

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 in the genus *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* organisms 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 90% of *Salmonella* infections in the U.S. are food-borne in origin. Typical food-borne transmission is the result of two events: first, contamination of the food product; second, improper handling of the food that fosters sufficient bacterial growth to reach an infectious dose.

Direct contact with infected animals is a route of transmission in some cases. In recent years, there have been several multi-state outbreaks linked to pet turtles and backyard flocks of chickens and ducks. Pet bearded dragons, lizards, snakes, salamanders and other reptiles as well as aquarium fish have also been responsible for several cases. Pet birds may also be a source.

Neonates are at a greater risk for fecal-oral transmission secondary to achlorhydria (absence of gastric acid) or lower levels of gastric acid secondary to consumption of large quantities of milk or formula with characteristically strong buffering properties. A mother who has not properly washed her hands may deliver a low dose of *Salmonella* to the baby; this low dose could survive stomach passage and cause infection.

Food handlers who are infected with *Salmonella* may contaminate foods they prepare when they do not wash hands after using the restroom. Some food-borne outbreaks have involved food handlers who were infected with *Salmonella* and who prepared the food while ill with the bacteria; however, most were probably infected from contact with the food rather than being the source of the bacteria that precipitated the outbreak. In fact, routine surveillance has recorded very few cases among food handlers.

Incidence

In the U.S., an estimated 1.2 million people are infected with non-typhoid *Salmonella* annually.

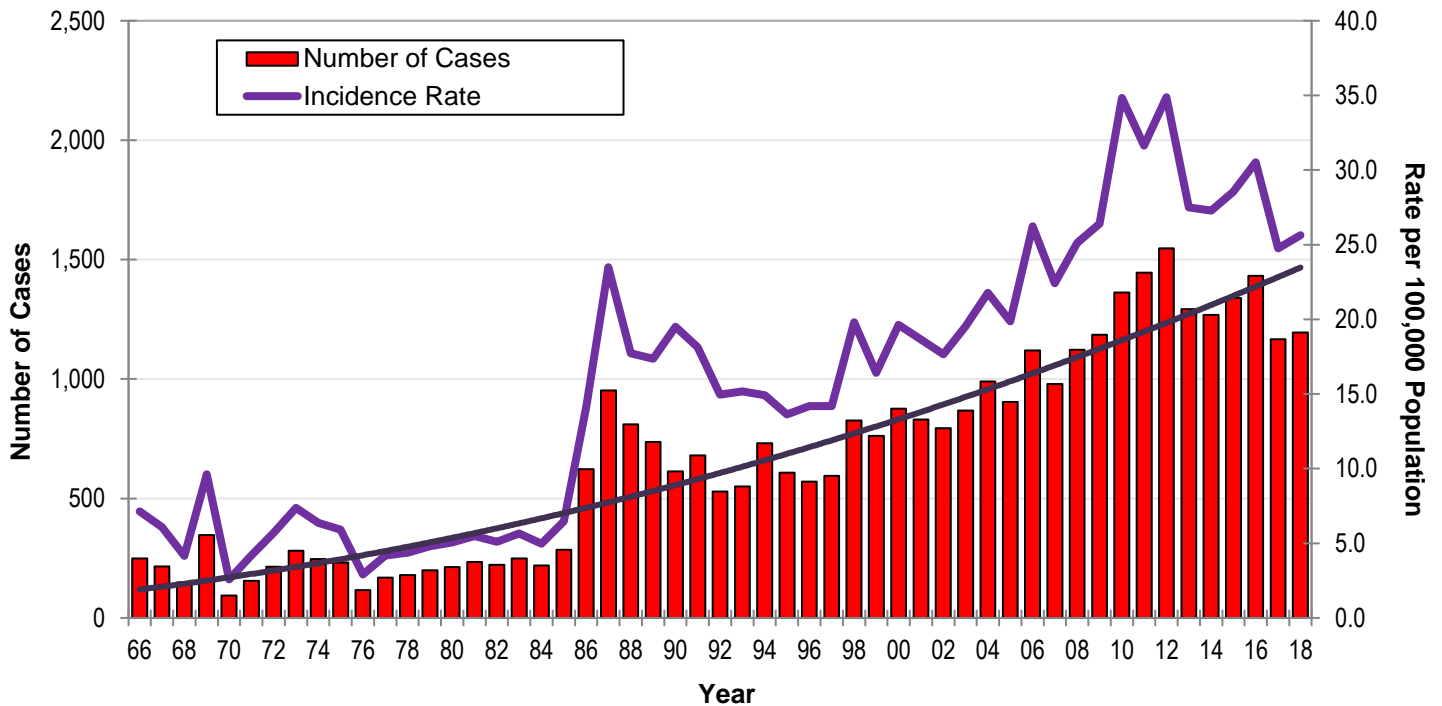
According to FoodNet data, incidence rates for *Salmonella* (2018) in the U.S. are as follows:

- The incidence rate reported among all age groups combined was 18.26 cases per 100,000 population.

- The highest incidence rate reported was among children younger than five years of age and was 68.71 cases per 100,000 population in 2018.
- Based on Centers for Disease Control and Prevention (CDC) estimates, there are about 20,500 cases of *Salmonella* infections occurring every year in Louisiana, with 95% caused by food-borne transmission (about 20,000 cases). Of these estimated 20,500 cases, only 1,500 are reported. There are approximately 350 *Salmonella* related hospitalizations annually, and between five and ten deaths.

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

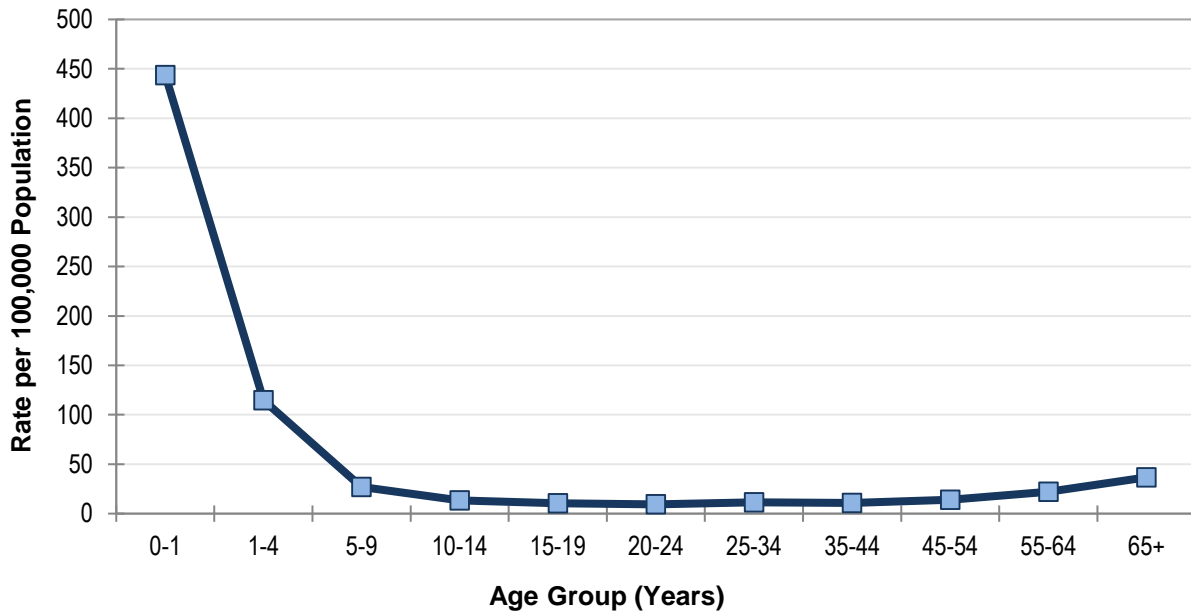
Figure 1: *Salmonella* Cases and Incidence Rates - Louisiana, 1966-2018



Age Distribution

Salmonella isolate submission is most common for cases in infants, newborn to one-year of age, and in children, one to five-years old. The high rate of identification in these young age groups may result from prompt seeking of medical care when symptoms become evident among infants and young children, and more frequent submission of stool cultures from children during investigations of diarrheal illnesses. These practices result in over-sampling of children. Most *Salmonella* infections in children occur outside of child-care environments, with only 1.1% of cases among infants and children being associated with a day care. There are no gender differences in disease occurrence (Figure 2).

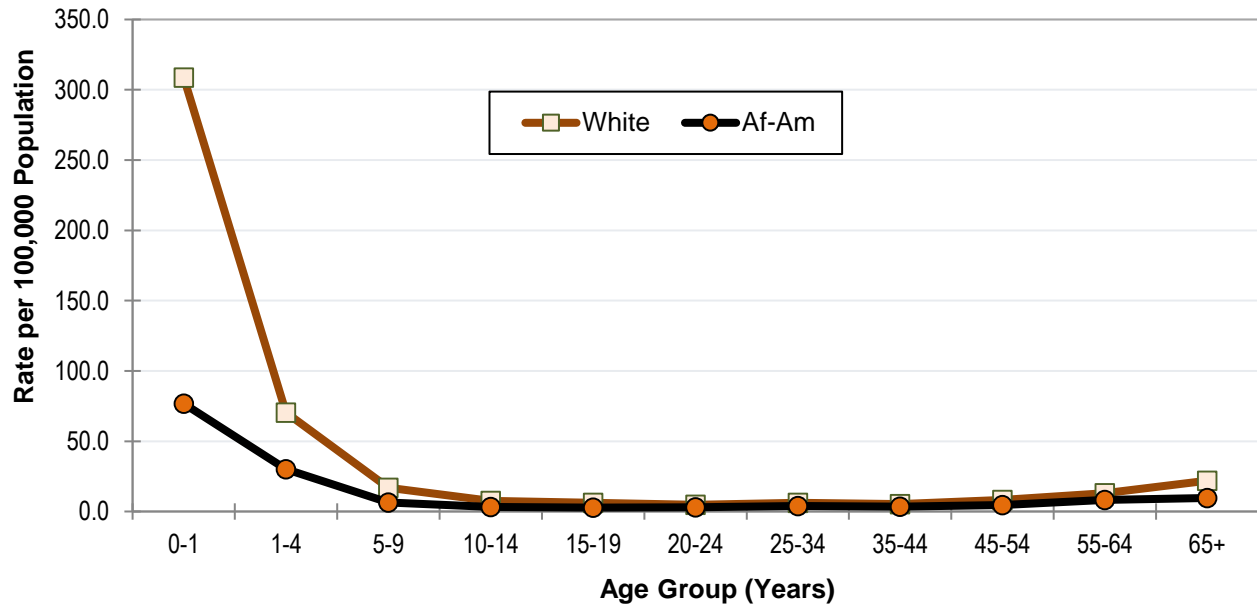
Figure 2: *Salmonella* Average Incidence Rates by Age - Louisiana, 2008-2018



Race Distribution

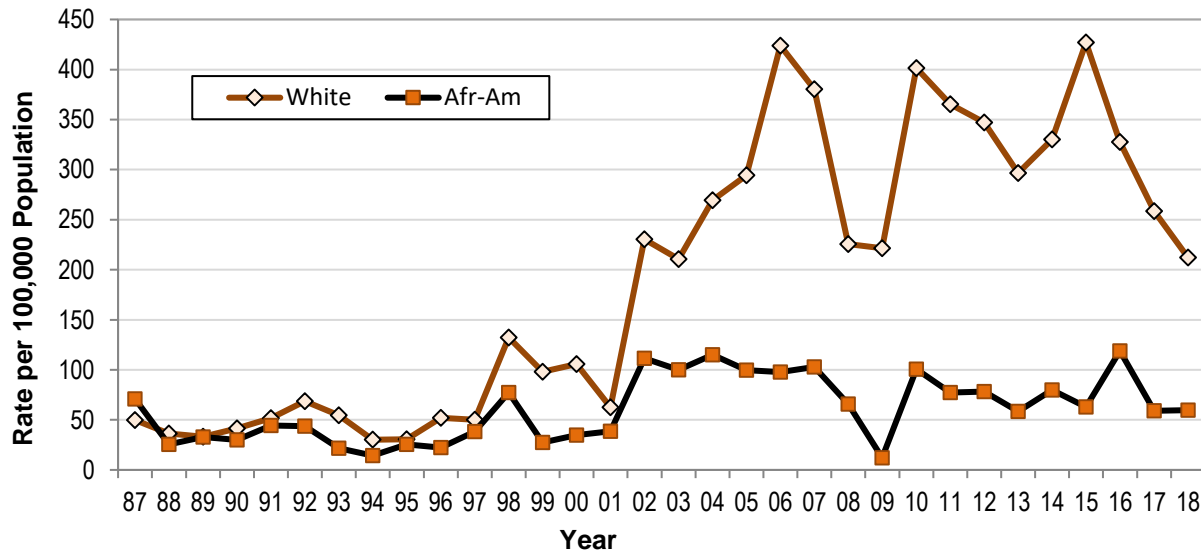
Whites have higher reported rates of *Salmonella* infection than African-Americans (Figure 3).

Figure 3: *Salmonella* average incidence rates by age and race – Louisiana, 2008-2018



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

Figure 4: *Salmonella* Incidence Rates among Infants (Newborn to One-Year of Age) by Race Louisiana, 1987-2018



Geographical Distribution

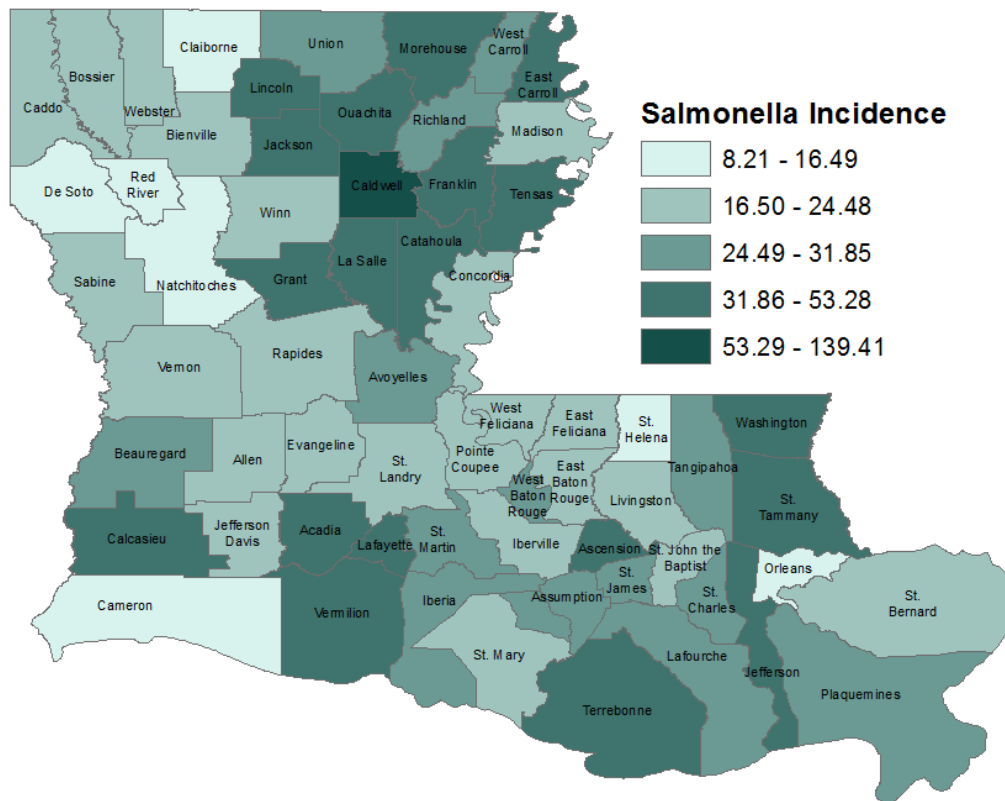
The geographic distribution of *Salmonella* reflects reporting practices rather than true differences in incidence. For example, because several parishes are served by medical facilities that are more apt to culture and report *Salmonella*. The rates in these areas are consistently high. (Table 1, Figure 5).

Table 1: *Salmonella* average incidence rates by parish - Louisiana, 2008-2018

Parish	Case Number	Avg. Inc.	Parish	Case Number	Avg. Inc.
Acadia	321	46.01	Madison	26	18.47
Allen	68	23.89	Morehouse	114	35.09
Ascension	418	34.99	Natchitoches	61	13.55
Assumption	85	31.85	Orleans	542	14.55
Avoyelles	124	25.87	Ouachita	649	37.24
Beauregard	105	26.19	Plaquemines	64	25.42
Bienville	40	24.05	Pointe Coupee	58	22.34
Bossier	282	21.66	Rapides	354	23.70
Caddo	565	19.45	Red river	14	13.34
Calcasieu	783	35.73	Richland	71	29.99
Caldwell	163	139.41	Sabine	51	18.52
Cameron	9	11.33	St Bernard	72	18.61

Catahoula	59	49.20	St Charles	174	28.97
Claiborne	16	8.21	St Helena	14	10.96
Concordia	44	18.63	St James	66	26.27
De Soto	50	16.49	St John	105	19.84
East Baton Rouge	1,063	21.42	St Landry	212	22.00
East Carroll	35	38.25	St Martin	171	28.98
East Feliciana	46	20.23	St Mary	129	20.98
Evangeline	89	23.00	St Tammany	1,196	45.35
Franklin	87	36.64	Tangipahoa	399	29.38
Grant	100	40.44	Tensas	22	35.12
Iberia	208	24.94	Terrebonne	524	41.40
Iberville	89	23.87	Union	76	29.27
Jackson	70	38.04	Vermilion	289	44.21
Jefferson	1,038	21.03	Vernon	102	17.50
Jefferson Davis	134	37.42	Washington	258	48.83
LaSalle	77	45.65	Webster	112	23.76
Lafayette	1,316	53.28	West Baton Rouge	73	27.55
Lafourche	330	30.35	West Carroll	40	29.93
Lincoln	188	35.84	West Feliciana	37	22.17
Livingston	349	24.48	Winn	36	20.29

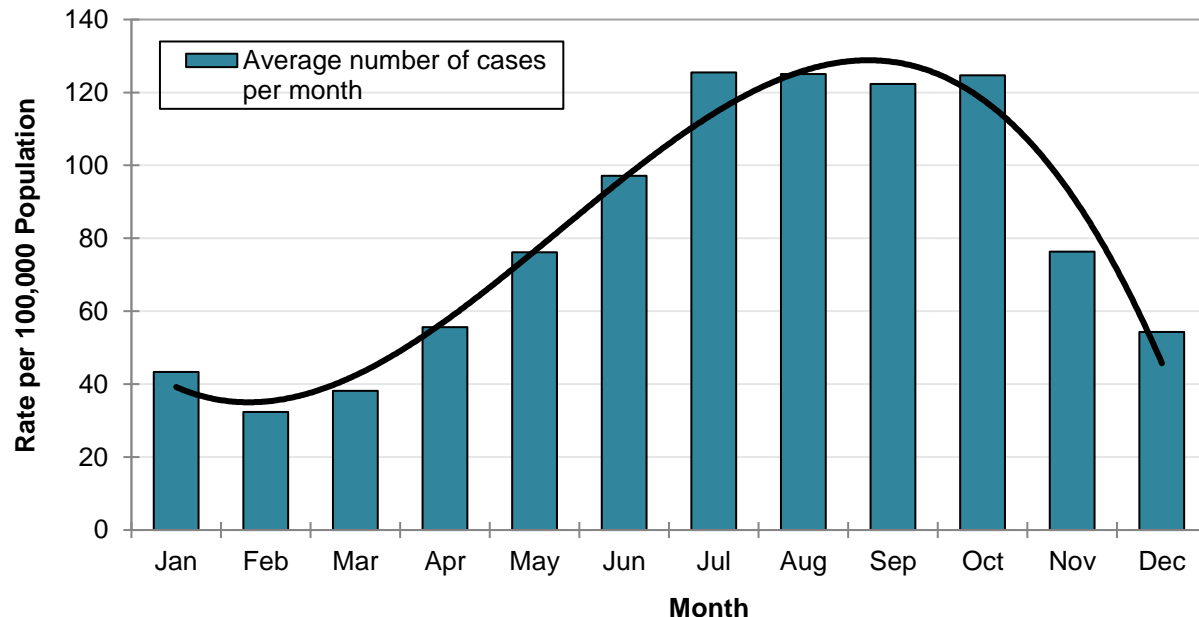
Figure 5: Salmonella Average Incidence Rate (Cases per 100,000 Population) Louisiana, 2008-2018



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, 1987-2018



Better growth of *Salmonella* at higher temperatures leads to higher concentrations 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.

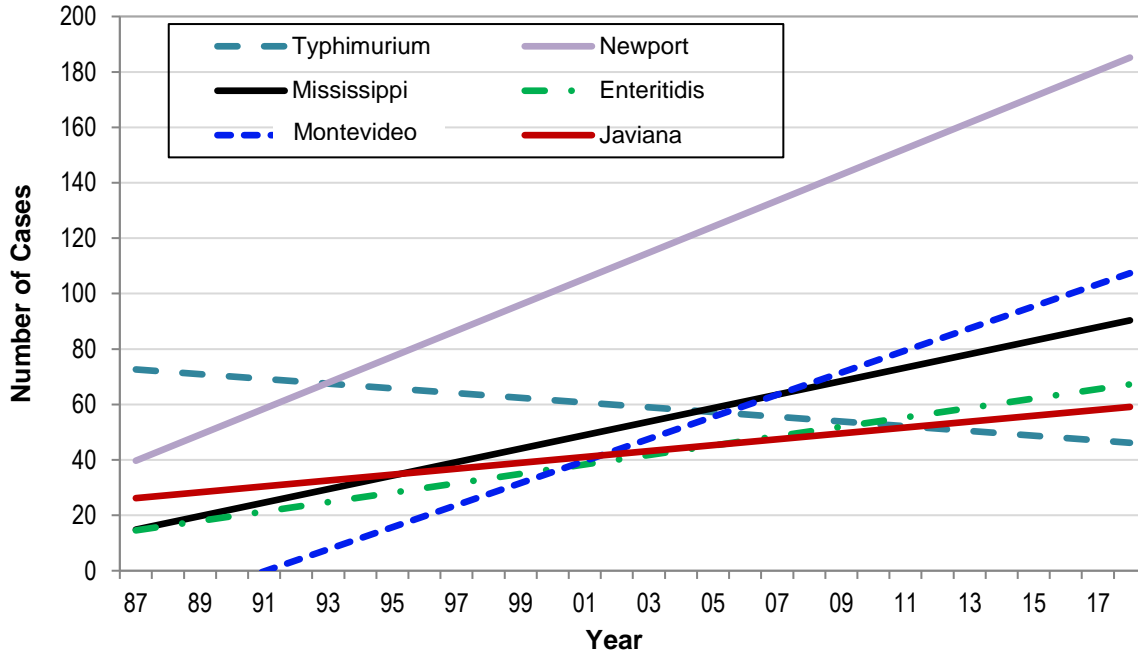
Serotypes

The 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 2,500 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 2018 are presented in Table 2.

Table 2: *Salmonella* Common Serotypes - Louisiana, 1987 – 2018

Serotype	Total
NEWPORT	3608
TYPHIMURIUM	1901
MISSISSIPPI	1683
MONTEVIDEO	1466
JAVIANA	1375
ENTERITIDIS	1312
MUENCHEN	692
HEIDELBERG	551
GIVE	445
BRANDERUP	385
GAMINARA	353
RUBISLAW	344
INFANTIS	343
BAREILLY	335
ORANIENBURG	291
THOMPSON	237
ANATUM	217
SAINT PAUL	162
HADAR	146
AGONA	142
LITCHFIELD	131
ADELAIDE	110
HVITTINGFOSS	140

Salmonella Newport, *S. Enteritidis*, *S. Javiana*, *S. Mississippi*, and *S. Montevideo* are increasing in numbers (Figure 7).

Figure 7: *Salmonella* trends – Serotype Isolates in Reported Cases - Louisiana, 1987-2018

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.

There have been clusters among rare serotypes: *Salmonella* Adelaide from 1999 to 2002, *S. Brandenburg* in 1994, and more recently *S. Hvittingfoss* from 2011 to 2015, *S. Inverness* and *S. Uganda* from 2012 to 2014, *S. Johannesburg*, *S. Urbana*, *S. Poona* from 2011 to 2012.

Serotype Uganda Outbreak Investigation

Salmonella enterica serotype Uganda is a rare serotype locally and nationally. Nationwide, the only previously published *Salmonella* Uganda outbreak was in 2001, involving cases associated with consuming pork products. In Louisiana, no cases of *Salmonella* Uganda were reported in the state from 2007 through 2011.

Between the end of October and the beginning of December 2012, six cases of *Salmonella* Uganda were confirmed by the Louisiana Department of Health (LDH) Public Health Laboratory and were found to have matching Pulse Field Gel Electrophoresis (PFGE) patterns. A seventh case was reported at the end of February 2013. The average age of the cases was 73 years with a range of 58 to 87 years; the majority of the cases were male (57%). Illness onset dates ranged from mid-October to mid-January. Seventy-one percent of the cases were hospitalized with no deaths reported. The cases resided in LDH Regions* 2 (14%), 4 (43%), 5 (29%), and 7 (14%). During the initial investigation, no cases were reported in other states.

All cases were interviewed to assess for exposures using a standardized questionnaire which asked about all food exposures prior to illness onset. No food item was reported being eaten by

more than one case. Based on the demographics, location of the cases, and the past outbreak involving pork products, a hypothesis was generated that suggested the source of the *Salmonella* was a regional meat-based food item. All cases were re-interviewed using a questionnaire that focused on meat-based food items popular in Louisiana; all seven cases reported consuming hog head cheese in the seven days prior to illness onset. Five of the seven cases reported consuming Brand A hog head cheese. No other food items were reported being eaten by more than one case.

Four intact packages of Brand A hog head cheese were purchased from a grocery store and were tested for *Salmonella* at the state laboratory. *Salmonella* was not detected in these four packages.

Brand A hog head cheese is produced in an out-of-state facility that is inspected by the United States Department of Agriculture (USDA). USDA was notified of the illnesses possibly associated with consumption of Brand A hog head cheese; as a result, the facility was inspected and their procedures were reviewed. Product testing at an independent laboratory found *Salmonella* in four of nine packages of Brand A hog head cheese. These findings resulted in the recall of 4,700 pounds of hog head cheese.

* Figure 8: Louisiana Department of Health Regional Map



2017 Caldwell Parish Outbreak

In October of 2017, the Louisiana Office of Public Health investigated a *Salmonella* outbreak in Caldwell Parish in Region 8 resulting in 118 cases of salmonellosis. Caldwell is one of the lowest populated parishes in the state, with an estimated 10,600 residents in 2017. The high number of cases related to this outbreak combined with the low population, partially explain the high rate of cases in Caldwell Parish presented in figures 9, 10 and 11.