

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

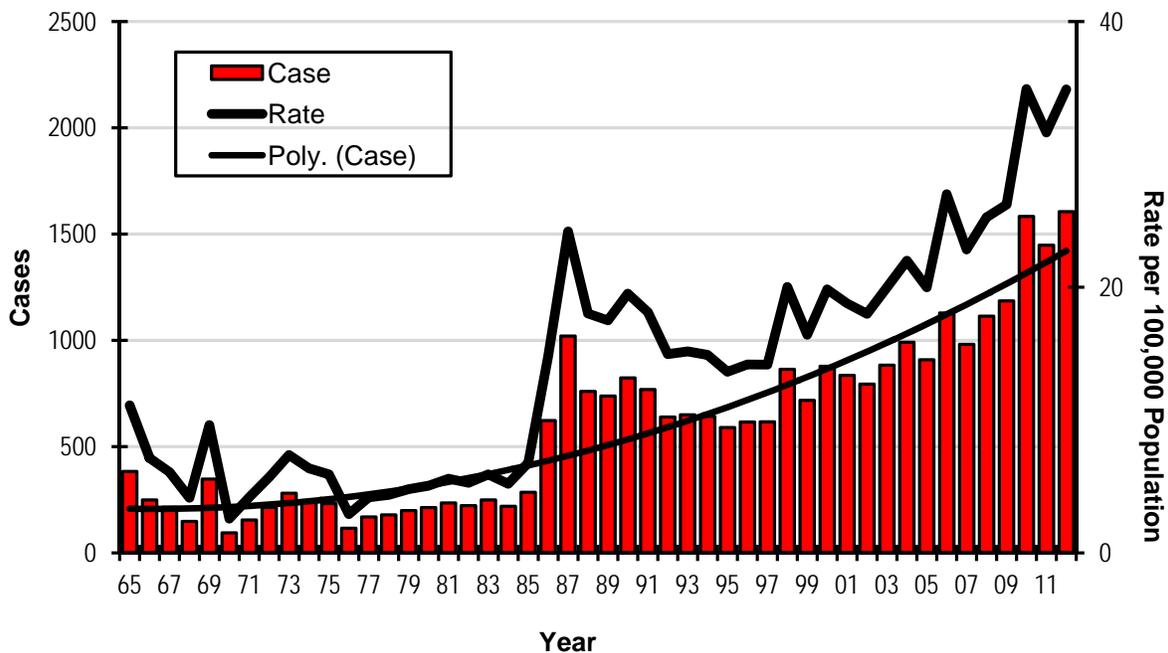
According to FoodNet data, incidence rates for *Salmonella* (2010) in the U.S. are as follows:

- The incidence rate reported among all age groups combined was 17.6 per 100,000 population.
- The highest incidence rate reported was among children younger than four years of age and was 69.5 per 100,000 population.

Rates observed in Louisiana were 35 per 100,000 in 2010.

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).

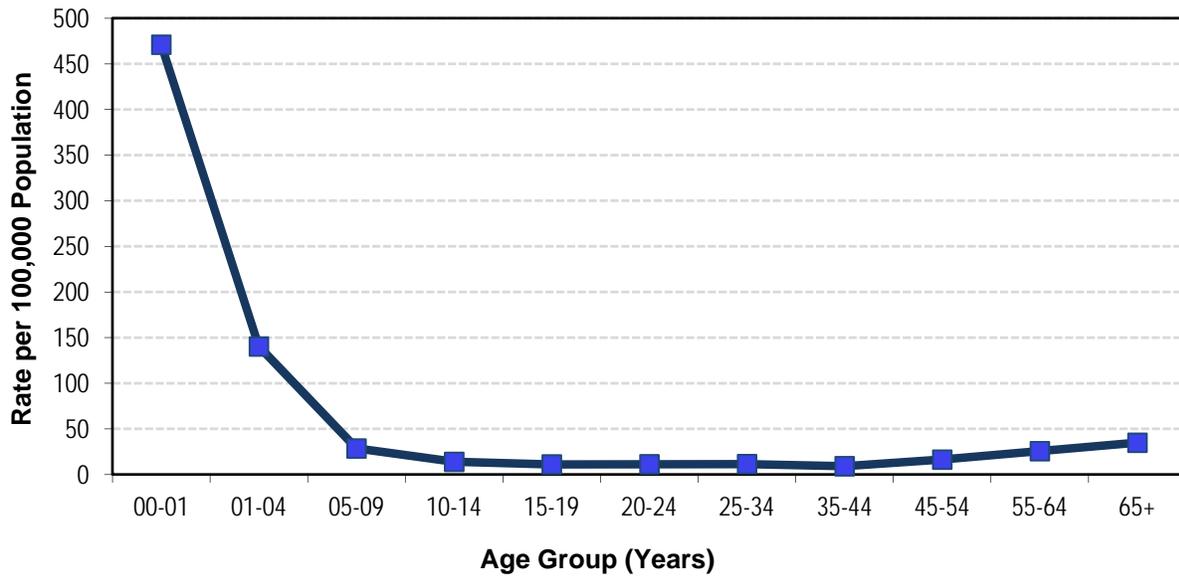
Figure 1: *Salmonella* cases and incidence rates - Louisiana, 1965-2012



## 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).

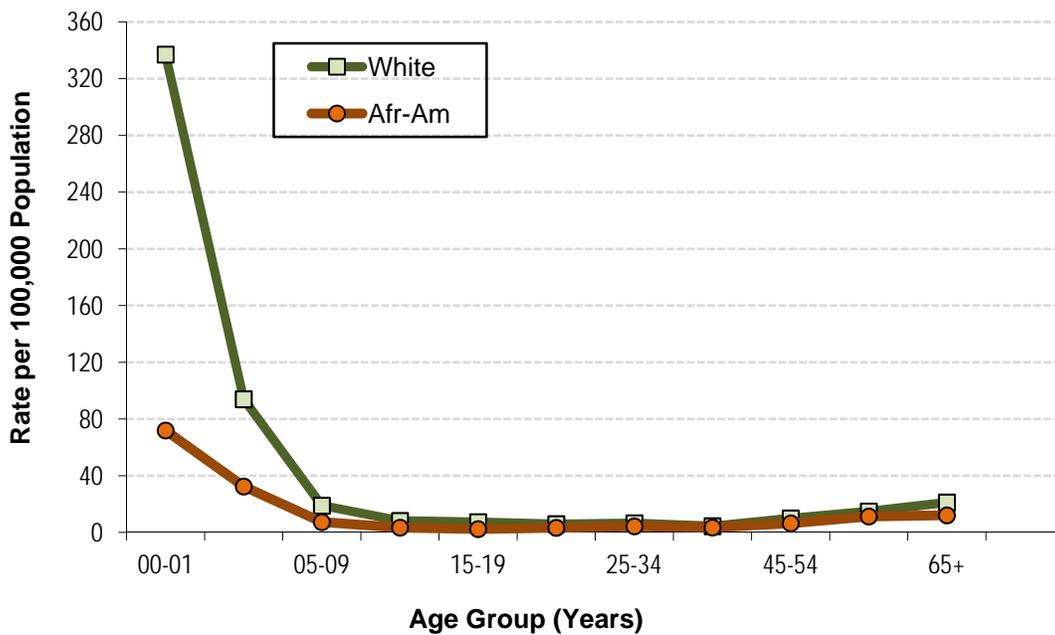
Figure 2: *Salmonella* average incidence rates by age - Louisiana, 2008-2012



**Race Distribution**

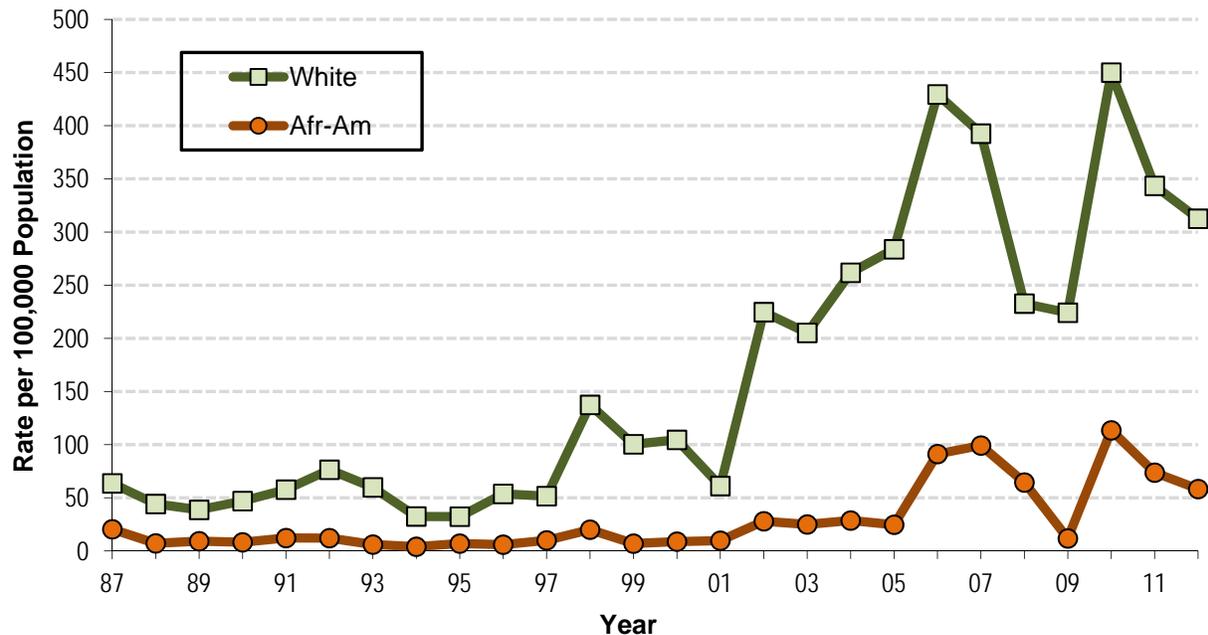
Whites have higher reported rates of *Salmonella* infection than African-Americans (Figure 3).

Figure 3: *Salmonella* average incidence rates by age and race – Louisiana, 2008-2012



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 (newborn to one year of age) Louisiana, 1987-2012



### Geographical Distribution

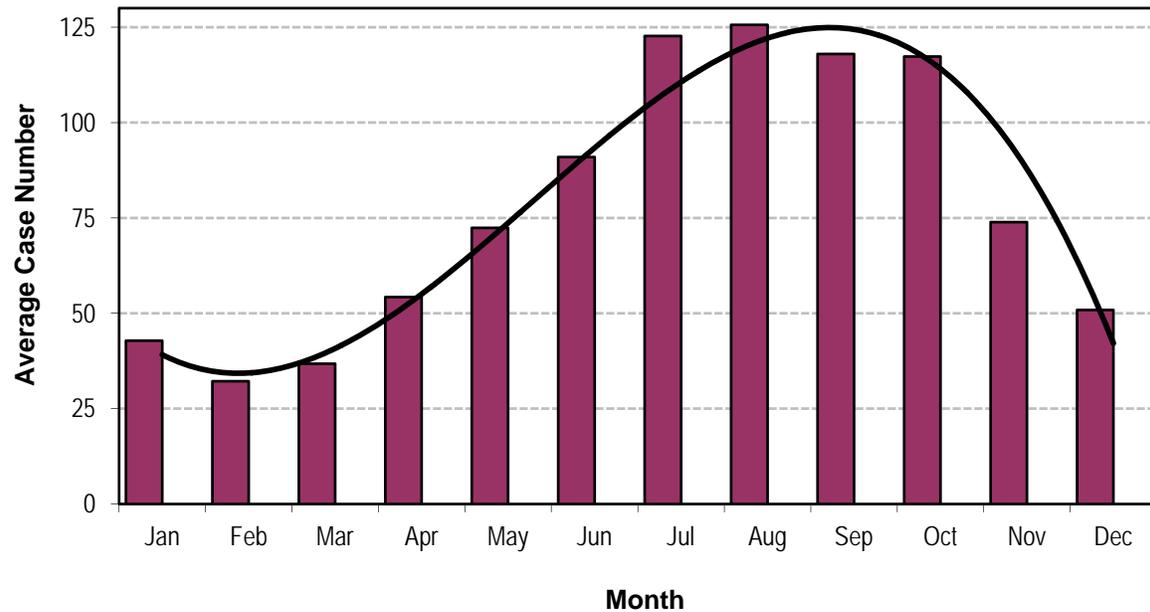
The geographic distribution of *Salmonella* reflects reporting practices rather than true differences in incidence. For example, because Terrebonne and the surrounding parishes are served by a medical facility that is very good at culturing and reporting *Salmonella*, the rates in the Terrebonne area are consistently high (Table 1).

Table 1: *Salmonella* average incidence rates by parish - Louisiana, 2007-2012

PARISH	# Cases	Avg. Inc.	PARISH	# Cases	Avg. Inc
ACADIA	160	43.5	MADISON	21	28.9
ALLEN	34	22.0	MOREHOUSE	57	33.5
ASCENSION	212	33.6	NATCHITOCHE	31	13.0
ASSUMPTION	49	35.0	ORLEANS	283	16.0
AVOUELLES	64	25.3	OUACHITA	357	38.9
BEAUREGARD	36	16.9	PLAQUEMINES	36	26.5
BIENVILLE	18	20.5	POINTE COUPEE	23	16.8
BOSSIER	122	17.8	RAPIDES	174	22.0
CADDO	279	18.2	RED RIVER	3	5.4
CALCASIEU	349	30.6	RICHLAND	31	24.9
CALDWELL	35	56.2	SABINE	25	17.3
CAMERON	2	4.7	ST. BERNARD	44	25.8
CATAHOULA	32	51.0	ST. CHARLES	100	31.6
CLAIBORNE	11	10.7	ST. HELENA	5	7.6
CONCORDIA	21	17.2	ST. JAMES	41	31.0
DESOTO	26	16.3	ST. JOHN	67	23.8
E. BATON ROUGE	603	22.9	ST. LANDRY	115	22.1
EAST CARROLL	25	52.0	ST. MARTIN	112	35.8
EAST FELICIANA	28	22.7	ST. MARY	66	20.4
EVANGELINE	44	21.2	ST. TAMMANY	774	55.7
FRANKLIN	40	32.3	TANGIPAHOA	254	35.5
GRANT	57	44.8	TENSAS	10	30.6
IBERIA	108	24.3	TERREBONNE	312	46.8
IBERVILLE	47	23.6	UNION	45	32.9
JACKSON	34	35.7	VERMILION	148	43.0
JEFFERSON	589	22.7	VERNON	38	12.4
JEFF. DAVIS	83	43.9	WASHINGTON	151	54.4
LA SALLE	38	29.1	WEBSTER	60	24.2
LAFAYETTE	731	86.1	W. BATON ROUGE	27	19.1
LAFOURCHE	201	102.5	WEST CARROLL	19	27.3
LINCOLN	109	40.0	WEST FELICIANA	16	17.2
LIVINGSTON	175	23.3	WINN	17	18.4

### 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 cases by month - Louisiana, 1987-2012

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.

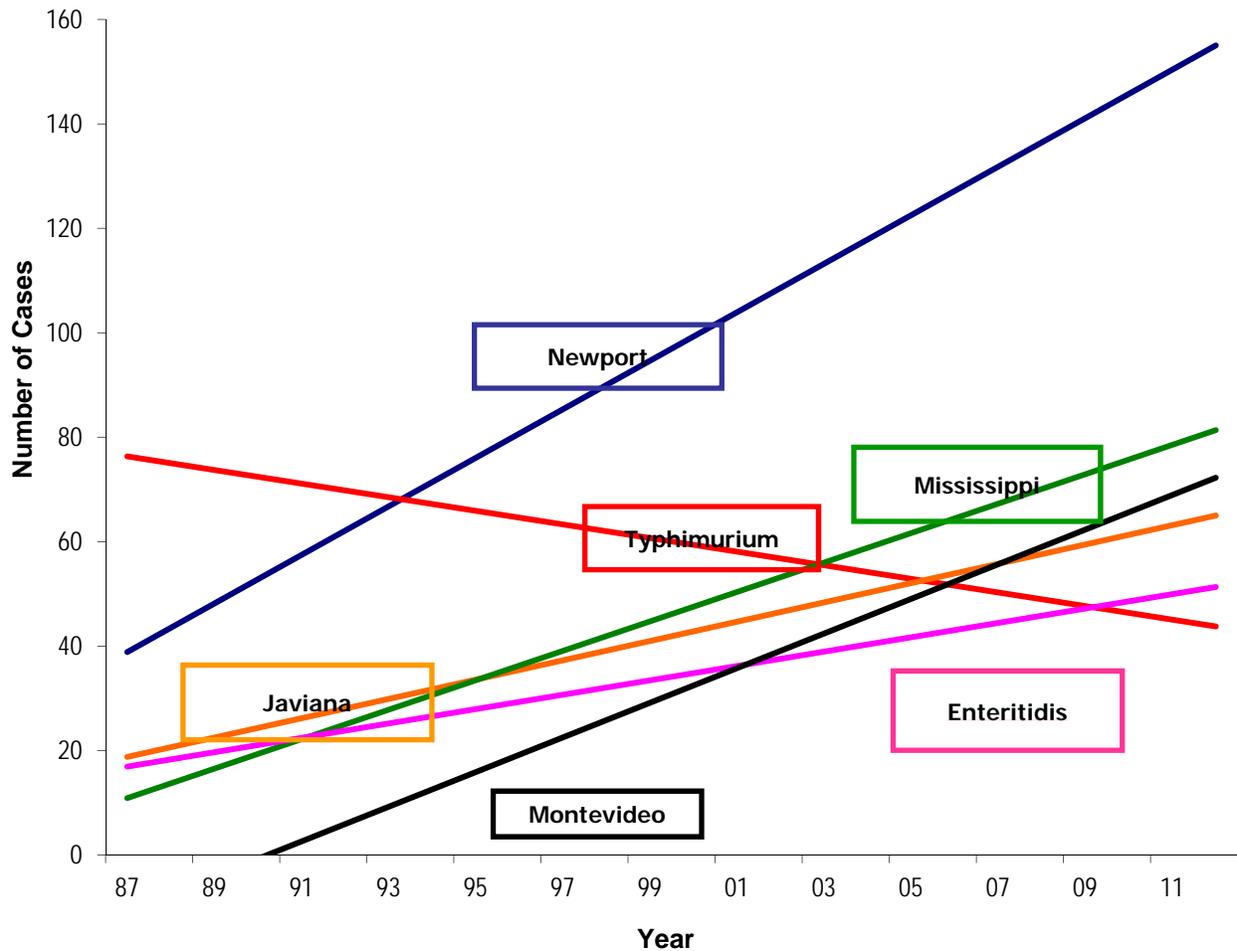
### Serotypes

The Centers for Disease Control and Prevention (CDC) adopted the Kauffmann-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 2012 are presented in Table 2.

Table 2: *Salmonella* common serotypes - Louisiana, 1987 – 2012

Serotype	Total
NEWPORT	2551
TYPHIMURIUM	1564
MISSISSIPPI	1212
JAVIANA	1099
ENTERITIDIS	889
MONTEVIDEO	811
HEIDELBERG	470
MUENCHEN	444
GIVE	283
BRANDERUP	244
GAMINARA	226
ORANIENBURG	215
BAREILLY	209
RUBISLAW	206
INFANTIS	194
THOMPSON	137
ANATUM	132
HADAR	132
AGONA	126
ADELAIDE	101
SAINT PAUL	96

*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, 1987-2012

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

*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 last five years, up until 2012.

Between the end of October and the beginning of December, 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