

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 90% 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; 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 U.S., an estimated 1.4 million people are infected with non-typhoid *Salmonella* annually.

According to FoodNet data, incidence rates for *Salmonella* (2013) in the U.S. are as follows:

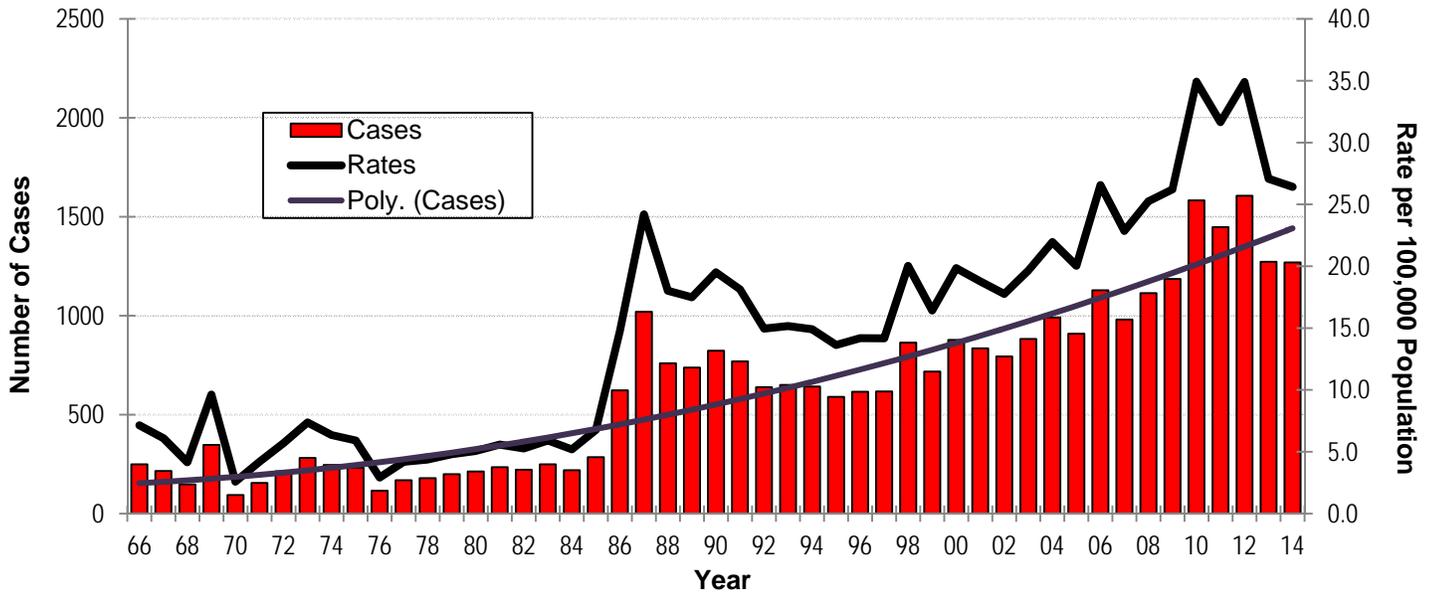
- The incidence rate reported among all age groups combined was 15.19 per 100,000 population.
- The highest incidence rate reported was among children younger than four years of age and was 61.67 per 100,000 population.
- Rates observed in Louisiana in the past few years ranged from 25 to 35 per 100,000 (in 2013 the rate was 27.07).
- Based on the Centers for Disease Control and Prevention estimates (Bishwa Adhikari et al 2004. Economic burden of Salmonella infections in the US, Am Agric Econ Assoc Ann Meeting, Denver CO), and making extrapolation for 2010 in the U.S. and Louisiana the estimated numbers are presented below:

	In the U.S. (*rounded)	/100,000 U.S. pop	Extrapolation for Louisiana	/100,000 LA population
All infections	1,400,000	460.0	22,000	490.0
Self care, no medical visit	1,250,000	410.0	19,500	430.0
Outpatient visit	162,000	55.0	2,700	60.0
Inpatient (Invasive disease)	3,500	1.2	55	1.2
Inpatient (Gastroenteritis)	16,500	5.5	170	3.8
Laboratory confirmed	39,000	13.0	1,300	28.9
Deaths	600	0.2	10	0.2

Of these estimated 3,000 cases diagnosed (outpatients and in-patients) from 1,000 to 1,300 are reported every year (about 30%). Hospitalizations caused by Salmonella infections are about 225 per year and deaths between five and ten.. Food-borne transmission would be responsible for about 95% of all Salmonella infections.

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

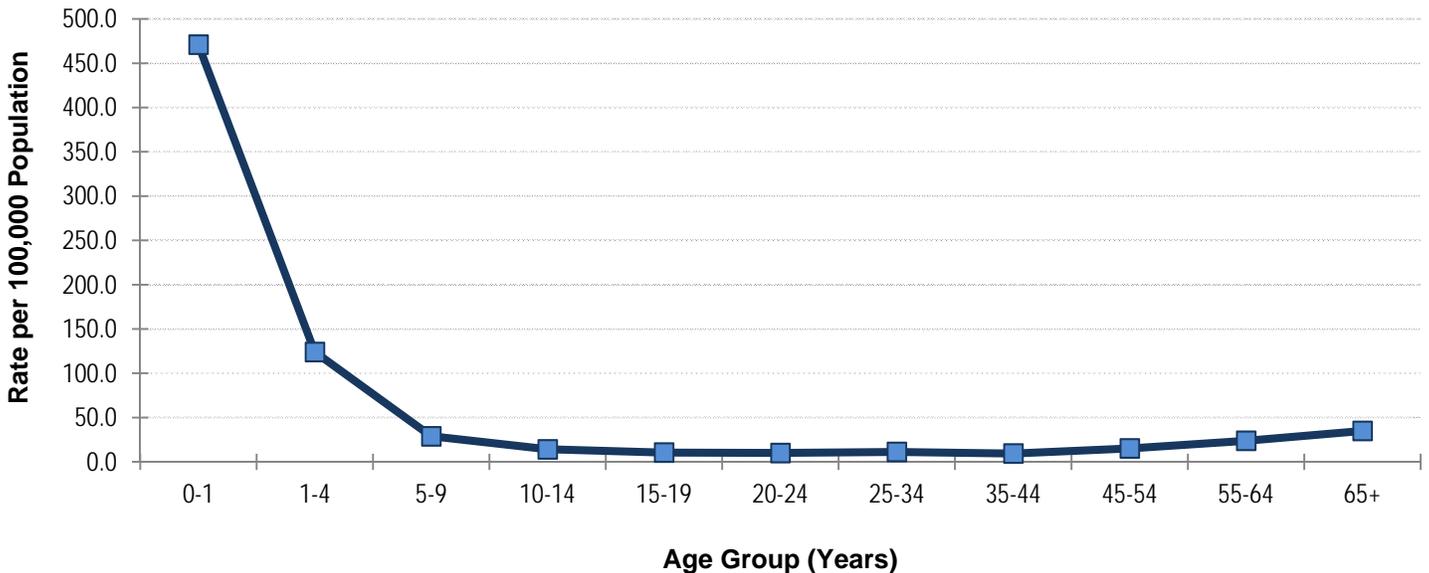
Figure 1: *Salmonella* cases and incidence rates - Louisiana, 1966-2014



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

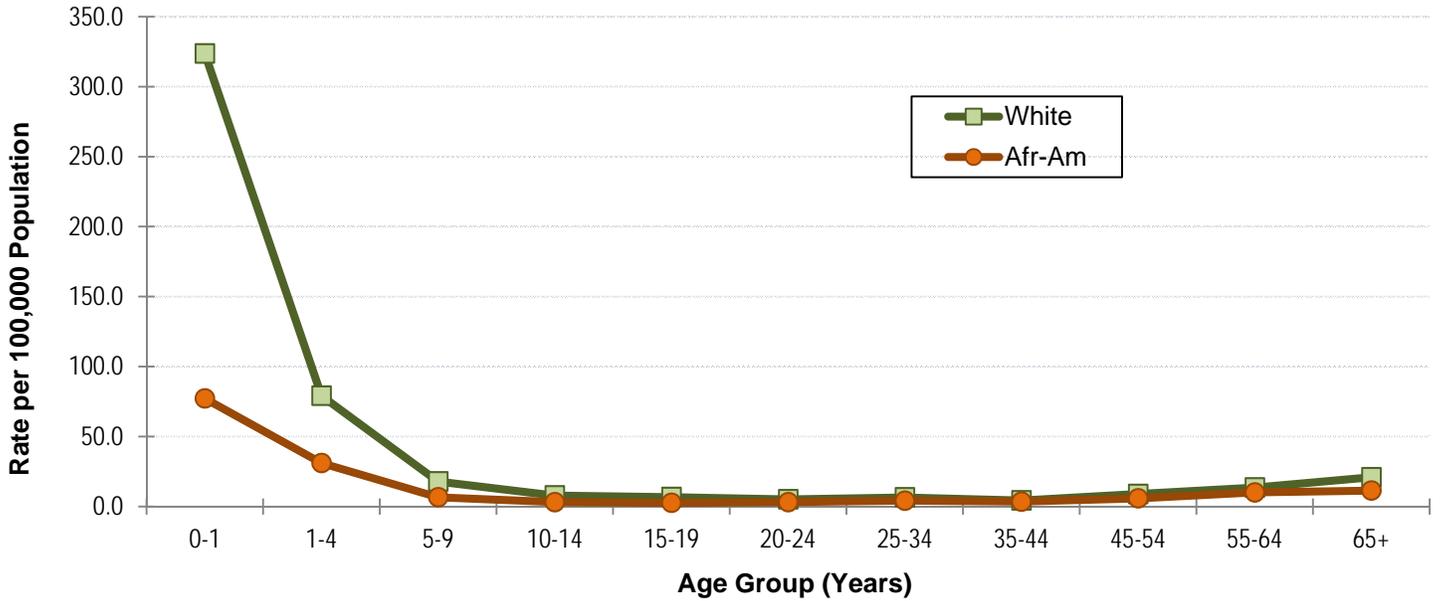
Figure 2: *Salmonella* average incidence rates by age - Louisiana, 2008-2014



Race Distribution

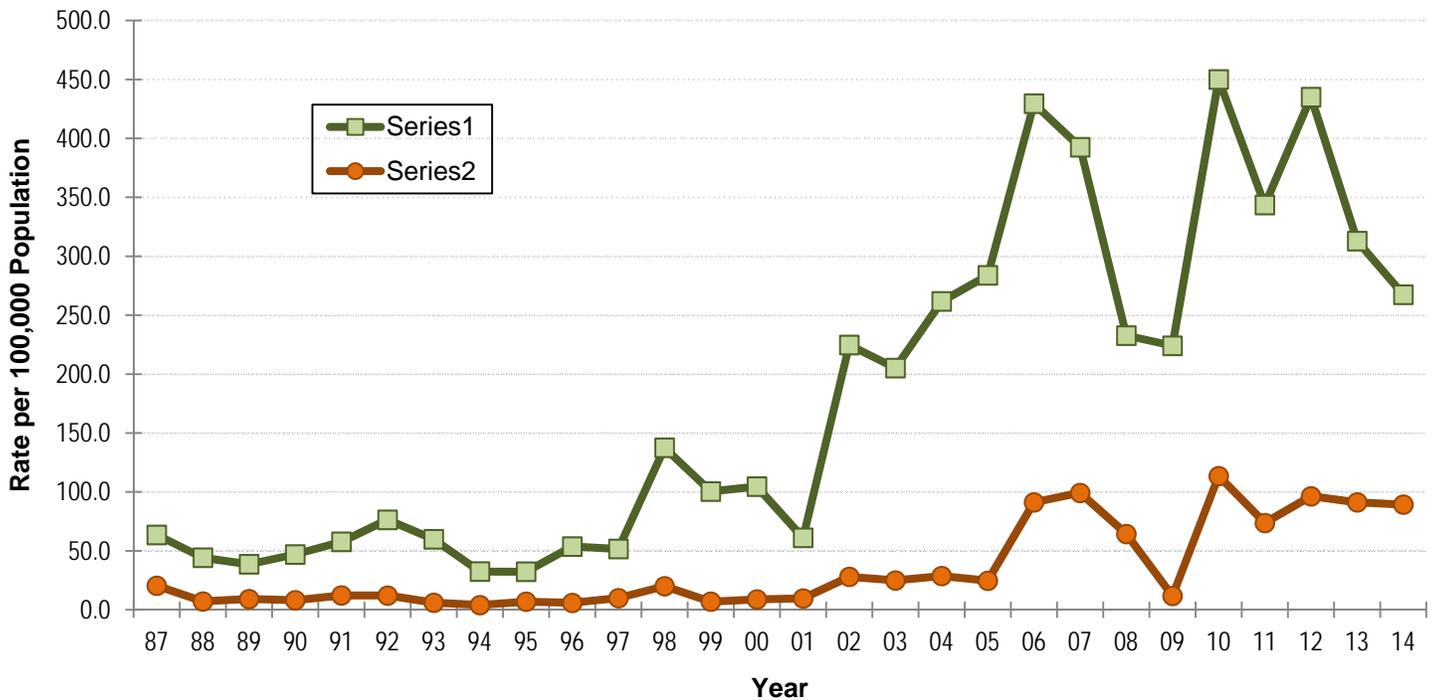
Whites have higher reported rates of *Salmonella* infection than African-Americans (Figure 3).

Figure 3: *Salmonella* average incidence rates by age and race – Louisiana, 2008-2014



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) Louisiana, 1987-2014



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 (Table 1).

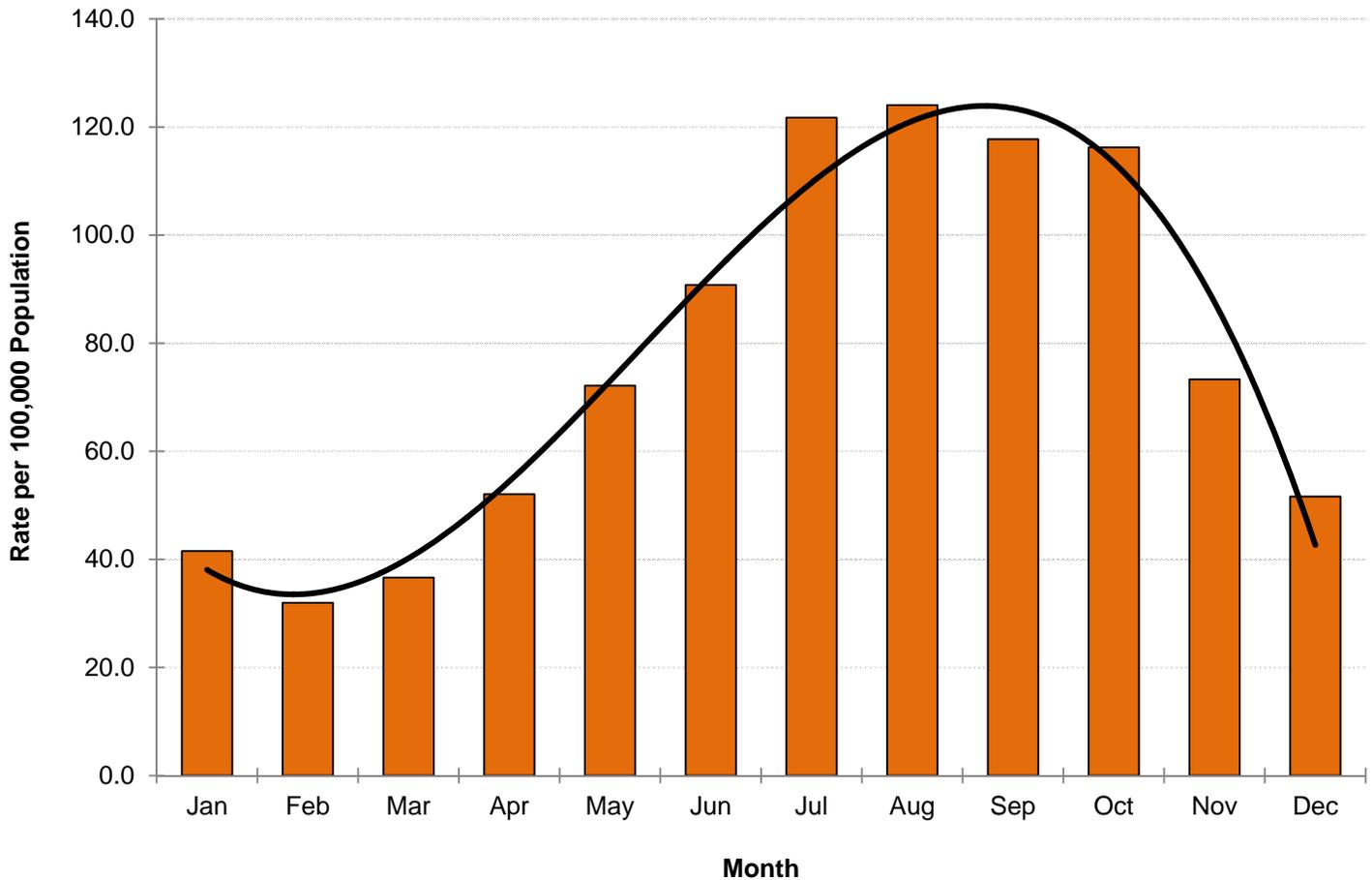
Table 1: *Salmonella* average incidence rates by parish - Louisiana, 2007-2014

Parish	Case Number	Avg. Inc.	Parish	Case Number	Avg. Inc.
Acadia	204	40.9	Madison	23	22.0
Allen	47	24.0	Morehouse	89	37.8
Ascension	293	34.3	Natchitoches	44	13.6
Assumption	65	33.9	Orleans	380	14.9
Avoyelles	95	27.5	Ouachita	477	38.1
Beauregard	57	19.8	Plaquemines	48	27.2
Bienville	27	22.3	Pointe Coupee	37	19.7
Bossier	194	20.8	Rapides	243	22.6
Caddo	393	18.8	Red river	6	7.8
Calcasieu	473	29.9	Richland	48	27.9
Caldwell	45	51.9	Sabine	36	18.1
Cameron	6	10.4	St Bernard	50	19.1
Catahoula	42	48.6	St Charles	129	29.9
Claiborne	15	10.7	St Helena	10	10.9
Concordia	33	19.3	St James	48	26.6
De Soto	39	17.8	St John	75	19.5
East Baton Rouge	798	22.5	St Landry	156	22.3
East Carroll	29	43.2	St Martin	127	30.2
East Feliciana	34	20.9	St Mary	96	21.7
Evangeline	65	23.4	St Tammany	968	51.6
Franklin	55	32.1	Tangipahoa	324	33.7
Grant	77	44.4	Tensas	14	31.1
Iberia	137	22.8	Terrebonne	381	42.1
Iberville	63	24.0	Union	58	31.0
Jackson	51	38.4	Vermilion	186	39.8
Jefferson	761	21.3	Vernon	57	13.6
Jefferson Davis	103	40.3	Washington	199	53.3
LaSalle	53	43.6	Webster	85	25.1
Lafayette	942	54.0	West Baton Rouge	45	23.4
Lafourche	247	31.8	West Carroll	29	30.3
Lincoln	144	38.5	West Feliciana	24	21.1
Livingston	251	24.6	Winn	23	18.0

Seasonal Pattern

There is a clear seasonal pattern in the occurrence of *Salmonella* infection with a peak from summer through fall (Figure 5).

Figure 5: *Salmonella* average rates by month - Louisiana, 1987-2014



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

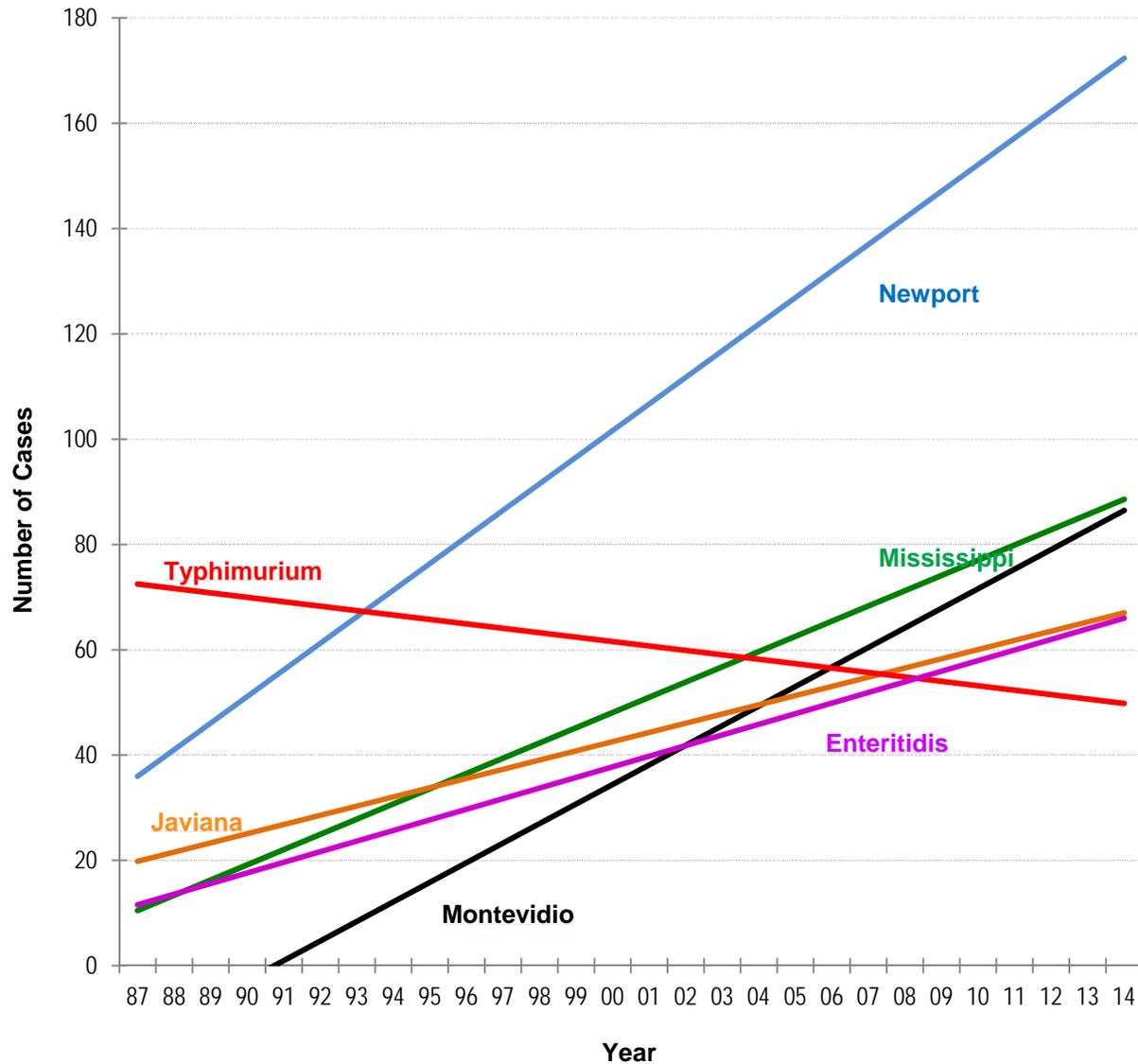
The CDC adopted the Kaufmann-White Scheme for designation of *Salmonella* serotypes on January 1, 2003. The genus *Salmonella* (family – Enterobacteriaceae) is divided into two species, *Salmonella enterica* and *Salmonella bongori*. *Salmonella enterica* is further subdivided into six subspecies that 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 2014 are presented in Table 2.

Table 2: *Salmonella* common serotypes - Louisiana, 1987 – 2014

Serotype	Total
NEWPORT	2916
TYPHIMURIUM	1712
MISSISSIPPI	1387
JAVIANA	1216
ENTERITIDIS	1086
MONTEVIDEO	1016
MUENCHEN	537
HEIDELBERG	519
GIVE	332
BRANDERUP	300
GAMINARA	268
ORANIENBURG	236
BAREILLY	241
RUBISLAW	264
INFANTIS	242
THOMPSON	160
ANATUM	157
HADAR	135
AGONA	131
SAINT PAUL	118
ADELAIDE	108

Salmonella newport, *S. javiana* and *S. mississippi* are increasing in numbers along with *S. montevideo* (Figure 6).

Figure 6: *Salmonella* trends – serotype isolates in reported cases - Louisiana, 1987-2014

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*, *S. johannesburg*, *S. urbana*, *S. inverness*, *S. poona*, and *S. Uganda* in 2011 to 2012 (Table 3).

Table 3: *Salmonella*, clusters of serotypes in reported cases - Louisiana, 1987-2012

Serotype	Total	1987-89	1990-94	1995-99	2000-05	2006-10	2011-12
Adelaide	101	1	1	12	84	1	2
Brandenburg	50	5	26	14	4	1	0
Hvittingfoss	40	1	0	0	0	5	34
Inverness	9	2	0	0	0	0	7
Johannesburg	5	1	0	0	0	0	4
Poona	14	0	1	2	0	0	11
Uganda	8	1	0	0	0	0	7
Urbana	33	1	1	0	0	2	29

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 in the five years prior to 2012.

Between the end of October and the beginning of December 2012, six cases of *Salmonella* Uganda were confirmed by the Louisiana Department of Health and Hospitals (DHH) 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 DHH 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, the hypothesis was made that 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 for *Salmonella* testing 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). The 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.

* Region 2= Baton Rouge area; Region 4= Lafayette area; Region 5=Lake Charles area; Region 7= Shreveport area