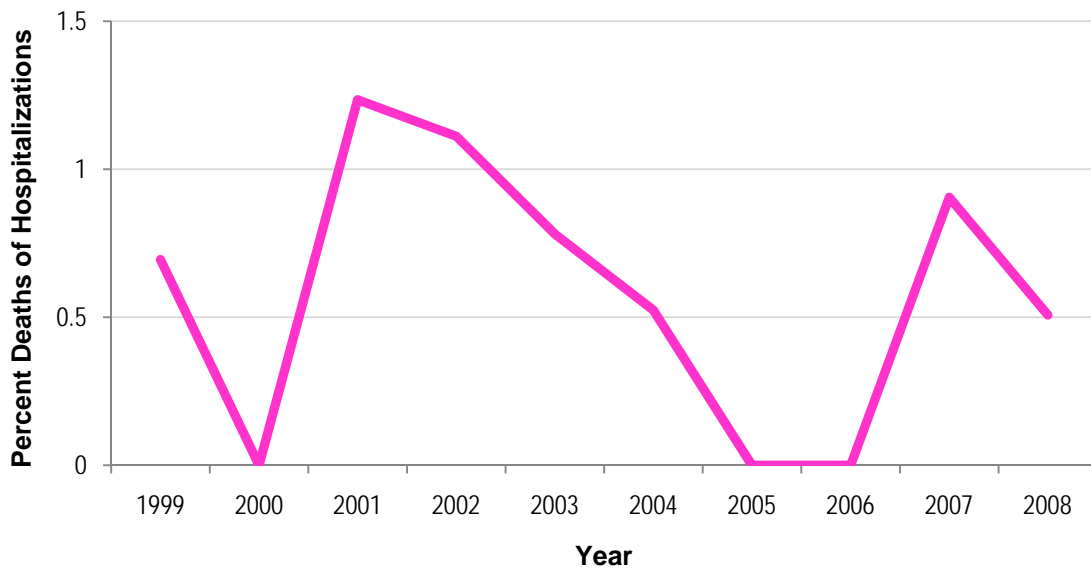
Figure 12: Seasonality for Salmonella – Louisiana, 1999-2008



Mortality

Between the years 1999 and 2008, the percent of hospitalizations that ended in death ranged from zero to 1.2% (Figure 13)

Figure 13: Percent death from Salmonella – Louisiana, 1999-2008



Between 2004 and 2008, the age groups five to fourteen years and forty-five to sixty-four years had the highest case fatality rate. (Figure 14)

Figure 14: Salmonella, case fatality by age group - Louisiana, 2004-2008

